

### ASPHALT BINDER WORKSHEET INDEX

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\*\* NP for "Not Presented"

❖ - Indicates the line has been modified since the previous version of the worksheets, 2013-09-20.

**PRESSURIZED AGING VESSEL (PAV)**(R28) \_\_\_\_\_  
(D6521) \_\_\_\_\_APPARATUS

Date: \_\_\_\_\_

Pressurized Aging Vessel (PAV):

1. Manufacturer: \_\_\_\_\_
2. Made of stainless steel?..... \_\_\_\_\_
3. Interior dimensions adequate to hold 10 stainless steel pans and pan holder? ..... \_\_\_\_\_
4. Pan holder holds 10 pans?..... \_\_\_\_\_
5. Pan holder capable of holding pans in a level position?..... \_\_\_\_\_
6. Vessel
  - (a) Separate unit to be placed in a forced air oven?..... \_\_\_\_\_
    - (1) Contains a stand or shelf which supports the vessel in a level position above the power surface of the oven? ..... \_\_\_\_\_
    - (2) Sufficiently large interior dimensions to allow forced air to freely circulate within the oven and around the vessel when the vessel is placed in the oven? ..... \_\_\_\_\_
  - or** (b) Independent temperature-controlled system (Prentex and ATS models)? ..... \_\_\_\_\_

Pressure Controlling System:

1. Pressure gauge capable of measuring and controlling the pressure to within  $\pm 1\%$  [*ASTM*:  $\pm 0.02$  MPa]?..... \_\_\_\_\_
2. Capable of maintaining the pressure within the loaded vessel at  $2.1 \pm 0.1$  MPa during the test?..... \_\_\_\_\_

Temperature Controlling System:

1. Capable of bringing the un-pressurized vessel to  $\pm 0.5^\circ\text{C}$  of the testing temperature within 2 hours after loading samples into vessel? ..... \_\_\_\_\_
2. Maintains the temperature within the vessel to  $0.5^\circ\text{C}$  during the test? ..... \_\_\_\_\_

Temperature Measuring Device:

1. Platinum RTD or equivalent, accurate and readable to the nearest  $0.1^\circ\text{C}$ ? ..... \_\_\_\_\_
2. Mounted inside the PAV? ..... \_\_\_\_\_

Temperature Recording Device:

1. Strip chart recorder or other data acquisition device capable of recording temperature throughout test to within  $\pm 0.1^\circ\text{C}$ ? ..... \_\_\_\_\_
- or**
2. Electronic device capable of reporting maximum and minimum requirements (to  $0.1^\circ\text{C}$ )? ..... \_\_\_\_\_

COMMENTS (R28/D6521):

(R28/D6521)

**PRESSURIZED AGING VESSEL (PAV)**(R28) \_\_\_\_\_  
(D6521) \_\_\_\_\_APPARATUS (Continued)

Date: \_\_\_\_\_

<b>Stainless Steel Pans</b>	1	2	3	4	5	6	7	8	9	10
Diameter 140 mm (AMRL: 140 ± 5 mm)?										
Depth 9.5 mm (AMRL: 9.5 ± 5 mm)?										
Approximate thickness 0.64 mm [AMRL: at least 0.38 mm?]										
Bottom not badly warped?										

Note to assessors: It is recommended that the laboratory has at least ten pans.

Balance:

1. Class G2/GP2 (readable to 0.1 g)?.....

Vacuum Oven:

1. Capable of maintaining temperatures within  $\pm 5.0^{\circ}\text{C}$  [ASTM: an accuracy of  $\pm 5^{\circ}\text{C}$ ], for temperatures up to  $180^{\circ}\text{C}$ ? .....
2. Capable of a vacuum of 1.0 kPa (7.5 mm Hg) absolute [ASTM:  $15 \pm 1$  kPa]? .....
- (a) Temperature measuring device or temperature sensor capable of measuring the vacuum oven chamber temperature to within  $\pm 5^{\circ}\text{C}$ ? .....
- (b) Vacuum measuring device or a vacuum gauge or digital vacuum measuring system capable of measuring the absolute pressure in the chamber to within  $\pm 0.5$  kPa ( $\pm 1.0$  in. Hg)? .....
3. AASHTO: If the vacuum oven is equipped with a relative pressure gauge, has it been adjusted for elevation according to the requirements of the test method? .....
- Note: weather data should not be used for this adjustment, as most weather data is pre-corrected for elevation.

Oven:

1. ASTM: Capable of maintaining a temperature of  $168 \pm 5^{\circ}\text{C}$ ? .....

Air Supply:

1. Commercial bottled air or equivalent? .....

COMMENTS (R28/D6521):

(R28/D6521)

**PRESSURIZED AGING VESSEL (PAV)**(R28) \_\_\_\_\_  
(D6521) \_\_\_\_\_CALIBRATION AND STANDARDIZATION

Date: \_\_\_\_\_

PAV Temperature Detector [ASTM: Sensor]:

1. AASHTO: Has the PAV temperature detector been verified to 0.1°C at least every 6 months using a calibrated thermometer? .....
2. **ASTM: Has the PAV temperature sensor calibration been verified at its respective meter or electronic circuitry to within  $\pm 0.1$  °C at least every 6 months using a calibrated temperature measuring device traceable to a national standard?** .....
3. **ASTM: Is the verification performed near the temperature of use within a range of 90.0 to 110.0 °C?** .....  
*Note: A suggested method for performing the verification is listed in section 9.1.1.*

PAV Pressure Gauge or Digital Pressure Measurement System:

1. AASHTO: Has the pressure gauge been calibrated to an accuracy of  $\pm 1\%$  ( $\pm 0.02$  MPa) at least every 6 months? .....
2. **ASTM: Has the pressure gauge or digital pressure measurement system calibration been verified to within  $\pm 0.02$  MPa at least every 6 months using a calibrated pressure indicator traceable to a national standard?** .....
3. **ASTM: Is the verification performed near the pressure of use within a range of 2.00 to 2.10 MPa?** .....

Vacuum Oven Temperature Verifications:

1. **Is the vacuum oven temperature sensor calibration verified to within  $\pm 1$  °C at least every 6 months using a calibrated temperature measuring device traceable to a national standard?** .....
2. **Is the verification performed near the temperature of use within a range of 150 to 190 °C?** .....

Vacuum Oven Pressure Verifications:

1. **Is the Vacuum oven vacuum gauge or digital vacuum measurement system - calibration verified to within  $\pm 0.5$  kPa ( $\pm 1.0$  in. Hg) absolute pressure at least every 6 months using a calibrated vacuum or pressure indicator traceable to a national standard?** .....
2. **Is the verification performed near the absolute pressure of use within a range of 12.5 to 17.5 kPa?** .....

*Note: ASTM standardization for operator controlled pressure application is listed in Section 9.4. This gives guidance on how to determine the best temperature at which to apply the pressure during the aging procedure.*

SAMPLE PREPARATION

1. Asphalt binder conditioned in accordance with RTFO, T240/D2872? .....
2. Hot residue from RTFO combined into single container and stirred? .....
3. If conditioned binder has cooled to room temperature, is it heated until sufficiently fluid to pour and stirred before it is poured into pans? .....
4. Pan holder (without pans) placed inside the pressure vessel (if oven is used, vessel placed inside oven)? .....
5. Aging temperature selected and vessel preheated (preheating the vessel 10 to 15°C above the aging temperature is acceptable)? .....

COMMENTS (R28/D6521):

(R28/D6521)

**PRESSURIZED AGING VESSEL (PAV)**(R28) \_\_\_\_\_  
(D6521) \_\_\_\_\_PROCEDURE

Date: \_\_\_\_\_

Loading PAV

1. 50 ± 0.5 g added to each stainless steel pan (not all pans need to be filled)?.....
2. Temperature of vessel reset to test temperature if it was preheated to a higher temp.?.....
3. Pan holder removed from PAV and pans placed in holder?.....
4. Pan holder with filled pans placed in PAV and PAV closed? .....
5. Temperature transducer and air supply connected (for ovens only)?.....
6. Steps (3) to (5) performed as quickly as possible to avoid cooling of the vessel and pan holder?.....

PAV Testing

1. If temperature inside vessel does not reach the desired temperature for applying pressure within 2 hours of loading pans into vessel, is procedure discontinued and samples discarded?.....
2. Air pressure of 2.1 ± 0.1 MPa applied?.....
3. Timing of test started when pressure is 2.1 ± 0.1 MPa?.....
4. Temperature and pressure maintained for 20 hours ± 10 minutes? .....
5. At the end of 20 hour test period, air pressure reduced over a 9 ± 1 minute interval [ASTM: 8 to 15 min.] (at an approximately linear rate of pressure decrease)? .....
- Note to Assessors: PAV depressurization timing should be stopped at 0.02 MPa
- Note ASTM: The bleed valve should be preset to equalize internal and external pressures on the PAV?
6. AASHTO: If temperature indicated by recording device falls 0.5 °C above or below the target aging temperature for a total of more than 60 minutes during the 20 hours aging period, test declared invalid? .....
7. ASTM: Test declared invalid if any of the following occur?
  - (a) Temperature deviates from the conditioning temperature by more than ±0.5°C for more than 60 minutes total during the conditioning period?.....
  - (b) Temperature deviates from the conditioning temperature by more than ±5°C for more than 10 minutes total during the conditioning period?.....
  - (c) If the device is capable of indicating only the minimum and maximum temperatures during the test, any temperature outside of ±0.5°C from the conditioning temperature?.....

Conditioning PAV Aged Material

1. Pan holder and pans removed from PAV and pans placed in an oven at an oven set at a minimum temperature for a minimum time until sufficiently fluid to pour [ASTM: 168±5 °C for 15 ±1 minutes]? .....
2. AASHTO: Any temperatures used beyond 175 °C noted in the report? .....
3. AASHTO: Material stirred gently during heating to assist in the removal of air bubbles? .....
4. Vacuum oven preheated until it stabilizes at 170 ± 5°C prior to use?.....
5. Pans removed from oven and residue poured into a single container?.....
6. Container allows residue depth to be between 15 and 40 mm? .....
7. Container transferred to the vacuum oven within one minute after last pan is scraped? .....
- Note: AASHTO ONLY: this step and all following vacuuming steps are optional for AASHTO R28 unless T314 is being performed on the collected residue.
8. Vacuum oven maintained at 170 ± 5°C for 15 ± 1 minutes without vacuum?..... ❖
9. Vacuum valve rapidly opened and pressure reduced to 15 ± 2.5 kPa (93.5 to 131.5 mm Hg or 3.7 to 5.2 in. Hg) absolute?.....
- Note: Gauge pressures will vary at different elevations or barometric pressures.
- AASHTO note: If the material foams over the lip of the container during degassing, slowly and temporarily reduce the vacuum until foaming ceases.
10. Vacuum maintained for 30 ± 1 minutes?.....
11. Vacuum released and container removed? .....
12. If bubbles are visible on the surface, removed by flashing surface with a torch or hot knife? .....
13. ASTM: If further testing is not performed immediately, container covered and stored at room temperature? .....

COMMENTS (R28/D6521):

(R28/D6521)

**GRADING OR VERIFYING PGB**

(R29) \_\_\_\_\_

APPARATUS

Date: \_\_\_\_\_

1. Does the laboratory have equipment available to run the following tests or practices? \* \_\_\_\_\_
  - (a) Pressure Aging Vessel (PAV) (R28)? \_\_\_\_\_
  - (b) Flash point (T48)? \_\_\_\_\_
  - (c) Rolling Thin-Film Oven (RTFO) (T240)? \_\_\_\_\_
  - (d) Bending Beam Rheometer (BBR) (AASHTO T313)? \_\_\_\_\_
  - (e) Direct Tension (DT) (T314) (Optional)? \_\_\_\_\_
  - (f) Dynamic Shear Rheometer (DSR) (T315)? \_\_\_\_\_
  - (g) Rotational Viscosity (T316)? \_\_\_\_\_

SAMPLE PREPARATIONFor Grading an Unknown Asphalt Binder

1. Approximately 400 g of unaged asphalt binder obtained? \_\_\_\_\_

For Verifying the Nominal Grade of an Asphalt Binder

1. Approximately 250 g of unaged asphalt binder obtained? \_\_\_\_\_

*Note to Assessor: If the laboratory does not do both grading and verification, an informational note will be written.*

PROCEDUREFor Grading an Unknown Asphalt Binder: (Assessor: Ask to see records):

1. DSR test (AASHTO T315) performed on the original asphalt binder? \_\_\_\_\_
  - (a) Sample tested beginning at 58°C? \_\_\_\_\_
  - (b) Test temperature increased or decreased in 6° increments until a value for  $G^*/\sin \delta \leq 1.00$  kPa is obtained? \_\_\_\_\_
  - (c) The highest test temperature where the value for  $G^*/\sin \delta$  is  $\geq 1.00$  kPa is used as the starting grade? \_\_\_\_\_
2. The flash point (AASHTO T48) determined on original binder is greater than 230°C\*? \_\_\_\_\_
3. The viscosity (AASHTO T316) determined on original binder is less than 3 Pa·s\*? \_\_\_\_\_
4. Approximately 200 g of asphalt binder is aged in the RTFO (AASHTO T240)? \_\_\_\_\_
  - (a) Change in mass determined is less than or equal to 1.00 percent\*? \_\_\_\_\_
5. DSR test (AASHTO T315) performed on RTFO residue? \_\_\_\_\_
  - (a) The test temperature determined as the starting grade (from DSR original binder) is used? \_\_\_\_\_
  - (b) If  $G^*/\sin \delta$  is  $\geq 2.20$  kPa, this test temperature used as the high temperature grade? \_\_\_\_\_
  - (c) If the value of  $G^*/\sin \delta$  is less than 2.20 kPa, the material is tested again at a temperature 6° lower? \_\_\_\_\_
  - (d) The lowest test temperature where  $G^*/\sin \delta$  is  $\geq 2.20$  kPa is used as the high temperature PG grade? \_\_\_\_\_
6. RTFO residue aged in the PAV (AASHTO T28)? \_\_\_\_\_
  - (a) Aged at a temperature of 90°C for material with a high temperature grade of 46 or 52°C? \_\_\_\_\_
  - (b) Aged at a temperature of 100°C for material with a high temperature grade of 58°C or higher? \_\_\_\_\_
  - (c) Aged at a temperature of 110°C to simulate a desert environment? \_\_\_\_\_
7. PAV residue combined into a single container? \_\_\_\_\_

\*If these requirements cannot be met (according to AASHTO M320), then no further testing is required.

COMMENTS (R29):

(R29)

**GRADING OR VERIFYING PGB**

(R29) \_\_\_\_\_

PROCEDURE (Continued)

Date: \_\_\_\_\_

8. DSR test (AASHTO T315) performed on PAV residue?..... \_\_\_\_\_
- (a) Initial test temperature conforms to the table below unless there is other information to suggest a temperature at which  $G^*\sin \delta$  exceeds 5,000 kPa?..... \_\_\_\_\_

Starting Grade*	Initial DSR Test Temperature- PAV Residue (°C)
PG 52	16
PG 58	19
PG 64	22
PG 70	28

\*Starting grade determined from DSR test on original and RTFO aged residue.

- (b) Test temperature increased or decreased at 3° C increments until the value for  $G^*\sin \delta$  exceeds 5,000 kPa?..... \_\_\_\_\_
9. BBR test (AASHTO T313) performed on PAV residue?..... \_\_\_\_\_
- (a) Two specimens prepared and tested (results averaged)?..... \_\_\_\_\_
- (b) The initial test temperature determined using the high temperature grade, the temperature determined for the DSR test on PAV residue, and Table of M320?..... \_\_\_\_\_
- (c) Test temperature increased in 6°C increments until the stiffness is less than or equal to 300.0 MPa and the slope m is greater than or equal to 0.300?..... \_\_\_\_\_
- (d) New BBR test specimens prepared for each change in test temperature?..... \_\_\_\_\_
10. DT test performed on PAV residue (Optional)?..... \_\_\_\_\_
- (a) Creep stiffness from BBR test on PAV residue is between 300 and 600 MPa?..... \_\_\_\_\_
- (b) Slope from BBR test on PAV residue is greater than or equal to 0.300?..... \_\_\_\_\_
- (c) Results of four specimens reported and averaged?..... \_\_\_\_\_
- (d) Initial test temperature used is the first temperature from BBR test on PAV aged residue at which the slope is greater than or equal to 0.300?..... \_\_\_\_\_
- (e) Test temperature increased in 6°C increments until a failure strain greater than or equal to 1.0 percent is obtained?..... \_\_\_\_\_
- (f) New test specimens prepared for each change in test temperature?..... \_\_\_\_\_
11. Final grade of the asphalt binder determined using the data collected and Table 1 of M320?..... \_\_\_\_\_

COMMENTS (R29):

(R29)

**GRADING OR VERIFYING PGB**

(R29) \_\_\_\_\_

PROCEDURE (Continued)

Date: \_\_\_\_\_

For Verifying the Nominal Grade of an Asphalt Binder: (Assessor: Ask to see records)

1. DSR test (AASHTO T315) performed on the original asphalt binder?.....
  - (a) The test temperature used is the high temperature grading designation? .....
  - (b) If the value of  $G^*/\sin \delta$  is  $\leq 1.00$  kPa, testing continued? .....
  - (c) If the value of  $G^*/\sin \delta$  is not  $\leq 1.00$  kPa, the specimen is treated like a binder of unknown grade (see above)? .....
2. The flash point (AASHTO T48) determined on original binder is greater than 230°C\*? .....
3. The viscosity (AASHTO T316) determined on original binder is less than 3 Pa·s\*? .....
4. Approximately 100 g of asphalt binder aged in the RTFO (AASHTO T240)?.....
  - (a) Mass loss determined is less than or equal to 1.00 percent\*? .....
5. DSR test (AASHTO T315) performed on RTFO residue? .....
- (a) The test temperature used is the high temperature grading designation? .....
  - (b) If the value of  $G^*/\sin \delta$  is  $\geq 2.20$  kPa, testing continued? .....
  - (c) If the value of  $G^*/\sin \delta$  is not  $\geq 2.20$  kPa, the specimen is treated like a binder of unknown grade (see above)? .....
6. PAV residue combined into a single container? .....
7. DSR test (AASHTO T315) performed on PAV residue?.....
  - (a) The test temperature determined from the temperature grading designation and Table 1 in M320? .....
  - (b) If the value of  $G^*\sin \delta$  is less than 5,000 kPa, testing continued? .....
  - (c) If the value of  $G^*\sin \delta$  is not less than 5,000 kPa, the specimen is treated like a binder of unknown grade (see above)? .....
8. BBR test (AASHTO T313) performed on PAV residue? .....
- (a) Two specimens prepared and tested (results averaged)? .....
  - (b) The test temperature determined from the temperature grading designation and Table 1 in M320? .....
  - (c) If the slope is  $\geq 0.300$ , testing continued? .....
  - (d) If the slope is not  $\geq 0.300$ , the specimen is treated like a binder of unknown grade (see above)? .....
9. DT test performed on PAV residue (Optional)?.....
  - (a) Creep stiffness from BBR test on PAV residue is between 300 and 600 MPa? .....
  - (b) Slope from BBR test on PAV residue is greater than or equal to 0.300? .....
  - (c) Results of four specimens reported and averaged? .....
  - (d) If the failure strain is greater than or equal to 1.0 percent, the grade is considered verified? .....
  - (e) If the failure strain is not greater than or equal to 1.0 percent, the specimen is treated like a binder of unknown grade (see above)? .....

\*If these requirements cannot be met (according to AASHTO M320), then no further testing is required.

COMMENTS (R29):

(R29)



**GRADING OR VERIFYING PGB**

(R29) \_\_\_\_\_

**REPORTING**

Date: \_\_\_\_\_

**For Grading an Unknown Asphalt Binder:**

1. Results of all tests performed reported? ..... \_\_\_\_\_
2. PG grade designation reported (example PG 52-34)? ..... \_\_\_\_\_

**For Verifying the Nominal Grade of an Asphalt Binder:**

1. Results of all tests performed reported? ..... \_\_\_\_\_
2. Whether or not binder meets the requirements of M320 reported? ..... \_\_\_\_\_

COMMENTS (R29):

(R29)



**SOLUBILITY OF ASPHALT MATERIALS IN TRICHLOROETHYLENE**(T44) \_\_\_\_\_  
(D2042) \_\_\_\_\_APPARATUS

Date: \_\_\_\_\_

1. **Gooch Crucibles**
  - (a) Glazed surface throughout except bottom exterior unfinished? .....
  - (b) Approximately 44 mm at the top tapering to 36 mm at the bottom [AMRL:  $\pm 2$  mm]? .....
  - (c) Approximate depth of 24 to 28 mm [ASTM: 20 to 30 mm]? .....
2. **Filtration Assembly**
  - (a) Heavy walled filter flask with side tube, capacity 250 mL or larger [ASTM: 250 to 500 mL]? .....  
*Note to assessors: any other assemblies permitting vacuum filtration with a Gooch crucible may be used.*
  - (b) Glass fiber pads with a diameter of 32, 35, or 37 mm [ASTM: 32 to 34 mm, fine porosity, fast flow rate, 1.5  $\mu$ m particle retention]? .....
3. **Suction Assembly**
  - (a) Satisfactory assembly? .....
4. **Trichloroethylene Solvent**
  - (a) Technical Grade Type 1 (Reagent Grade) Trichloroethylene, or Technical Grade 1,1,1 Trichloroethane .....
  - (b) ASTM: Trichloroethylene, Technical (Reagent) grade? .....
5. **Desiccator**
  - (a) Satisfactory design and charged with effective desiccant? .....
6. **Drying Oven**
  - (a) Maintains temperature at  $110 \pm 5^\circ\text{C}$  ( $230 \pm 9^\circ\text{F}$ )? .....
7. **Miscellaneous Items**
  - (a) Suitable container for weighing and dissolving sample? .....
  - (b) Class A balance (readable to 0.0001 g) available? .....
  - (c) Policeman (optional)? .....

PREPARATION OF THE GOOCH CRUCIBLE

1. **AASHTO Procedure**
  - (a) Filtering apparatus assembled? .....
  - (b) Crucible placed on filter tube? .....
  - (c) New glass fiber pad placed in crucible? .....
  - (d) Pad wetted with solvent and seated firmly with light suction? .....
  - (e) Crucible and contents dried at  $110 \pm 5^\circ\text{C}$  ( $230 \pm 9^\circ\text{F}$ ) for at least 20 min? .....
  - (f) Crucible and contents cooled in a desiccator for at least 20 min. and then weighed to nearest .0001g? .....
  - (g) Drying and cooling procedure repeated until constant mass ( $\pm 0.0003$  g) is obtained? .....
  - (h) Crucible stored in a desiccator until used? .....
2. **ASTM Procedure**
  - (a) New filter pad placed in crucible and dried in oven at  $110 \pm 5^\circ\text{C}$  for 15 min (no wetting and seating required)? .....
  - (b) Cooled in a desiccator for  $30 \pm 5$  and weighed to the nearest 0.0001 g? .....
  - (c) Stored in a desiccator until ready to use? .....

COMMENTS (T44/D2042):

(T44/D2042)

**SOLUBILITY OF ASPHALT MATERIALS IN TRICHLOROETHYLENE**(T44) \_\_\_\_\_  
(D2042) \_\_\_\_\_PROCEDURE

Date: \_\_\_\_\_

1. If the sample is not fluid is it heated with care to prevent local overheating? .....
2. Sample stirred occasionally and the entrapment of air avoided? .....
3. **ASTM: Sample heated at any temperature not more than 100 °C above softening point?** .....
4. Approximately 2 g [AMRL:  $\pm 0.5$  g] of sample placed in tared (nearest 0.001 g) container? .....
5. Container with sample allowed to cool and then weighed to nearest 1 mg (0.001 g)? .....
6. 100 mL of solvent added to container, flask stoppered, and then container agitated as necessary until the sample is dissolved? .....
7. **ASTM: Solvent added in small portions with constant agitation?** .....
8. Lumps completely digested and container sides free of undissolved sample? .....
9. **ASTM Only: No undissolved material visible after 15 minutes in the solvent?** .....  
*Note to Assessors: for referee testing, flask and solution shall be placed in a water bath at  $38.0 \pm 0.3$  °C for 1 hour before filtering. Please discuss with laboratory if necessary.*
10. Crucible placed in filter tube and wetted? .....
11. Asphalt solution decanted through filter with light suction? .....
12. If insoluble matter is visible:
  - (a) Retained in container until solution has drained through filter? .....
  - (b) Container washed with solvent and insoluble matter transferred to crucible? .....
  - (c) Container and policeman (if used) rinsed? .....
  - (d) Insoluble matter washed until the filtrate is substantially colorless? .....
  - (e) Strong suction applied to remove remaining solvent? .....
13. Crucible removed and bottom washed free of dissolved matter? .....
14. Placed in oven at  $110 \pm 5$  °C for at least 20 min? .....
15. Cooled in desiccator for at least 20 min. [ASTM:  $30 \pm 5$  min] and then weighed to nearest .0001 g? .....
16. Steps (14) and (15) repeated until constant mass of  $\pm 0.0003$  g obtained? .....
17. Percent insoluble reported to nearest 0.1%? .....
18. **ASTM: If percent insoluble is less than 1%, reported to nearest 0.01%?** .....
19. **ASTM: If the crucible in desiccator must be left overnight, is it placed in oven for 30 min. and then cooled again in desiccator?** .....

COMMENTS (T44/D2042):

(T44/D2042)

**APPARATUS FOR FLASH AND FIRE POINT  
BY CLEVELAND OPEN-CUP**

(T48) \_\_\_\_\_  
(D92) \_\_\_\_\_

APPARATUS

Date: \_\_\_\_\_

1. Flash Tester
  - (a) Automatic or Manual? (Please Record) \_\_\_\_\_
  - (b) Supported on level and steady surface? \_\_\_\_\_
  - (c) Draft-free location? \_\_\_\_\_
2. Test Cup
  - (a) Outer diameter of the flange 97 to 101 mm [*ASTM: 97 to 100 mm*]? \_\_\_\_\_
  - (b) Outer diameter below the flange 67.5 to 69 mm? \_\_\_\_\_
  - (c) Inner diameter of the cup 62.5 to 64 mm [*ASTM: 63 to 64 mm*]? \_\_\_\_\_
  - (d) Rim to the fill mark 9 to 10 mm in length? \_\_\_\_\_
  - (e) Depth of the cup 32.5 to 34 mm? \_\_\_\_\_
  - (f) Bottom thickness 2.8 to 3.6 mm [*ASTM: 2.8 to 3.5*]? \_\_\_\_\_
3. Heating Plate
  - (a) Plate of acceptable design covering heater top? \_\_\_\_\_
  - (b) Hard board of suitable design? \_\_\_\_\_
  - (c) Support holds plate level and steady? \_\_\_\_\_
4. Test Flame Applicator
  - (a) Mounted on apparatus? \_\_\_\_\_
  - (b) Swing radius not less than 150 mm (6 in.)? \_\_\_\_\_
  - (c) Orifice diameter approximately 0.8 mm (0.031 in.)? \_\_\_\_\_
  - (d) Orifice not more than 2.5 mm [*ASTM: 2 mm*] above the cup? \_\_\_\_\_
  - (e) Diameter of the tip 1.6 to 5.0 mm [*ASTM: approximately 1.6 mm*]? \_\_\_\_\_
  - (f) Bead 3.8 to 5.4 mm [*ASTM: 3.2 to 4.8 mm*]? \_\_\_\_\_
  - (g) Bead mounted on apparatus [*ASTM: not required to be mounted*]? \_\_\_\_\_
5. Heater
  - (a) Centered under plate opening? \_\_\_\_\_
  - (b) No local superheating? \_\_\_\_\_
  - (c) No gases or flames up around the cup? \_\_\_\_\_
6. Thermometer
  - (a) ASTM 11C/11F or IP 28C/28F? \_\_\_\_\_  
or Electronic device such as a resistance thermometer or thermocouple? \_\_\_\_\_
  - (b) Support can hold thermometer vertically  $6.4 \pm 0.1$  mm from the cup bottom? \_\_\_\_\_
  - (c) Thermometer positioned halfway between the center and side of cup? \_\_\_\_\_
  - (d) Positioned on diameter perpendicular to arc of sweep of test flame? \_\_\_\_\_
7. *Filling Level Gage (AASHTO Only – Optional)*
  - (a) *Height of projections 9 to 10 mm?* \_\_\_\_\_
  - (b) *Flame orifice guide-hole diameter 0.8 mm?* \_\_\_\_\_
  - (c) *Guide hole not more than 2.5 mm above bottom edge of gage?* \_\_\_\_\_

COMMENTS (T48/D92):

(T48/D92)

**FLASH AND FIRE POINTS BY CLEVELAND OPEN-CUP**

(T48) \_\_\_\_\_

(D92) \_\_\_\_\_

CALIBRATION AND STANDARDIZATION

Date: \_\_\_\_\_

1. Temperature measuring device calibrated according to manufacturer's instructions? ..... \_\_\_\_\_
2. Performance of manual or automated apparatus verified (annually) by testing a certified reference material (CRM), or equivalent (not AMRL Proficiency Sample), which is reasonably close to the expected temperature range of the samples to be tested? (CRM must have certificate from manufacturer)?..... \_\_\_\_\_
3. *Using a secondary working standard (SWS), a mean flash point and statistical control limits (3 $\sigma$ ) for the SWS established? (Optional)..... \_\_\_\_\_*
  - (a) *When an observed flash point is outside of these control limits, is a close check of the apparatus made and the test repeated with a fresh specimen while paying close attention to the procedural details?..... \_\_\_\_\_*

Additional information taken from Annex A2 (included only for guidance)

**CRM** - A certified reference material is a stable, pure (99 + mole % purity) hydrocarbon or other stable petroleum product with a method-specific flash point established by a method-specific interlaboratory study following RR: D02-1007\* or ISO Guide 34 and 35.

Typical Flash Point Values and Typical Limits for CRM			
Hydrocarbon	Purity (mole%)	Flash Point (°C)	Limits (°C)
n-tetradecane	99+	115.5	±8.0
n-hexadecane	99+	138.8	±8.0

Calculation of the limits for other CRM's can be determined from the reproducibility values of this test method, reduced by interlaboratory effect and then multiplied by 0.7 (see Research Report RR:S15-1008\*).

**SWS** – A secondary working standard is a stable, pure (99 + mole % purity) hydrocarbon, or other petroleum product whose composition is known to remain appreciably stable.

- Research Reports and supporting data are filed at ASTM International Headquarters.

PREPARATION OF TEST CUP

1. Cup washed with solvent to remove any test specimen or traces of gum or residue?..... \_\_\_\_\_
2. If deposits of carbon are present, removed with steel wool? ..... \_\_\_\_\_
3. Cup rinsed with cool water and dried on hot plate or over open flame? ..... \_\_\_\_\_
4. Cup cooled to at least 56°C (100°F) below the flash point before using?..... \_\_\_\_\_

COMMENTS (T48/D92):

(T48/D92)

**FLASH AND FIRE POINTS BY CLEVELAND OPEN-CUP**

(T48) \_\_\_\_\_

(D92) \_\_\_\_\_

PROCEDURE

Date: \_\_\_\_\_

**Anticipated Flash Point:** \_\_\_\_\_ °C \_\_\_\_\_ °F

1. Sample melted at temperature not exceeding 56°C (100°F) below the probable flash point?..... \_\_\_\_\_
2. Cup filled with top of sample meniscus at filling line? ..... \_\_\_\_\_
3. Excess removed with a pipette? If sample on outside of cup, is it cleaned and refilled? Air bubbles destroyed?..... \_\_\_\_\_
4. Test flame adjusted to 3.8 to 5.4 mm [*ASTM: 3.2 to 4.8 mm*] diameter?..... \_\_\_\_\_
5. Temperature raised 10 to 20°C (18 to 36°F) [*ASTM: 5 to 17 °C (9 to 30 °F)*] per min? ..... \_\_\_\_\_
  - (a) When expected flash point is unknown, test flame applied beginning at least 5°C (9°F) above starting temp & temp increased 4 to 7°C (7 to 13°F) [*ASTM: 5 to 6 °C (9 to 11 °F)*] per min? ..... \_\_\_\_\_  
*ASTM Note: Some preliminary test flame applications during the initial heating phase maybe useful in detecting whether unexpected volatile material is present in the sample (recommend 10°C intervals).*  
*ASTM Note: With low flash point material or with highly viscous material it is advised to use the 5 to 6 °C / min for the duration of the test.*
6. When sample temp is approximately 56°C (100°F) [AMRL: ± 8°C (± 15°F)] below anticipated flash point is heat decreased?..... \_\_\_\_\_
7. Rate adjusted to 4 to 7°C (7 to 13°F) [*ASTM: 5 to 6 °C (9 to 11 °F)*] per minute? ..... \_\_\_\_\_
8. Starting at least 28°C (50°F) below flash point, rate maintained and test flame applied?..... \_\_\_\_\_
9. Test flame applied for each 2°C (5°F) mark with smooth continuous motion?..... \_\_\_\_\_
10. Direction reversed with each pass of test flame?..... \_\_\_\_\_  
*Note to Assessors: Automatic testers that only pass the flame in 1 direction are acceptable.*
11. Test flame passed across cup in approximately 1.0 second?..... \_\_\_\_\_
12. Care taken to avoid disturbing vapors by careless movement or breathing near cup during last 28°C (50°F) rise in temperature? ..... \_\_\_\_\_
13. If a skin should form, is it carefully moved aside with a small spatula or stirring rod?..... \_\_\_\_\_
14. Test terminated if foaming occurs during last 28°C (50°F) rise in temperature? ..... \_\_\_\_\_
15. Temperature read when flash appears at any point on surface of sample? ..... \_\_\_\_\_
16. If flash is detected on first application, is the test stopped then restarted with a fresh sample? ..... \_\_\_\_\_
17. True flash, not halo, recorded?..... \_\_\_\_\_  
*Note to Assessors: The sample is deemed to have flashed when a large flame appears and instantaneously propagates itself over the entire surface. A blue halo or an enlarged flame is not a flash.*
18. Local barometric pressure at time of test recorded? (\_\_\_\_\_) mm Hg ..... \_\_\_\_\_  
*Note to Assessors: Many aneroid barometers, such as those used at weather stations and airports are pre-corrected to give sea level readings and will not give the correct readings for this test.*
19. If barometric pressure at lab is not 760 ± 15 mm Hg, flash point corrected using formula in book?..... \_\_\_\_\_
20. Flash point reported to nearest 1°C (2°F)?..... \_\_\_\_\_

COMMENTS (T48/D92):

(T48/D92)

**PENETRATION OF BITUMINOUS MATERIALS**

(T49) \_\_\_\_\_

(D5) \_\_\_\_\_

APPARATUS

Date: \_\_\_\_\_

1. **Penetrometer**

- (a) Dial accurate to 0.1 mm? ..... \_\_\_\_\_
- (b) Spindle readily detaches? ..... \_\_\_\_\_
- (c) Mass of spindle 47.45 to 47.55 g? ..... \_\_\_\_\_
- (d) Mass of 50 g weight 49.95 to 50.05 g? ..... \_\_\_\_\_
- (e) Mass of 100 g weight 99.95 to 100.05 g? ..... \_\_\_\_\_
- (f) Needle moves vertically and perpendicular to flat base? ..... \_\_\_\_\_
- (g) Device equipped with a leveling indicator? ..... \_\_\_\_\_
- (h) Level indicator verified annually with a hand held level? ..... \_\_\_\_\_

2.

<b>PENETROMETER NEEDLES</b>	<b>1</b>	<b>2</b>	<b>3</b>
Needle Number (not required, please reference for reporting)?			
Mass of needle 2.45 to 2.55 g?			
Needle Diameter of 1.00 to 1.02 mm?			
Ferrule Diameter of 3.15 to 3.25 mm?			
Ferrule length of 37 to 39 mm?			
Needle straight (roll on flat surface)?			
Surface finish smooth?			
End symmetrically tapered and straight?			

At least three satisfactory needles available (for penetrations over 200)? ..... \_\_\_\_\_

3. **Sample Containers** Metal or glass flat bottom sample containers of the following dimensions:

- (a) For penetrations less than 40, container 33 to 55 mm diameter and 8 to 16 mm deep? ..... \_\_\_\_\_
- (b) For penetrations less than 200, container 55 mm diameter and 35 mm deep? ..... \_\_\_\_\_
- (c) For penetrations between 200 and 350, container 55 to 75 mm diameter and 45 to 70 mm deep? ..... \_\_\_\_\_
- (d) For penetrations greater than 350, container 55 mm diameter and 70 mm deep? ..... \_\_\_\_\_

*Note to Assessors: For referee testing, the container for testing materials with penetrations below 40 shall be 55 mm in diameter by 35 mm in depth.*

4. **Water Bath**

- (a) Capable of maintaining temperature within 0.1°C (0.2°F) (e.g. 77.0 ± 0.2°F)? ..... \_\_\_\_\_
- (b) At least 10 liters of water in bath? ..... \_\_\_\_\_
- (c) Perforated shelf at least 100 mm below surface of water and at least 50 mm from bottom of bath? ..... \_\_\_\_\_
- (d) Water in bath clean? ..... \_\_\_\_\_

5. **Thermometer**

- (a) Any thermometer or thermometric device with 0.1°C (0.2°F) subdivisions? ..... \_\_\_\_\_
- (b) Thermometer used calibrated? ..... \_\_\_\_\_
- (c) AASHTO only: Thermometer immersed to level of shelf? ..... \_\_\_\_\_

6. **Bath Transfer Dish for Container** (for penetrations made outside of the bath)

- (a) Capacity of at least 350 mL? ..... \_\_\_\_\_
- (b) Sufficient depth for water to cover sample container? ..... \_\_\_\_\_
- (c) Means of preventing rocking of sample container provided (usually magnet)? ..... \_\_\_\_\_

7. **Timing Device**

- (a) Electric timer, stopwatch, or other device graduated to 0.1 s or less and accurate to ± 0.1 s for 60-s interval? ..... \_\_\_\_\_
- or (b) Audible seconds counter providing one beat every 0.5 s (time for an 11-count interval is 5.0 ± 0.1 s)? ..... \_\_\_\_\_
- or (c) Automatic timing device on penetrometer accurately calibrated to provide interval ± 0.1 s? ..... \_\_\_\_\_

8. **Light Source** for illuminating surface of specimen? ..... \_\_\_\_\_

COMMENTS (T49/D5):

(T49/D5)

**PENETRATION OF BITUMINOUS MATERIALS**

(T49) \_\_\_\_\_

(D5) \_\_\_\_\_

**SAMPLE PREPARATION**

Date: \_\_\_\_\_

1. Sample heated to less than 90°C above expected softening point for asphalt? .....
2. Sample heated for the minimum time necessary to make sample sufficient fluid? .....
3. Sample stirred? .....

**PROCEDURE**

1. Expected penetration value? .....
2. Sample poured and container loosely covered if conditions warrant? .....
3. Sample poured into container? (Time: \_\_\_\_\_) .....
4. Sample depth at least 10 mm greater than 120% of the depth of expected penetration? .....
5. If the sample is less than 65 mm in diameter and the expected penetration is more than 200, 3 separate samples poured for each variation in test conditions? .....
6. Sample allowed to cool at 15 to 30°C for:
  - (a) 45 min to 1.5 hours for 33 mm x 16 mm or smaller containers? .....
  - (b) 1 to 1.5 hours for 55 x 35 mm containers? .....
  - (c) 1.5 to 2 hours for larger containers? .....
7. Sample and transfer dish (if used) then placed in water bath for similar time? (Time : \_\_\_\_\_) .....
8. Test run at 25°C with a test load of 100 g (50 g weight + 47.50 g spindle + 2.50 g needle) and a time of 5 s? ....  
***Note to Assessors:** Other test conditions listed in method for special testing. Specify if used at the bottom of page*
9. If transfer dish is used, water covers entire sample? .....
10. Needle cleaned with toluene or other solvent, dried with clean cloth, and inserted into penetrometer? .....
11. Levelness of apparatus ensured using the level indicator? .....
12. Needle with weight adjusted to just make contact with sample surface? .....
13. Dial reading noted or adjusted to zero? .....
14. Needle quickly released for  $5.0 \pm 0.1$  s and dial adjusted to measure penetration? .....
15. Penetration ignored if any container movement noted? .....
16. If transfer dish is used, dish with sample returned to bath after each penetration? .....
17. When one needle is used, cleaned with solvent moistened cloth after each penetration and then wiped with a clean, dry cloth? .....
18. Test run with a long needle for samples with a penetration greater than 350, run with a short needle otherwise? .....
19. If penetration value is over 200, are needles left in sample until completion of test? .....
20. Three penetrations made? .....
21. Penetrations at least 1 cm (10 mm) from side and bottom of container and each other? .....
22. Average of at least three penetration values determined not differing by more than the amount shown in the table below? .....

Penetration	0 to 49	50 to 149	150 to 249	250 to 500
Max Difference	2	4	12	20

COMMENTS (T49/D5):

(T49/D5)



**FLOAT TEST FOR BITUMINOUS MATERIALS**

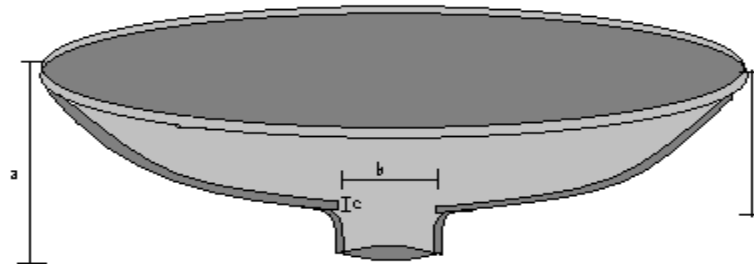
(T50) \_\_\_\_\_

(D139) \_\_\_\_\_

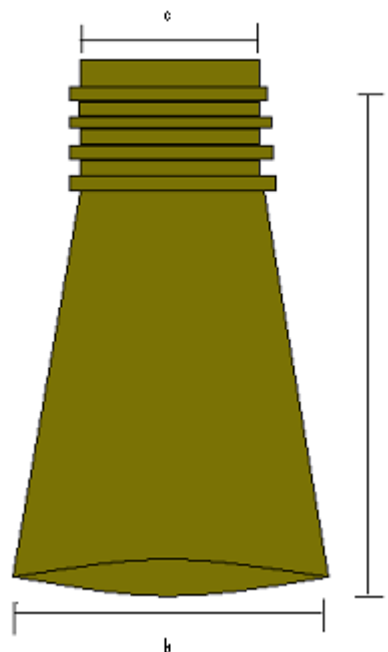
APPARATUS

Date: \_\_\_\_\_

Float	1	2	3	4
Made of Aluminum alloy?				
Weight: $37.90 \pm 0.20\text{g}$				
a = Total height: $35.0 \pm 1.0\text{mm}$				
b = Diameter of opening: $11.1 \pm 0.1\text{mm}$				
c = Thickness of shoulder: $1.4 \pm 0.1\text{mm}$				
d = Height of rim above lower side of shoulder: $27.0 \pm 0.5\text{mm}$				



Collar	1	2	3	4
Made of Brass?				
Weight: $9.8 \pm 0.20\text{g}$				
a = Height: $22.5 \pm 0.2\text{mm}$				
b = Inner diameter at bottom: $12.82 \pm 0.10\text{mm}$				
c = Inner diameter at top: $9.70 \pm 0.05\text{mm}$				



**FLOAT TEST FOR BITUMINOUS MATERIALS**(T50) \_\_\_\_\_  
(D139) \_\_\_\_\_APPARATUS (Continued)

Date: \_\_\_\_\_

1. Have float and collar assemblies been standardized for depth of immersion? .....
2. ASTM 15C or ASTM 15F thermometer or equivalent thermometric device? .....
3. **Water Baths**
  - (a) Testing Bath
    - (1) Circular bath with inside diameter at least 185 mm and water depth of at least 185 mm?.....
    - or** (2) Rectangular bath at least 150 by 300 mm and water depth of at least 110 mm?.....
    - (3) Height of bath container above water level at least 40 mm?.....
    - (4) Heated by gas or electric heater or other suitable means? .....
    - (5) Thermometer supported in bath to a depth of  $40 \pm 2$  mm below the water surface? .....
  - (b) Cold Bath
    - (1) Maintained at  $5.0 \pm 1.0^\circ\text{C}$  ( $41.0 \pm 1.8^\circ\text{F}$ )? .....
    - (2) Large enough to hold float and collar assembly and plate? .....
4. Spatula or steel knife? .....
5. A smooth, flat plate approximately 50 by 75 mm [AMRL: Large enough for the samples, but small enough to fit into the bath] for pouring sample into collar?.....
6. Suitable release agent? .....
7. Stop watch? .....

PROCEDURE

1. Collar placed with smaller end down on plate prepared with release agent? .....
2. Sample melted at lowest possible temperature that will bring it to a fluid condition (If emulsion residue sample,  $500^\circ\text{F}$  ( $260^\circ\text{C}$ ))? .....
3. Sample stirred without incorporating air bubbles? .....
4. Collar filled until more than level full? .....
5. Sample cooled at room temperature for 15 to 60 min. (not necessary for tar products)? .....
6. Sample immersed in  $5^\circ\text{C}$  ( $41^\circ\text{F}$ ) water bath for 5 minutes? .....
7. Excess material trimmed with slightly heated spatula or steel knife?.....
8. Sample flush with top of collar?.....
9. Collar and plate put back in  $5^\circ\text{C}$  ( $41^\circ\text{F}$ ) water bath for 15 to 30 minutes?.....
10. Testing bath maintained at  $\pm 0.5^\circ\text{C}$  ( $0.9^\circ\text{F}$ ) of test temperature throughout the test?.....
11. When temperature is determined, is the thermometer immersed at  $40 \pm 2$  mm below water surface? .....
12. Collar and contents removed from plate and screwed into float?.....
13. Float and collar assembly completely immersed in  $5^\circ\text{C}$  ( $41^\circ\text{F}$ ) water for 1 minute? .....
14. Water removed from inside of float?.....
15. Assembly floated on testing bath immediately after removal of water? .....
16. Spinning of assembly avoided? .....
17. Timer started as soon as assembly is placed in testing bath?.....
18. Timer stopped when water breaks through tested material?.....
19. Time recorded? .....

COMMENTS (T50/D139):

(T50/D139)

## DUCTILITY OF BITUMINOUS MATERIALS

(T51) \_\_\_\_\_  
(D113) \_\_\_\_\_APPARATUS

Date: \_\_\_\_\_

Molds	1	2	3	4	5	6
Design conforms to Fig. 1?						
Thickness: 9.9 to 10.1 mm?						
Width at midpoint: 9.9 to 10.1 mm?						
Made of brass?						
Mold Plates	1	2	3			
Non-absorbent?						
Made of brass?						
Flat and level?						

1. Water Bath

- (a) Maker: \_\_\_\_\_
- (b) AASHTO: Depth of water shall be not less than 50 mm. ....
- (c) AASHTO: Specimens can be immersed to a depth of at least 25 mm? .....
- (d) AASHTO: Water free from oil and slime? .....
- (e) AASHTO: Volume of water not less than 10 L? .....
- (f) **ASTM: Specimens immersed and supported such that they are surrounded by water?** .....
- (g) Bath maintains temperature within 0.5°C (0.9°F)? .....

2. Ductility Machine

- (a) Maker: \_\_\_\_\_
- (b) Serial No. (or I.D. No.)? .....
- (c) Space for at least 25 mm of water above and below sample at start of test? .....
- (d) Machine maintains specified speed within 5 percent (e.g. 5.00 ± 0.25 cm/min.)? .....
- (e) Machine functions without undue vibration? .....
- (f) **ASTM: Means of measuring elongation of the specimen in centimeters?** .....

3. Agent for Adjusting Specific Gravity (information only)

- (a) Specimen sinks to the bottom: \_\_\_\_\_
- (b) Specimen floats to the top: \_\_\_\_\_

4. Thermometer

- (a) ASTM 63C or 63F thermometer or any other liquid in glass equivalent? .....
- or**
- (b) An equivalent thermometric device that has been calibrated in accordance with Test Method E220 or E644 (Assessors: Records should indicate use of one of these methods)? .....
- (c) AASHTO: An electronic temperature device may be used if it exhibits the same temperature response as the mercury thermometer? .....

5. Release Agent

- (a) One of the following:
- Glycerin and Dextrin, Talc, or Kaolin (China Clay) .....
- Versamid Resin and Mineral Oil .....
- AASHTO: Dow-Corning stopcock grease .....
- Other materials that have been shown not to affect physical properties of the test specimen: .....

6. Miscellaneous Equipment

- (a) Straight-edged trimmer at least 1 ½ in. wide [ASTM: Wider than the specimen]? .....
- (b) **ASTM: 300-µm (No. 50) sieve?** .....

COMMENTS (T51/D113):

(T51/D113)

## DUCTILITY OF BITUMINOUS MATERIALS

(T51) \_\_\_\_\_  
(D113) \_\_\_\_\_PROCEDURE

Date: \_\_\_\_\_

1. Mold assembled on plate prepared with release agent?..... \_\_\_\_\_
2. Interior surface of mold sides treated with release agent along center pieces only?..... \_\_\_\_\_
3. Sample carefully heated to prevent local overheating and then stirred? \*..... \_\_\_\_\_
4. Mold filled by pouring a thin stream back and forth from end to end? ..... \_\_\_\_\_
5. Mold filled until more than level full?..... \_\_\_\_\_
6. Disarrangement of mold parts avoided during filling?..... \_\_\_\_\_
7. Sample, mold, and plate cooled at room temperature? Start Time:..... \_\_\_\_\_
8. Cooling time 30 - 40 min. at room temperature? End Time:..... \_\_\_\_\_
9. Placed in water bath for 30 min. [ASTM 30 to 40 min]? Start Time:..... \_\_\_\_\_
10. Bath water within 0.5°C (0.9°F) of test temperature? ..... \_\_\_\_\_
11. Excess material cut off with hot straight-edged putty knife or spatula? End Time:..... \_\_\_\_\_
12. Mold level full?..... \_\_\_\_\_
13. Specimen not pulled away from mold? ..... \_\_\_\_\_
14. Sample, mold and plate placed again in water bath? Start Time:..... \_\_\_\_\_
15. Bath water within 0.5°C (0.9°F) of test temperature? ..... \_\_\_\_\_
16. Conditioned in water bath for 85 - 95 min.? End Time:..... \_\_\_\_\_
17. Mold taken off plate and side pieces of mold detached?..... \_\_\_\_\_
18. Bending of the specimen, distortion, or fracture avoided?..... \_\_\_\_\_
19. Briquette placed in testing machine and tested immediately? ..... \_\_\_\_\_
20. Water in testing machine within 0.5°C (0.9°F) of test temperature? ..... \_\_\_\_\_
21. Specimen pulled to a point or thread and does not touch bottom or surface? ..... \_\_\_\_\_
22. Is gravity adjusted and test repeated if thread does contact top or bottom? ..... \_\_\_\_\_
23. Distance clips pulled to produce rupture measured in cm? ..... \_\_\_\_\_
24. If specimen does not rupture is it noted on the report (ASTM: *Noted as "length+" - i.e. "150 cm+"*) ..... \_\_\_\_\_
25. For referee testing, three specimens tested and results averaged?..... \_\_\_\_\_

*\*Note: ASTM: If emulsion or cutback residue is used, it is recommended that the material be sieved through at 300 mm (No. 50) sieve prior to pouring. If the material is sieved prior to testing, it should be noted on the report. For referee testing residue material must be poured through a 300 mm sieve.*

COMMENTS (T51/D113):

(T51/D113)

**SOFTENING POINT OF BITUMINOUS MATERIALS**

(T53) \_\_\_\_\_

(D36) \_\_\_\_\_

APPARATUS

Date: \_\_\_\_\_

<b>RINGS (at least two)</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
Outer Diameter at top of shoulder: 22.7 to 23.3 mm?						
Inner Diameter at top of shoulder: 19.5 to 20.1 mm?						
Outer Diameter at bottom of ring: 18.5 to 19.1 mm?						
Inner diameter at bottom of ring: 15.6 to 16.2 mm?						
Total Height of rings: 6.0 to 6.8 mm?						

<b>STEEL BALLS (at least two)</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
Diameter approximately 9.5 mm [AMRL: 9 to 10 mm]						
Weight: 3.45 to 3.55 g?						

1. **Ball Centering Guides**

(a) Two brass guides resembling guides in Fig. 1 (c) available? .....

2. **Bath**

(a) Glass vessel with a minimum inside diameter of 85 mm and not less than 120 mm in depth? .....

*Note to Assessors: An 800 mL beaker, Griffin Low-Form, heat resistant glass, meets this requirement.*3. **Thermometers**

(a) ASTM 15C or 15F for distilled water? .....

(b) ASTM 16C or 16F for USP Glycerin? .....

(c) ASTM 113C or 113F [ASTM: ASTM 16C or 16F] for Ethylene Glycol? .....

(d) Thermometer positioned so bottom of bulb is level with the bottom of rings and within 13 mm (0.5 in.) of the rings but not touching them or the ring holder? .....

(e) Thermometer can be read after 3 minutes with bulb at bottom of rings? .....

(f) AASHTO: Another thermometric device meeting the following requirements

(1) Maximum scale error no greater than that of the thermometer specified in ASTM E1? .....

(2) Capable of indicating the temperature within 0.2°C (0.5°F)? .....

(g) **ASTM: Any thermometric device can be used as long as meets the following requirements:**(1) **Equal accuracy or better?** .....(2) **Capable of indicating temperature to within 1° C (2° F)?** .....(3) **Stable to within 1° C (2° F) for the duration of exposure?** .....4. **Ring Holder**

(a) Holder accommodates two rings only in a horizontal position? .....

(b) Bottom of rings 25 mm above upper surface of bottom plate? .....

(c) Lower surface of bottom plate 16 ± 3 mm above bottom of the bath? .....

5. **Bath Liquids**

(a) Freshly boiled distilled water for tests between 30 and 80°C (86 and 176°F)? .....

(b) USP Glycerin for tests between 80 and 157°C (176 and 315°F)? .....

(c) Ethylene Glycol for test between 30 and 110°C (86 and 230°F)? .....

(1) Boiling point between 193 and 204°C (379 and 399°F)? .....

(2) **ASTM: Boiling point between 195 and 197°C (383 and 387°F)?** .....6. **Miscellaneous**

(a) Release agent available (standard or comparable)? .....

(b) Base plate, brass, and approximately 50 by 75 mm [AMRL: Large enough for the samples]? .....

(c) Forceps? .....

(d) Knife or spatula? .....

(e) Gas burner or electric heater? .....

COMMENTS (T53/D36):

(T53/D36)

**SOFTENING POINT OF BITUMINOUS MATERIALS**

(T53) \_\_\_\_\_

(D36) \_\_\_\_\_

PROCEDURE

Date: \_\_\_\_\_

1. Sample heated less than 2 hours and to temperature less than 110°C (200°F) above the softening point? .....
2. Pouring plate coated with release agent?.....
3. Brass rings heated to approximate pouring temperature?.....
4. Enough sample poured into two rings to provide excess when cool?.....
5. Samples cooled on flat surface at room temperature? Start Time:.....
6. If samples are soft at room temperature, cooling done at minimum of 10°C (18°F) below expected softening point? .....
7. Elapsed cooling time at least 30 minutes? End Time:.....
8. Excess material cut off level with warmed knife? .....
9. Apparatus assembled with rings, correct thermometer, and ball centering guides in position?.....
10. Bath filled to a depth of 102 to 108 mm (4 to 4.25 in.) with appropriate bath liquid?.....
11. Balls adjusted to bath temperature before use? .....
12. Bath maintained at the proper starting temperature for 15 minutes:
  - (a) Ethylene glycol and freshly boiled, distilled water:  $5 \pm 1^\circ\text{C}$  ( $41 \pm 2^\circ\text{F}$ )?.....
  - (b) USP Glycerin:  $30 \pm 1^\circ\text{C}$  ( $86 \pm 2^\circ\text{F}$ )? .....
13. Care taken to avoid contamination of bath liquid? .....
14. Ball placed in each ball centering guide with forceps? .....
15. Heat applied from below avoiding drafts? .....
16. After 3 minutes, is rate of temperature rise controlled to  $5.0 \pm 0.5^\circ\text{C}$  ( $9.0 \pm 1.0^\circ\text{F}$ ) per minute? .....
17. Temperature shown by the thermometer at the instant the sample surrounding the ball touches the bottom plate recorded for each ring and ball? .....
18. Total elapsed time from preparation to completion of testing less than 6 hours?.....
19. Total elapsed time from pouring to completion of testing less than 4 hours? .....
20. If softening point temperatures differ by more than 1°C (2°F), is test repeated? .....
21. Results obtained in an ethylene glycol bath corrected to water or glycerin using appropriate formula? .....
22. Mean temperature of duplicate determinations reported to:
  - (a) Nearest 0.5°C or 1.0°F when using an ASTM 16C/16F thermometer? .....
  - (b) Nearest 0.2°C or 0.5°F when using an ASTM 15C/15F thermometer? .....
  - (c) Nearest 0.5°C or 1.0°F when using an ASTM 113C/113F thermometer? .....

COMMENTS (T53/D36):

(T53/D36)

**WATER IN BITUMINOUS MATERIALS**

(T55) \_\_\_\_\_

(D95) \_\_\_\_\_

APPARATUS

Date: \_\_\_\_\_

1. Solvents
  - (a) Xylene (Industrial grade) (for asphaltic materials)?.....
  - or** (b) 20% toluene and 80% Xylene? .....
  - or** (c) Petroleum [*ASTM: petroleum naphtha*] or coal-tar naphtha? .....
  - (d) Petroleum distillate .....
2. Water content of solvent determined by running a blank using an equal amount of solvent as used for the test sample? .....
3. Still made of metal or glass? .....
4. Gas burner or electric heater? (Ring burner used with metal stills)? .....
5. Reflux condenser? .....
6. Graduated glass trap? .....

VERIFICATION

1. Does the trap come with a manufacturer-supplied certificate stating accuracy and NIST traceability requirements have been met? .....
- or**
2. Have the accuracy of the graduation marks on the trap been verified by use of a NIST-traceable 5 mL Micro Burette or Micro Pipette readable to the nearest 0.01 mL? .....
- (a) For trap styles A, B, C, and D verification performed as follows:
  - (1) Verified at 0.1 mL intervals up to the 1.0 mL line? .....
  - (2) Verified at 1.0 mL intervals up to the total volume of the trap? .....
- (b) For trap styles E verification performed as follows:
  - (1) Verified at the 0.1, 1.0, 2.0, 4.0, and 5.0 mL lines? .....
- (c) For trap styles F, verification performed as follows:
  - (1) Verified at 0.05, 0.5, 1.0, 1.5, and 2.0 mL lines? .....

Table 1: Trap Types			
Trap Style	Bottom Shape	Size of Trap	Divisions (mL)
A	Conical	10	0.1 up to 1.0, 0.2 up to 10.0
B	Conical	25	0.1
C	Conical	25	0.2
D	Conical	25	0.2
E (i)	Round	5	0.1
E (ii)	Round	5	0.05
E (iii)	Round	10	0.1
F	Round	2	0.05

3. The entire glassware assembly verified prior to first use and at regular frequency thereafter as follows:
  - (a) 400 mL of dry (0.02% water maximum) solvent, to be used for testing, tested in accordance with the procedure below? .....
  - (b) Contents of the trap discarded? .....

COMMENTS (T55/D95):

(T55/D95)

**WATER IN BITUMINOUS MATERIALS**

(T55) \_\_\_\_\_

(D95) \_\_\_\_\_

VERIFICATION (Continued)

Date: \_\_\_\_\_

- (c) Volume of water specified as the first test in Table 2 added to the distillation flask and the sample retested? .....
- (d) Contents of the trap again discarded? .....
- (e) Volume of water specified as the second test in Table 2 added to the distillation flask and the sample retested? .....
- (f) Trap readings are within the tolerances specified in Table 2? .....
- (g) If trap readings are not within tolerance, the device is checked for vapor leaks, too rapid boiling, or inaccuracies in verification of the trap and the steps above repeated? .....

*Note to Assessors: View at least one past record of verification of the glassware assembly.*

Table 2: Trap Verification				
Trap Style	Test 1 Volume of Water (mL)	Permissible Limits for Test 1	Test 2 Volume of Water (mL)	Permissible Limits for Test 2
A	1	$1 \pm 0.1$	9	$9 \pm 0.21$
B	12	$12 \pm 0.2$	24	$24 \pm 0.2$
C	12	$12 \pm 0.2$	24	$24 \pm 0.2$
D	12	$12 \pm 0.2$	24	$24 \pm 0.2$
E (i)	1	$1 \pm 0.1$	4.5	$4.5 \pm 0.1$
E (ii)	1	$2 \pm 0.05$	4.5	$4.5 \pm 0.05$
E (iii)	5	$5 \pm 0.1$	9	$9 \pm 0.1$
F	1	$1 \pm 0.05$	1.9	$1.9 \pm 0.05$

SAMPLE PREPARATION

1. Sample either measured in cylinder or weighed in still to accuracy of 1 percent? .....
2. If cylinder is used, was it rinsed clean with total of 100 mL solvent? .....
3. If weighed into still, one 50-mL and two 25-mL solvent portions added to still? .....

PROCEDURE

1. Satisfactory assembly of components? .....
- Note to Assessors: Glass beads may be added to reduce bumping.*
2. Trap selected according to expected water content? .....
3. Loose cotton (or similar) plug inserted in top of condenser? .....
4. All connections vapor or liquid tight (caution if the apparatus leaks)? .....
5. Cold water circulated in jacket of condenser? .....
6. Heat applied and rate adjusted to have 2 to 5 drops distillate per second from the condenser? .....
7. For metal stills, ring burner about 3 in. above bottom and lowered as test proceeds? .....
8. Distillation continued until no water visible except in trap? .....
9. No increase in water in trap for 5 minutes? .....
10. Ring of water dislodged from condenser? .....
11. Drops of water in trap dislodged? .....
12. When cool, volume of water in trap read to nearest division? .....
13. Water in the sample calculated? .....

COMMENTS (T55/D95):

(T55/D95)



**DISTILLATION OF CUT-BACK ASPHALTIC PRODUCTS**(T78) \_\_\_\_\_  
(D402) \_\_\_\_\_APPARATUS

Date: \_\_\_\_\_

1. **Flasks**
  - (a) Flasks have a side arm?.....
  - (b) 500 mL capacity? .....
2. **Condensers**
  - (a) Jacket length of 200 to 300 mm? .....
  - (b) Tube length of 440 to 460 mm? .....
  - (c) Glass jacket? .....
3. **Adapter**
  - (a) Reinforced top?.....
  - (b) Smoothly curved? .....
  - (c) Inside outlet line vertical? .....
  - (d) End cut or ground?.....
  - (e) End 40 to 50° to inside line? .....
4. **Shield**
  - (a) Made of 22 gauge steel? .....
  - (b) Shield asbestos-lined (3 mm) or ceramic insulation? .....
  - (c) Transparent mica windows?.....
  - (d) Two piece top consisting of 6.4 mm mill board? .....
5. **Graduated Receiver** 100 mL with 1 mL graduations or smaller receiver with 0.1 mL graduations? .....
6. **Heating assembly**
  - (1) Gas burner?.....
    1. Two pieces of 1.18-mm gauze? .....
    2. Tripod or ring stand? .....
    3. Shield for burner? .....
  - (2) Electric heating mantle?.....
    1. Connected to variable transformer? .....
7. **Miscellaneous**
  - (a) Thermometers: Either ASTM 8C / 8F or IP 6C? .....
  - (b) Flame snuffer for residue? .....
  - (c) Suitable cork for flask? .....
  - (d) Weighted receiver cover? .....
  - (e) Tight joint between flask & condenser?.....
  - (f) Flask neck to adapter end: length adjustable to 650 ± 50 mm?.....
  - (g) Class G2 balance? .....
  - (h) Residue container with slip-on cover, 75 ± 5 mm diameter and 55 ± 5 mm in height?.....

COMMENTS (T78/D402):

(T78/D402)

**DISTILLATION OF CUT-BACK ASPHALTIC PRODUCTS**(T78) \_\_\_\_\_  
(D402) \_\_\_\_\_PROCEDURE

Date: \_\_\_\_\_

1. Apparatus clean, dry, and assembled correctly?..... \_\_\_\_\_
2. Thermometer properly aligned 6.4 mm above bottom of flask?..... \_\_\_\_\_
3. Correction of nominal temperatures because of elevation or barometric pressure made to nearest 1°C (2°F) (*The lab should show the tables and how they determine corrections*)? ..... \_\_\_\_\_
4. Sample warmed if necessary and thoroughly stirred?..... \_\_\_\_\_
5. If sample contains sufficient water to cause foaming or bumping, is it dehydrated at least 250 mL? ..... \_\_\_\_\_
6. Specific gravity of material known?..... \_\_\_\_\_
7. Weight of 200 mL calculated from specific gravity at 15.6°C? ..... \_\_\_\_\_
8. 200 mL of sample weighed into flask within 0.5 g? ..... \_\_\_\_\_
9. Apparatus assembled and water passed through condenser jacket? ..... \_\_\_\_\_
10. Area where test is performed free of drafts? ..... \_\_\_\_\_
11. Heat applied at start time:\_\_\_\_\_
12. First drop leaves flask side arm within 10 ± 5 min. after heat first applied? First drop time:\_\_\_\_\_
13. Drip rate from adapter 50 to 70 drops / min. up to 260°C (500°F)? ..... \_\_\_\_\_
14. Drip rate from adapter 20 to 70 drops / min. from 260 to 316°C (500 to 600°F)?..... \_\_\_\_\_
15. Volume of distillate recorded at all specified corrected temperatures to 0.5 mL? ..... \_\_\_\_\_  
**Note:** Temperatures are corrected based on the difference between local barometric pressure and 760 mmHg  
The nominal temperatures for recording (at 760 mmHg) are 190, 225, 260, and 316°C.
16. During dry spells, rate of temperature increase 5°C / minute? ..... \_\_\_\_\_
17. Elapsed time from 316 to 360°C (600 to 680°F) less than 10 minutes?..... \_\_\_\_\_
18. Heat cut off as soon as temperature reaches 360°C (680°F)? ..... \_\_\_\_\_
19. Flask and thermometer removed for pouring residue? ..... \_\_\_\_\_
20. From cut off of heat to start of pouring; not over 30 seconds?..... \_\_\_\_\_
21. Side tube of flask substantially horizontal during pouring? ..... \_\_\_\_\_
22. Residue poured into 240 mL (8 oz.) container set on its cover? ..... \_\_\_\_\_
23. Skin pushed aside? ..... \_\_\_\_\_
24. Any residual distillate in condenser drained into receiver?..... \_\_\_\_\_
25. Residue stirred and poured into test containers as soon as no further vaporization is apparent? ..... \_\_\_\_\_
26. When residue reaches 135 ± 5°C (275 ± 9°F), poured for further testing? ..... \_\_\_\_\_

COMMENTS (T78/D402):

(T78/D402)

**FLASH POINT DETERMINATION USING TAG OPEN CUP**(T79) \_\_\_\_\_  
(D3143) \_\_\_\_\_APPARATUS

Date: \_\_\_\_\_

1. **Test cup**
  - (a) Outer Diameter at the base of the ring 53.2 to 57.0 mm? .....
  - (b) Overall height 50.0 to 53.2 mm? .....
  - (c) Base of ring to cup rim 7.1 to 8.7 mm? .....
  - (d) Mass less than 95 g? .....
2. **Bath**
  - (a) Made of copper? .....
  - (b) Equipped with a constant level overflow? .....
3. **Thermometer and holder**
  - (a) Thermometer with a range of -5 to 110°C (20 to 230°F) and conforming to requirements for an ASTM 9C / 9F thermometer as prescribed in ASTM E1? .....
  - (b) *ASTM: Or a PRT with a 3- or 4- wire design, 50mm (2 in) greater than immersion depth? .....* ♦
  - (c) *Thermometer calibrated according to E77 (mercury) or E644 (PRT)? .....* ♦
  - (d) Holder capable of positioning thermometer as follows:
    - (1) Vertically 6.4 mm from inner bottom of cup? .....
    - (2) Midway between center and edge of cup? .....
    - (3) On line through center of cup and pivot of the taper? .....
4. **Ignition taper**
  - (a) Maintained in fixed horizontal plane by swivel device? .....
  - (b) Center of orifice 3.2 mm above upper edge of cup? .....
  - (c) Jet of taper at least 152 mm from center of swivel? .....
  - (d) Jet passes across center of cup at right angles to thermometer? .....
  - (e) Tip of taper approx. 1.6 mm [AMRL: ± 0.4 mm] in diameter? .....
  - (f) Flame size comparator bead on apparatus or hole in leveling device? .....
  - (g) If comparator bead is mounted on taper, the jet tip extends at least 3 mm beyond the bead? .....
  - (h) Diameter of bead or hole no more than 4 mm? .....
5. **Leveling device**
  - (a) Made of suitable metal at least 3.2 mm thick? .....
  - (b) Two projections 25.4 mm apart and 3.18 ± 0.25 mm in length? .....
  - (c) Larger hole no more than 4 mm and centered 3.2 mm from bottom and 25.4 mm from end? .....
  - (d) Center of smaller hole 3.2 mm from bottom of level and 63.5 mm from end of level? .....
6. **Heater**
  - (a) Small gas burner? .....
  - (b) Electric heater with variable transformer? .....
- or
7. **Miscellaneous**
  - (a) One of the following available:
    - (1) Draft-free hood in flash room? .....
    - (2) Draft shield? .....
  - (b) Bath liquid:
    - (1) Water for flash points to 79.5°C? .....
    - (2) 1:1 water-glycol solution for points above? .....
  - (c) *ASTM: Cleaning Solvents:*
    - (1) *Technical grade and capable of cleaning and drying test cup? .....*

COMMENTS (T79/D3143):

(T79/D3143)

**FLASH POINT DETERMINATION USING TAG OPEN CUP**(T79) \_\_\_\_\_  
(D3143) \_\_\_\_\_PROCEDURE

Date: \_\_\_\_\_

1. Room temperature:  $25 \pm 5^{\circ}\text{C}$ ? .....
2. Tester placed within draft shield or draft-free fume hood? .....
3. Tester shielded from strong light? .....
4. Test bath filled with either water or 1:1 water-glycol solution? .....
5. Temperature of bath media at least  $16.5^{\circ}\text{C}$  ( $30^{\circ}\text{F}$ ) [**ASTM:  $10^{\circ}\text{C}$  ( $18^{\circ}\text{F}$ )**] below expected flash point? .....
6. Glass test cup placed in bath? .....
7. Bath filled to approximately 1/8 in. from the top when test cup in place? .....
8. Leveling device rested on rim of cup? .....
9. Cup filled until the level just touches the pointer of leveling device? .....
10. Taper lit and flame adjusted to less than 4 mm in diameter? .....
11. *AASHTO: Heat applied to bath and temperature rise of sample is  $1.0 \pm 0.3^{\circ}\text{C}$  ( $2.0 \pm 0.5^{\circ}\text{F}$ ) per minute?* .....
12. **ASTM: Heat applied to bath and temperature rise of sample is  $1^{\circ}\text{C}$  ( $2^{\circ}\text{F}$ )/min  $\pm 6$  seconds?** .....
13. Sample level adjusted at 10 to  $15^{\circ}\text{C}$  (18 to  $27^{\circ}\text{F}$ ) below expected flash point? .....
14. Test flame passed across sample at the same temperature? .....
15. Test flame applied at successive  $1^{\circ}\text{C}$  ( $2^{\circ}\text{F}$ ) intervals? .....
16. Passed across cup only once at each temperature? .....
17. Each pass requires about 1 second? .....
18. Flame passed across sample in continuous motion? .....
19. Direction reversed with each pass of test flame? .....
20. Temperature at time of first distinct flash in interior of test cup recorded as flash point? .....
21. **ASTM: Recorded flash corrected for barometric pressure if the pressure differs from 101.3 kPa (760 mm Hg)?** .....
22. *Note to Assessors: Aneroid barometers (those used at weather stations and airports) are pre-corrected to give sea-level readings and shall not be used.*
22. **ASTM: Corrected flash reported to the nearest  $0.5^{\circ}\text{C}$  ( $1^{\circ}\text{F}$ )?** .....

COMMENTS (T79/D3143):

(T79/D3143)

AASHTO Materials Reference Laboratory

**THIN-FILM OVEN TEST**(T179) \_\_\_\_\_  
(D1754) \_\_\_\_\_APPARATUS

Date: \_\_\_\_\_

Sample containers	1	2	3	4	5	6	7	8
Diameter: 140 mm?								
Depth approximately 9.5 mm?								
Thickness 0.64 mm [AMRL: at least 0.38 mm]?								
Made of stainless steel?								
Bottom not badly warped?								

1. **Ovens**

- (a) AASHTO: Inside at least 330 x 330 x 330 mm (13 x 13 x 13 in.) \_\_\_\_\_
- (b) **ASTM: Maximum dimensions of 535 x 535 x 535 mm?** \_\_\_\_\_
- (c) Tightly fitted hinged door? \_\_\_\_\_
- (d) Hinged door has a window at least 100 x 100 mm (4 x 4 in.), clear, 2 sheets of glass? \_\_\_\_\_
- (e) Air vents (*Assessors check to feel air current with hand over vent*)? \_\_\_\_\_
- (f) Shelf
- (1) Approximately centered in oven (**ASTM: 6 in. above bottom**)? \_\_\_\_\_
- (2) Minimum diameter 250 mm (**ASTM: Maximum = 450 mm**)? \_\_\_\_\_
- (3) Rotates at  $5.5 \pm 1$  rpm? \_\_\_\_\_
- (4) Made of metal? \_\_\_\_\_
- (5) Air can flow through shelf when samples in place? \_\_\_\_\_
- (6) Shelf constructed or marked so that sample containers can be placed in same position for each test? \_\_\_\_\_
- (7) Each container position symmetrical with respect to shaft and any holes in shelf? \_\_\_\_\_
- (8) **ASTM: Maximum tilt during rotation no more than 3% from horizontal?** \_\_\_\_\_
- (g) ASTM 13C thermometer (**ASTM: or PRT conforming to ASTM E1137 verified accurate to 163 °C**)? \_\_\_\_\_
- (1) Readable through door? \_\_\_\_\_
- (2) Can be positioned vertically? \_\_\_\_\_
- (3) Approximately 6.4 mm (**ASTM: 40 mm**) above shelf? \_\_\_\_\_
- (4) At midpoint of shelf radius (**ASTM: Radially centered over a sample container position?**)? \_\_\_\_\_
- (h) Oven capable of maintaining temperature of  $163 \pm 1^\circ\text{C}$ ? \_\_\_\_\_
- (i) Oven capable of returning to  $162^\circ\text{C}$  within 15 min. after introducing two sample pans? \_\_\_\_\_

2. **Miscellaneous**

- (a) Rigid heat-resistant insulation board(s) (for reheating of residue)? \_\_\_\_\_
- (b) Spatula or putty knife? \_\_\_\_\_
- (c) Class B (0.001 g) balance available if the loss on heating is desired? \_\_\_\_\_
- (d) 240 mL (8 oz.) ointment tin? \_\_\_\_\_
- (e) Class G2 (0.1 g) balance available to weigh the pans and sample? \_\_\_\_\_

COMMENTS (T179/D1754):

(T179/D1754)

**THIN-FILM OVEN TEST**(T179) \_\_\_\_\_  
(D1754) \_\_\_\_\_PROCEDURE

Date: \_\_\_\_\_

1. Sample heated to less than 150°C (302°F), stirring frequently with thermometer while avoiding the incorporation of air bubbles.....
2. AASHTO: Oven temperature control adjusted so that thermometer reads  $163 \pm 1^\circ\text{C}$  ( $325 \pm 2^\circ\text{F}$ ) while oven is at equilibrium (with empty sample containers in predetermined positions)? .....
3. **ASTM: Oven preheated to setting for at least two hours prior to testing?** .....
4.  $50.0 \pm 0.5$  g of material weighed into each of two or more tared TF pans? .....
5. At same time, original asphalt properties samples prepared (if desired)? .....
6. Samples in TF pans cooled to room temperature?.....
7. If percent loss is desired, each TF sample weighed to nearest mg (0.001 g)? .....
8. TF pans with sample quickly placed in oven in predetermined positions on shelf after removing empty pans? ...
9. Vacant positions on the shelf filled with empty sample containers so every position is occupied?.....
10. Oven closed and shelf rotated?.....
11. Samples removed 5 hours after oven recovered to  $162^\circ\text{C}$ ? .....
12. Oven holds at  $163 \pm 1^\circ\text{C}$ ? .....
13. Total time in oven not more than 5 hours and 15 minutes? .....
14. If change in mass is desired:
  - (a) Samples cooled to room temp. and weighed to nearest mg (0.001 g)? .....
  - (b) Samples placed on refractory boards and returned to oven? .....
  - (c) Oven closed, shelf rotated for  $15 \pm 2$  minutes, and then samples removed? .....
15. **ASTM: Oven preheated to setting for at least two hour prior to testing?** .....
16. **ASTM: Pans removed individually and scraped into the ointment tin?** .....
17. **ASTM: Oven door closed, heater power on, and shelf rotating during scraping?** .....
18. **ASTM: Final pan removed within five minutes of the initial pan?** .....
19. AASHTO: Almost all residues removed from pans by scraping? .....
20. AASHTO: Placed in 240 mL (8 oz) container? .....
21. Combined residues thoroughly mixed by stirring (AASHTO: a hot plate may be used)? .....
22. Material poured into containers and molds for further testing? .....
23. Tests on residue completed within 72 hours? .....

COMMENTS (T179/D1754):

(T179/D1754)

**KINEMATIC VISCOSITY TEST**(T201) \_\_\_\_\_  
(D2170) \_\_\_\_\_APPARATUS

Date: \_\_\_\_\_

1. **Viscometers**

- (a) Viscometer Number: \_\_\_\_\_
- (b) Viscometer calibration constant: \_\_\_\_\_
- (c) Viscometer used: Cannon Fenske: \_\_\_\_\_, Lantz – Zeitfuchs: \_\_\_\_\_, BS/IP/RF: \_\_\_\_\_,  
Zeitfuchs – Cross Arm: \_\_\_\_\_
- (d) If BS/IP/RF viscometers are used, special pipette available? ..... \_\_\_\_\_
- (e) Viscometers clean and in good condition? ..... \_\_\_\_\_

2. **Cleaners**

- (a) Cleaned using either a glass cleaning oven not set above 500°C or a solvent based system as below? .. \_\_\_\_\_
- (1) Strong acid cleaning solution [ASTM: *only if deposits are observed within the viscometer*]? ..... \_\_\_\_\_
- (2) Distilled water? ..... \_\_\_\_\_
- (3) Residue-free acetone? ..... \_\_\_\_\_
- (4) Clean dry air? ..... \_\_\_\_\_
- (5) Completely miscible solvent? ..... \_\_\_\_\_
- (6) Completely volatile solvent? ..... \_\_\_\_\_

3. **Pre-heating apparatus**

- (a) Oven or bath at  $63 \pm 3^\circ\text{C}$  ( $145 \pm 5^\circ\text{F}$ ) for cutbacks? ..... \_\_\_\_\_
- (b) Means of heating to  $135 \pm 5^\circ\text{C}$  ( $275 \pm 10^\circ\text{F}$ ) for asphalt cements? ..... \_\_\_\_\_

4. **Viscometer bath or baths**

- (a) AASHTO: Maintains test temperature  $\pm 0.1^\circ\text{C}$  ( $0.2^\circ\text{F}$ )? ..... \_\_\_\_\_
- (b) ASTM: Test temperature  $\pm 0.01^\circ\text{C}$  ( $\pm 0.02^\circ\text{F}$ )? ..... \_\_\_\_\_
- (c) Temperature of the bath medium does not vary by more than  $\pm 0.1^\circ\text{C}$  ( $\pm 0.2^\circ\text{F}$ )  
[ASTM:  $\pm 0.03^\circ\text{C}$  ( $\pm 0.05^\circ\text{F}$ )] over the length of the viscometer, or from viscometer  
to viscometer in the various bath positions at  $60^\circ\text{C}$  ( $140^\circ\text{F}$ )? ..... ❖ \_\_\_\_\_
- (d) Viscometer immersed to 20 mm above sample reservoir or top of capillary at test temperature? ..... \_\_\_\_\_
- (e) Thermometer correctly immersed at test temperature? ..... \_\_\_\_\_

*Note: Distilled water has been found to be an acceptable bath liquid for tests at  $140^\circ\text{F}$  and white oil has been found to be an acceptable bath liquid for tests at  $275^\circ\text{F}$ . If other liquids are used, please note below.*

5. **Thermometers**

- (a) ASTM 47C / 47F or IP 35C / 35F for tests at  $140^\circ\text{F}$  ..... \_\_\_\_\_
- or (b) ASTM 110C / 110F for tests at  $275^\circ\text{F}$ ? ..... \_\_\_\_\_
- or (c) Any other thermometric device with an accuracy of at least  $0.04^\circ\text{F}$  ( $0.02^\circ\text{C}$ )? ..... \_\_\_\_\_
- (d) Thermometer or other device calibrated at least every six months? ..... \_\_\_\_\_

6. **Timers**

Manufacturer	1/10 s graduations?	Accurate to 0.45 s in 15 min?	Serial Number

- (a) Timers calibrated every 6 months? ..... \_\_\_\_\_

7. **Miscellaneous**

- (a) Air-tight containers of about 30 mL capacity for cutbacks? ..... \_\_\_\_\_
- (b) Suitable containers for preheating asphalt cements? ..... \_\_\_\_\_
- (c) Provision for filtering, drying air when cleaning tubes? ..... \_\_\_\_\_

COMMENTS (T201/D2170):

(T201/D2170)

**KINEMATIC VISCOSITY TEST**(T201) \_\_\_\_\_  
(D2170) \_\_\_\_\_PROCEDURE

Date: \_\_\_\_\_

1. What type of samples does the laboratory test?
  - (a) Cutback Asphalt? .....
  - (b) Asphalt Cement? .....
  - (c) Both? .....

Note: If only cutback asphalt is tested, please write an informational note on the report.
2. Sample heated and stirred until sufficiently fluid to pour? .....  
Cutbacks: Sample stirred at room temp. for 30 sec. [if necessary, sealed container placed in bath or oven at  $145 \pm 5^{\circ}\text{F}$  ( $63 \pm 3^{\circ}\text{C}$ ) until fluid enough to stir] and viscometer charged immediately? .....
3. Minimum of 20 mL transferred to a suitable container? .....  
Cutbacks: If not tested immediately, 20 mL sample sealed? .....
4. For pouring, 20 mL sample heated to  $275 \pm 10^{\circ}\text{F}$  ( $135.0 \pm 5.5^{\circ}\text{C}$ )? .....  
Cutbacks: For pouring, if necessary (materials with viscosities above 800 cSt at  $140^{\circ}\text{F}$ ) 20 mL sealed container heated in bath or oven at  $145 \pm 5^{\circ}\text{F}$  ( $63 \pm 3^{\circ}\text{C}$ ) for not more than 30 min. ....
5. Viscometer selected is clean and dry? .....
6. Viscometer used preheated to test temperature? .....
7. Charged correctly according to design of instrument? .....
8. Viscometer remains in the bath for minimum 10 min. and maximum 30 min.? .....
9. Flow started as prescribed by design of instrument? .....
10. Efflux time measured to within 0.1 seconds? .....
11. If efflux time is less than 60 seconds, is tube with smaller capillary chosen and operation repeated? .....
12. Upon completion of the test, is the tube cleaned according to Sec. 8.8 (either solvent or a glass cleaning oven not set above  $500^{\circ}\text{C}$ )? .....
13. Kinematic viscosity calculated to three significant figures by *Time X Calibration Factor*? .....

COMMENTS (T201/D2170): \_\_\_\_\_

(T201/D2170)

AASHTO Materials Reference Laboratory



**ABSOLUTE VISCOSITY TEST**(T202) \_\_\_\_\_  
(D2171) \_\_\_\_\_APPARATUS

Date: \_\_\_\_\_

1. **Viscometers**

- (a) Viscometer Number: \_\_\_\_\_
- (b) Viscometer calibration constant: \_\_\_\_\_
- (c) Viscometer used: Cannon Manning: \_\_\_\_\_, Asphalt Institute: \_\_\_\_\_, Modified Koppers: \_\_\_\_\_
- (d) Viscometers clean and in good condition? ..... \_\_\_\_\_

2. **Cleaners**

- (a) Cleaned using either a glass cleaning oven not set above 500°C or a solvent based system as below? .. \_\_\_\_\_
- (1) Strong acid cleaning solution [ASTM: *only if deposits are observed within the viscometer*]? ..... \_\_\_\_\_
- (2) Distilled water? ..... \_\_\_\_\_
- (3) Residue-free acetone? ..... \_\_\_\_\_
- (4) Clean dry air? ..... \_\_\_\_\_
- (5) Completely miscible solvent? ..... \_\_\_\_\_
- (6) Completely volatile solvent? ..... \_\_\_\_\_

3. **Viscometer bath**

- (a) AASHTO: Maintains test temperature  $\pm 0.1^\circ\text{C}$  ( $0.2^\circ\text{F}$ )? ..... \_\_\_\_\_
- (b) ASTM: Test temperature  $\pm 0.01^\circ\text{C}$  ( $\pm 0.02^\circ\text{F}$ )? ..... \_\_\_\_\_
- (c) Temperature of the bath medium does not vary by more than  $\pm 0.1^\circ\text{C}$  ( $\pm 0.2^\circ\text{F}$ ) [ASTM:  $\pm 0.03^\circ\text{C}$  ( $\pm 0.05^\circ\text{F}$ )] over the length of the viscometer, or from viscometer to viscometer in the various bath positions at 60°C (140°F)? ..... ❖ \_\_\_\_\_
- (d) Top timing mark at least 20 mm below surface of liquid? ..... \_\_\_\_\_
- (e) Thermometer correctly immersed at test temperature? ..... \_\_\_\_\_

4. **Vacuum system**

- (a) Capable of maintaining vacuum of  $300.0 \pm 0.5$  mm? ..... \_\_\_\_\_
- (b) Holds vacuum when system is evacuated and closed? ..... \_\_\_\_\_
- (c) Standardized at least once a year? ..... \_\_\_\_\_

5. **Thermometer**

- (a) ASTM 47F or 47C? ..... \_\_\_\_\_
- (b) Any other thermometric device with an accuracy of at least  $0.04^\circ\text{F}$  ( $0.02^\circ\text{C}$ )? ..... \_\_\_\_\_
- (c) Thermometer or other device calibrated at least every six months? ..... \_\_\_\_\_

6. **Timers**

Manufacturer	1/10 s graduations?	Accurate to 0.45 s in 15 min?	Serial Number

- (a) Timers calibrated every 6 months? ..... \_\_\_\_\_

7. **Miscellaneous**

- (a) Means for melting asphalt cement available? ..... \_\_\_\_\_
- (b) Containers 20 mL or larger available? ..... \_\_\_\_\_
- (c) Oven or bath at  $275 \pm 10^\circ\text{F}$  available? ..... \_\_\_\_\_
- (d) Means for drying and filtering air stream available? ..... \_\_\_\_\_
- (e) No. 50 (300- $\mu\text{m}$ ) sieve? (optional) ..... \_\_\_\_\_
- (f) Supports for viscometer? ..... \_\_\_\_\_

COMMENTS (T202/D2171):

(T202/D2171)

**ABSOLUTE VISCOSITY TEST**(T202) \_\_\_\_\_  
(D2171) \_\_\_\_\_PROCEDURE

Date: \_\_\_\_\_

1. Sample heated and stirred until sufficiently fluid to pour? .....
2. The maximum temperature shall not exceed 100°C (180°F) above expected softening point? .....
3. At least 20 mL poured into suitable container? .....
4. If suspected that sample contains solid material, sample strained through No. 50 (300-µm) sieve? .....
5. Asphalt heated to 275 ± 10°F (135 ± 5.5°C), stirring occasionally? .....
6. Clean, dry viscometer selected for flow time exceeding 60 seconds? .....
7. Viscometer preheated at 275 ± 10°F (135 ± 5.5°C)? .....
8. Charged to within 2 mm of fill line? .....
9. Maintained in preheated oven or bath at 275 ± 10°F (135 ± 5.5°C) for 10 ± 2 minutes? .....
10. Within 5 minutes of removing the tube from the oven or bath, sample placed in testing bath? .....
11. 300.0 ± 0.5 mm of mercury vacuum established? .....
12. Manometer properly zeroed? .....
13. Allowed to sit in bath for 30 ± 5 minutes? .....
14. Flow started? .....
15. Flow between successive timing marks determined to 0.1 seconds? .....
16. First flow time exceeding 60 seconds recorded and marks identified? .....
17. Viscometer drained in oven (optional)? .....
18. Upon completion of the test, is the tube cleaned according to Sec. 8.1.9 (either solvent or a glass cleaning oven not set above 500°C)? .....
19. Viscosity calculated to three significant figures by *Time X Calibration Factor*? .....
20. Temperature and vacuum pressure recorded? .....

COMMENTS (T202/D2171):

(T202/D2171)



**DENSITY (PYCNOMETER METHOD)**

(T228) \_\_\_\_\_

(D70) \_\_\_\_\_

APPARATUS

Date: \_\_\_\_\_

<b>PYCNOMETERS</b>	<b>1</b>	<b>2</b>	<b>3</b>
Made of Glass?			
Capacity of 24 to 30 mL?			
Weight not more than 40 g?			
Ground glass stopper diameter 22 to 26 mm?			
Stopper top smooth plane?			
Stopper hole diameter 1.0 to 2.0 mm?			
Bottom of stopper concave?			
Concavity 4.0 to 18.0 mm high at center?			
Pycnometer calibrated?			
Physical condition OK?			
Bottom edge of stopper not chipped?			
Edges of hole in stopper not chipped?			

*Note to Assessors: Frosted glass is acceptable, glass etching is unacceptable.*

Thermometers:

1. Liquid in glass, total immersion thermometer readable to at least 0.1°C or 0.2°F (ex. 63C or 63F)? \_\_\_\_\_
- or*
2. Any other thermometric device with at least 0.1°C or 0.2°F subdivisions? \_\_\_\_\_
3. Thermometer calibrated? \_\_\_\_\_
4. Maximum scale error of 0.1°C? \_\_\_\_\_

Beakers:

1. Capacity of 600 mL or larger? \_\_\_\_\_
2. Filled with enough freshly boiled distilled or deionized water at test temperature to allow the top of the pycnometer to be immersed to a depth of at least 40 mm? \_\_\_\_\_
3. Bottom of beaker immersed in the water bath at least 100 mm without the top being submerged? \_\_\_\_\_
4. Any convenient method used to insure the beaker does not tip over or restrict the bath circulation (*ASTM: beaker clamped in place*)? \_\_\_\_\_

Water Bath

1. Capable of  $\pm 0.1^\circ\text{C}$  at test temperature? \_\_\_\_\_

Balance

1. Class B (0.001 g)? \_\_\_\_\_

COMMENTS (T240/D2872):

(T240/D2872)

**DENSITY OF SEMI-SOLID BITUMINOUS  
MATERIALS (PYCNOMETER METHOD)**

(AASHTO T228) \_\_\_\_\_  
(ASTM D70) \_\_\_\_\_

PROCEDURE

Date: \_\_\_\_\_

1. Sample heated and stirred avoiding incorporation of air bubbles until sufficiently fluid to pour and for not more than 60 min. over flame or hotplate, or 2 hours in an oven? .....
2. **ASTM: Sample not heated for more than 60 minutes and 110 °C (230 °F) above expected softening point? ...**
3. Pycnometer calibrated? (A, B) .....
4. Lab says that calibration was performed by Sec. 10? (Steps 12-18 below).....
5. Pycnometer clean and dry?.....
6. Pycnometer warmed? .....
7. Pycnometer filled about ¾ full? .....
8. Sample does not touch sides above final level?.....
9. Air bubbles avoided?.....
10. If air bubbles are present, are they removed with a Bunsen flame?.....
11. Pycnometer cooled to ambient temperature for at least 40 min.?.....
12. Mass of pycnometer and sample determined? (C).....
13. Pycnometer filled with freshly boiled distilled or deionized water at test temperature and stoppered without allowing any air bubbles to remain in the pycnometer? .....
14. Pycnometer placed in beaker and transferred to the bath [**ASTM: beaker clamped in place**]? .....
15. Immersed in the water bath for at least 30 minutes?.....
16. Top of pycnometer stopper immediately dried with one stroke of towel, no redrying? .....
17. Outside of pycnometer dried? .....
18. Mass of pycnometer, sample, and water determined? (D).....
19. All masses determined to the nearest 0.001 g?.....
20. Lab says that book formula used in calculating specific gravity?.....

$$S.G. = (C - A) / [(B - A) - (D - C)]$$

A = weight of pycnometer

C = weight of pycnometer + asphalt

B = weight of pycnometer + water

D = weight of pycnometer + asphalt + water

21. Specific gravity reported to 0.001? .....

COMMENTS (T228/D2872):

(T240/D2872)

**ROLLING THIN-FILM OVEN**(T240) \_\_\_\_\_  
(D2872) \_\_\_\_\_APPARATUS

Date: \_\_\_\_\_

Oven:

1. Chamber
  - (a) Height of 381 mm (15 in.) [ $\pm 12.7$  mm (1/2 in.) AMRL]? .....
  - (b) Width of 483 mm (19 in.) [ $\pm 12.7$  mm (1/2 in.) AMRL]? .....
  - (c) Depth of  $445 \pm 13$  mm ( $17 \frac{1}{2} \pm \frac{1}{2}$  in.)? .....
  - (d) Floor and ceiling vented? .....
2. Plenum
  - (a) (ceiling and walls only) 38 mm ( $1 \frac{1}{2}$  in.) [ $\pm 12.7$  mm (1/2 in.) AMRL]? .....
3. Window
  - (a) Two sheets of heat-resistant glass providing an unobstructed view to interior? .....
  - (b) Window height 203 mm to 229 mm (8 to 9 in.)? .....
  - (c) Window width: 305 mm to 330 mm (12 to 13 in.)? .....
4. Heater
  - (a) **ASTM: Top of heating element  $1 \pm \frac{1}{8}$  in. ( $25 \pm 3$  mm) below oven floor?** .....
5. Fan
  - (a) Outside diameter of fan 133.4 mm ( $5 \frac{1}{4}$  in.) [ $\pm 12.7$  mm (1/2 in.) AMRL]? .....
  - (b) Fan height 73 mm ( $2 \frac{7}{8}$  in.) [ $\pm 12.7$  mm (1/2 in.) AMRL]? .....
  - (c) Centered in width of oven? .....
  - (d) Blows air into chamber? .....
  - (e) Carriage face to axis distance of 152 mm (6 in.) [ $\pm 9.52$  mm ( $\frac{3}{8}$  in.) AMRL]? .....
  - (f) Fan set so that it turns in an opposite direction to its vanes? .....
6. Sensor
  - (a) The sensing element of the thermostat may be placed at any location the oven to maintain temperature control? .....
7. Thermometer
  - (a) ASTM 13C thermometer? .....
  - (b) Distance from thermometer bulb to right side of the oven 51 mm (2 in.) [ $\pm 9.52$  mm ( $\frac{3}{8}$  in.) AMRL]? .....
  - (c) Bulb level is approximately mid-depth of the oven? .....
  - (d) Bulb level with carriage axis within 25 mm (1 in.)? .....
  - (e) (Optional) - Optically transparent polymer sheath having a maximum thickness of 0.25 mm (0.01 in.)? .....

*Note to Assessors: If a sheath is used, it shall be installed with substantial physical contact between the sheath and the thermometer. The thermometer should be standardized after installation of a sheath.*
- or**
8. Electronic Temperature Measurement System
  - (a) Electronic measurement circuitry includes a digital display having a resolution of  $0.1^{\circ}\text{C}$  ( $0.2^{\circ}\text{F}$ ) or better? .....
  - (b) **AASHTO: Standardized according to the interval in AASHTO R18?** .....
  - (c) **AASHTO: Tip of the sensor located in the same manner as the bulb of a mercury thermometer?** .....
  - (d) **ASTM: Sensor is 3 or 4 wire, Grade A Platinum Resistance Thermometer conforming to the requirements of Specification E 1137?** .....

COMMENTS (T240/D2872):

(T240/D2872)

## ROLLING THIN-FILM OVEN

(T240) \_\_\_\_\_  
(D2872) \_\_\_\_\_

## APPARATUS (Continued)

Date: \_\_\_\_\_

## Electronic Temperature Measurement System (Continued)

- (e) **ASTM: Calibrated as a unit containing both the temperature sensor and the electronic measurement circuitry prior to being placed into service?**..... \_\_\_\_\_
- (f) **ASTM: Verified annually as a unit with the test oven equilibrated at normal operating temperature while the verification sensor is in mechanical contact with the normal test sensor?** ..... \_\_\_\_\_
- (g) **ASTM: Calibrations and verifications NIST traceable?** ..... \_\_\_\_\_
- ASTM Note: If the difference between the verification sensor and the normal test sensor exceeds 0.2 °C (0.4 °F), the verification will be regarded as having failed, and the temperature measurement system shall be recalibrated.**
9. Carriage
- (a) Diameter of 305 mm (12 in.)  $\pm$  12.7 mm (1/2 in.) AMRL]?..... \_\_\_\_\_
- (b) Holds 8 containers?..... \_\_\_\_\_
- (c) Rotation rate  $15.0 \pm 0.2$  rpm (15 rev/60  $\pm$  0.8 sec)? ..... \_\_\_\_\_
- (d) Face of carriage to back oven wall is 111.1 mm (4 3/8 in.)  $\pm$  4.8 mm (3/16 in.) AMRL]?..... \_\_\_\_\_
10. Air Jet
- (a) Copper tube, not covered by foil or other material?..... \_\_\_\_\_
- (b) Orifice diameter 1.02 mm (0.04 in.) and circular without obstruction? ..... \_\_\_\_\_
- Note to Assessors: The orifice diameter opening can be checked by the laboratory if it appears to be blocked using a #60 drill bit.**
- (c) Distance from Orifice to open end of the sample container is  $6.4 \pm 0.8$  mm (1/4  $\pm$  1/16 in.) **[ASTM: 1/4 in. (6.4 mm)]?** ..... \_\_\_\_\_
- (d) Directed along the container axis and blowing into the center of the container opening? ..... \_\_\_\_\_
11. Flow Meter
- (a) Standardized at least every 12 months **[ASTM: calibrated periodically]**? ..... \_\_\_\_\_
12. Air Supply
- (a) Regulated, dust free, and equipped with a drying device? ..... \_\_\_\_\_
- (b) Flow meter rate set at 4000 mL/min or equivalent calibrated value?..... \_\_\_\_\_
13. Oven to melt sample?..... \_\_\_\_\_
14. Cooling Rack
- (a) Wire or sheet metal and made of aluminum or stainless steel? ..... \_\_\_\_\_
- (b) Allows containers to cool horizontally **[ASTM: Allows containers to cool in the same horizontal plane]**? ..... \_\_\_\_\_
- (c) At least 25 mm (1 in.) clearance between containers and any solid surface?..... \_\_\_\_\_

Sample Containers	1	2	3	4	5	6	7	8
<b>Length:</b> 138.2 to 141.2 mm (5.44 to 5.56 in.)?								
<b>O.D.:</b> 62.8 to 65.2 mm (2.473 to 2.567 in.)?								
<b>Opening:</b> 30.3 to 33.3 mm (1.19 to 1.31 in.)?								
<b>Dip in Top:</b> 0.7 to 2.3 mm (0.03 to 0.09 in.)?								

COMMENTS (T240/D2872):

(T240/D2872)

**ROLLING THIN-FILM OVEN**(T240) \_\_\_\_\_  
(D2872) \_\_\_\_\_APPARATUS (Continued)

Date: \_\_\_\_\_

## 15. Balances

- (a) Class B (0.001 g) for change in mass? ..... \_\_\_\_\_
- (b) Class G2 (0.1 g) for weighing residue and sample? ..... \_\_\_\_\_
- (c) AASHTO: Standardized every 12 months (in accordance with R18)? ..... \_\_\_\_\_

## 16. AASHTO Only: Electronic Level (Optional)

- (a) At least 125 mm (5 in.) long? ..... \_\_\_\_\_
- (b)  $30 \pm 3$  mm ( $1.2 \pm 0.1$  in.) wide? ..... \_\_\_\_\_
- (c) Bearing surfaces ground flat? ..... \_\_\_\_\_
- (d) Hold button the freeze the display? ..... \_\_\_\_\_

PROCEDUREOven Preparation:

1. AASHTO: Oven adjusted so that the horizontal axis of the glass containers are level within  $\pm 1.0^\circ$ ? ..... \_\_\_\_\_  
Note: T240 recommends that the levelness of the carriage is checked by the procedure found in Appendix A.
2. AASHTO: Carriage bearing checked for wear every 6 months and when the levelness of the carriage is checked? ..... \_\_\_\_\_
3. Fan started (The fan shall remain on whenever the oven heater is on and the oven door is closed.)? ..... \_\_\_\_\_
4. Oven preheated at least 2 hours [ASTM: 16 hours]? ..... \_\_\_\_\_
5. Temperature adjusted such that  $163.0 \pm 1.0^\circ\text{C}$  ( $325 \pm 1.8^\circ\text{F}$ ) [ASTM:  $163.0 \pm 0.5^\circ\text{C}$  ( $325 \pm 1^\circ\text{F}$ )] is maintained during testing? ..... \_\_\_\_\_

Preparation of the Sample:

1. As received, sample free of water? ..... \_\_\_\_\_
2. Melted in oven set not over  $163^\circ\text{C}$  ( $325^\circ\text{F}$ ) [ASTM:  $150^\circ\text{C}$  ( $302^\circ\text{F}$ )]? ..... \_\_\_\_\_
3. Heated only long enough to be completely fluid in a container with the cover loose? ..... \_\_\_\_\_
4. Manually stirred without incorporating air bubbles prior to pouring? ..... \_\_\_\_\_
5.  $35.0 \pm 0.5$  g poured into each of the required containers? ..... \_\_\_\_\_
6. Immediately after pouring, sample container turned to a horizontal position? ..... \_\_\_\_\_
7. Cylinder rotated slowly at least one full rotation, attempting to pre-coat its cylindrical surface (Note: complete pre-coating may not be possible for certain binders)? ..... \_\_\_\_\_
8. Care taken to prevent the sample from flowing out of the container? ..... \_\_\_\_\_
9. AASHTO: Sample does not coat the central part of the open end of the container? ..... \_\_\_\_\_
10. Placed in a clean cooling rack for 60 to 180 minutes? (Start Time: \_\_\_\_\_) ..... \_\_\_\_\_
11. Cooling rack in draft-free location at room temperature, away from ovens or other sources of heat? ..... \_\_\_\_\_
12. Two separate bottles used for change in mass determination? ..... \_\_\_\_\_
13. Bottles weighed in a vertical position to at least the nearest 0.001 g (after cooling period)? ..... \_\_\_\_\_

COMMENTS (T240/D2872):

(T240/D2872)

**ROLLING THIN-FILM OVEN**(T240) \_\_\_\_\_  
(D2872) \_\_\_\_\_PROCEDURE (Continued)

Date: \_\_\_\_\_

Rolling Thin-Film Oven Test:

1. Oven at temperature prior to loading sample bottles? ..... \_\_\_\_\_
  2. Sample bottles placed in carriage so it is balanced? ..... \_\_\_\_\_
  3. Unused spaces filled with empty containers (all containers must be filled for referee test)? ..... \_\_\_\_\_
  4. Door closed and carriage/fan started? ..... \_\_\_\_\_
  5. Air flow started at a rate of  $4000 \pm 300$  mL/min [*ASTM*:  $\pm 200$  mL/min]? (Start Time: \_\_\_\_\_) ..... \_\_\_\_\_
  6. Temperature recovery within 10 minutes  $163.0 \pm 1^\circ\text{C}$  ( $325.0 \pm 1.8^\circ\text{F}$ )  
[*ASTM*:  $163.0 \pm 0.5^\circ\text{C}$  ( $325 \pm 1^\circ\text{F}$ )] (at thermometer)? ..... \_\_\_\_\_
  7. Samples removed 85 minutes after being placed in oven? ..... \_\_\_\_\_
- Note to Assessors: Remember to have a timer ready to time scraping sample bottles starting after change-in-mass bottles are removed from the oven.*

Change-In-Mass Samples:

1. Samples removed first 85 minutes after being placed in oven, placed horizontally in a cooling rack, and allowed to cool for 60 to 180 minutes? (Start Time: \_\_\_\_\_) ..... \_\_\_\_\_
2. Bottles weighed in a vertical position to at least the 0.001 g? ..... \_\_\_\_\_
3. Percent change in mass calculated (see equation next page)? ..... \_\_\_\_\_
4. Noted (*AASHTO*: and reported) if any sample flowed out of the bottle? ..... \_\_\_\_\_
5. *AASHTO*: If any sample flowed out of the container, that container is not used for mass loss determination? .. \_\_\_\_\_
6. *AASHTO*: Two containers used for referee testing? ..... \_\_\_\_\_

Residue Samples:

1. Bottles removed one at a time (After change in mass bottles)? ..... \_\_\_\_\_
2. Free flowing residue poured into a container? ..... \_\_\_\_\_
3. Remainder of residue in bottle scraped (Circumferential scraping recommended)? ..... \_\_\_\_\_
4. Average of 90% or more of residue scraped out of bottles? ..... \_\_\_\_\_
5. While residue is being transferred, is oven door closed, power, air, and carriage all on? ..... \_\_\_\_\_
6. Final container removed within 5 minutes of the initial container? ..... \_\_\_\_\_
7. All residues poured into one container? ..... \_\_\_\_\_
8. Container at least 30 % greater than total expected volume of residue? ..... \_\_\_\_\_
9. Residue in container stirred gently without incorporating air bubbles? ..... \_\_\_\_\_
10. *ASTM*: Residue tested within 72 hours or discarded? ..... \_\_\_\_\_

Percent Change-In-Mass (if performed)

$$(M_i - M_f) / M_b$$

 $M_i$  = Initial mass of bottle + sample $M_f$  = Final mass of bottle + sample $M_b$  = Mass of sample

1. Percent change in mass reported to the nearest 0.001 percent? ..... \_\_\_\_\_
2. Mass loss reported as a negative number, mass gain reported as a positive number? ..... \_\_\_\_\_

COMMENTS (T240/D2872):

(T240/D2872)



# **SPECIFIC GRAVITY OR API GRAVITY OF LIQUID ASPHALT BY HYDROMETER METHOD**

(T295) \_\_\_\_\_  
(D3142) \_\_\_\_\_

## APPARATUS

Date: \_\_\_\_\_

### 1. Hydrometers

TABLE 1 Recommended Hydrometers (Partial Listing)

ASTM Designation	Type	Units	Range		Scale	
			Total	Each unit	Interval	Accuracy
1H to 4H	long plain form	API	-1 to 41	12	0.1	0.1
21H to 28H	short plain form	API	0 to 41	6	0.1	0.1
85H to 90H	long plain form	Sp. Gr. 60/60F	0.800 to 1.100	0.050	0.0005	0.001
105H to 108H	intermediate plain form	Sp. Gr. 60/60F	0.800 to 1.000	0.050	0.001	0.001
315H to 320H	long plain form	Kg/m <sup>3</sup>	800 to 1100	50	0.5	0.5

### 2. Thermometers

- (a) Thermometer with maximum scale error of 0.1°C (0.25°F) [such as ASTM 12C/12F or IP 64C/64F] or any other thermometric device of equal accuracy? .....
- (b) *ASTM: Thermometer standardized every 12 months?* .....
- (c) *ASTM: If not conforming to requirements for 12C/12F, calibrated by ASTM Test Method E220?* .....
- (d) *ASTM: If thermohydrometer used, temperature scale range from 20 to 65°C or 60 to 220°F (designation H)?* .....

### 3. Hydrometer cylinder

- (a) Made of glass, plastic, or metal? .....
- (b) If plastic; resistant to discoloration? .....
- (c) Inner Diameter at least 20 mm (¾ in) greater than Outer diameter of hydrometer used? .....
- (d) Hydrometer floats with at least 25 mm (1 in) clearance between bottom of hydrometer and bottom of cylinder? .....

### 4. Water bath

- (a) At test temperature within ± 0.5°C? .....
- (b) Depth approximately same as sample in hydrometer cylinder? .....
- (c) Thermometer or electronic temperature measuring device accurate to 0.25°C (0.5°F)? .....

### 5. Ovens

- (a) At test temperature within ± 3°C? .....
- (b) Thermometric device accurate to 1°C (2°F)? .....

COMMENTS (T295/D3142):

(T295/D3142)

# **SPECIFIC GRAVITY OR API GRAVITY OF LIQUID ASPHALT BY HYDROMETER METHOD**

(T295) \_\_\_\_\_  
(D3142) \_\_\_\_\_

## APPARATUS

Date: \_\_\_\_\_

1. Select test temperature in accordance with Section 9 (see table below)? .....

## **Recommended Testing Temperatures**

Grade	Testing Temperature °C (°F)
MC-30	Room
SC-70, MC-70, RC-70	40 (104)
SC-250, MC-250, RC-250	60 (140)
SC-800, MC-800, RC-800	80 (176)
SC-3000, MC-3000, RC-3000	100 (212)

2. Sample heated in oven to within  $\pm 3^{\circ}\text{C}$  ( $5^{\circ}\text{F}$ ) of test temperature? .....
3. Sample container loosely covered? .....
4. Hydrometer, cylinder, and thermometer brought to test temperature? .....
5. Sample transferred to clean hydrometer cylinder carefully? .....
6. Air bubbles removed from sample surface by touching with a piece of clean filter paper? .....
7. If metal cylinder, level within 5 mm (1/4 in) of top of cylinder? .....
8. If test is performed at other than room temperature:
- (a) Constant temperature bath within  $\pm 0.5^{\circ}\text{C}$  ( $1.0^{\circ}\text{F}$ ) of test temperature? .....
- (b) Sample in cylinder placed in constant temperature bath? .....
- (c) Sample temperature equilibrated with bath temperature? .....
- (d) Thermometric device immersed properly in sample? .....
- (e) Sample temperature steady and recorded to nearest  $0.2^{\circ}\text{C}$  ( $0.5^{\circ}\text{F}$ )? .....
9. Hydrometer gently lowered into sample, avoiding wetting stem above the immersion level? .....
10. Hydrometer becomes completely stationary? .....
11. Air bubbles allowed to rise to sample surface? .....
12. Hydrometer floats freely, not touching cylinder wall? .....
13. Hydrometer read to nearest scale division? .....
14. Observation corrected for meniscus height? .....
15. Sample immediately stirred, keeping thermometric device correctly immersed, and temperature observed? .....
16. Temperature recorded to nearest  $0.2^{\circ}\text{C}$  ( $0.5^{\circ}\text{F}$ )? .....
17. If temperature differs from previous reading by more than  $0.5^{\circ}\text{C}$  ( $1.0^{\circ}\text{F}$ ) is hydrometer reading repeated until the temperature becomes stable within  $0.5^{\circ}\text{C}$  ( $1.0^{\circ}\text{F}$ )? .....
18. Appropriate corrections made to the observed hydrometer reading? .....
19. Final corrected hydrometer reading recorded to the nearest  $0.1^{\circ}$  API, 0.001 specific gravity, or  $0.5\text{ kg/m}^3$ ? .....
20. Mean temperatures observed (before and after) recorded to the nearest  $0.5^{\circ}\text{C}$  ( $1.0^{\circ}\text{F}$ )? .....
21. Corrected values converted to standard temperature using Guide D1250 and ASTM D1250 (Vol. 5.01)? .....
- (a) API gravity use Table 5A, then (*ASTM: if desired*) Table 3 to obtain the density at  $15.6^{\circ}\text{C}$  (*ASTM: or specific gravity at 60/60°F*)? .....
- (b) Specific gravity use Table 23A, then (*ASTM: if desired*) Table 21 to obtain the density at  $15.6^{\circ}\text{C}$  (*ASTM: or specific gravity at 60/60°F*)? .....
- (c) Density scaled hydrometer use Table 53A, (*ASTM: then if desired use Table 21 to obtain specific gravity 60/60°F or API gravity at 60°F.*)? .....
22. Reported at  $15.6^{\circ}\text{C}$  to nearest  $1\text{ kg/m}^3$  (*ASTM: or specific gravity 60/60°F or degrees API gravity*)? .....

COMMENTS (T295/D3142):

(T295/D3142)

**FORCE DUCTILITY OF BITUMINOUS MATERIALS**

(AASHTO T300) \_\_\_\_\_

APPARATUS

Date: \_\_\_\_\_

<b>MOLDS</b>	1	2	3	4	5	6	7	8
Design conforms to Fig. 1?								
Thickness: 9.9 - 10.1 mm?								
Width at min. cross-section: 9.9 - 10.1 mm?								
Brass?								
<b>MOLD PLATES</b>								
Non-absorbent?								
Flat and level?								

1. Release Agent
  - (a) As specified in Note 1? (Identify: \_\_\_\_\_).....
2. Water Bath
  - (a) Maker: \_\_\_\_\_
  - (b) Depth of bath not less than 50 mm (2 in.)? .....
  - (c) Bath capable of maintaining temperature within 0.5°C (1.0°F)? .....
  - (d) Mold can be immersed to a depth of at least 25 mm (1 in.)? .....
  - (e) Volume of water not less than 10 L? .....
  - (f) Water free of oil and slime or other organic growth? .....
3. Testing Machine
  - (a) Maker: \_\_\_\_\_
  - (b) Serial No. (or I.D. No.)? .....
  - (c) Space for at least 25 mm of water above and below sample at start of test? .....
  - (d) Machine functions without undue vibration? .....
4. Agents for Adjusting Specific Gravity of Test Bath (informational only)
  - (a) Specify: \_\_\_\_\_
5. Thermometer
  - (a) For tests at 4°C (39.2°F) use ASTM Thermometer 63C (63F)? .....
  - (b) For tests performed at other temperatures: range and accuracy same as that of the 63 (63F)? .....
  - (c) Thermometer calibrated in accordance with E77? .....
6. Heater
  - (a) Oven or hot plate (electric or gas)? .....
7. Miscellaneous Equipment
  - (a) Straight edged trimmer at least 1 1/2 in. wide? .....
  - (b) Container? .....

COMMENTS (T300):

(T300)

**FORCE DUCTILITY OF BITUMINOUS MATERIALS**

(AASHTO T300) \_\_\_\_\_

APPARATUS (Continued)

Date: \_\_\_\_\_

8. Calibrated Force Adapter
  - (a) Stainless steel platform and LVDT? .....
  - (b) Accurate to 0.04 N (0.01 lbs)? .....
  - (c) Utilizes existing pins on the ductility machine? .....
9. Digital Indicator
  - (a) Power supply and digital display that serves the LVDT sensor? .....
  - (b) Interfaces with chart recorder, computer or other readout? .....
10. Chart Recorder (Optional)? .....

PROCEDURE

1. Sample Preparation
  - (a) Asphalt cement heated preventing local overheating? .....
  - (b) Sample thoroughly stirred prior to pouring? .....
2. Mold assembled on plate prepared with release agent? .....
3. Interior surfaces of mold sides treated with release agent? .....
4. Mold filled by pouring a thin stream back and forth from end to end? .....
5. Mold filled until more than level full? .....
6. Disarrangement of mold parts avoided during filling? .....
7. Sample, mold, and plate cooled at room temperature? ( ) .....
8. Cooling time 30-40 minutes (at room temp.)? ( ) .....
9. Placed in water bath at test temperature for 30 minutes? ( ) .....
10. Excess material cut off with hot straight edged putty knife or spatula? .....
11. Mold level full? .....
12. Specimen not pulled away from mold or base plate? .....
13. Sample, mold and plate placed again in water bath at test temperature? ( ) .....
14. Conditioned in water bath for 85-95 min.? ( ) .....
15. Mold taken off plate and side pieces of mold detached? .....
16. Briquette placed in testing machine? .....
17. Briquette tested immediately? .....
18. Clips attached to the pins or hooks of the force adapter and the testing machine? .....
19. Clips pulled apart at a specific rate? .....
20. Specified minimum ductility met? .....
21. Briquette ruptures? .....
22. Limit of travel of the machine reached? .....
23. Is gravity adjusted if thread does contact top or bottom? .....
24. Distance clips pulled measured and recorded? .....
25. Test not considered normal if the material comes in contact with the surface of the water or the bottom of the bath? .....
26. Force ductility ratio calculated as the ratio of the force at the second peak ( $f_2$ ) divided by the force at the first peak ( $f_1$ )? .....
27. If no second peak is apparent, is the force at minimum specified ductility, point of rupture, or 30 cm used as ( $f_2$ )? .....
28. Tensile stress ratio reported to nearest 0.1? .....

COMMENTS (T300):

(T300)

# **ELASTIC RECOVERY OF BITUMINOUS MATERIALS BY DUCTILOMETER**

(AASHTO T301) \_\_\_\_\_  
(ASTM D6084) \_\_\_\_\_

## APPARATUS

Date: \_\_\_\_\_

Molds	1	2	3	4	5	6
Design conforms to Fig. 1?						
Width at midpoint: $10.0 \pm 0.1$ mm?						
Brass?						
End pieces similar to T51/D113?						
<b>Side Pieces</b>						
Thickness: $10.0 \pm 0.1$ mm?						
<b>Base Plates</b>						
Nonabsorbent?						
Flat and level?						

- Release agent as specified in Note 1 (any of the following)?
  - Glycerin and dextrin or talc [**ASTM: or kaolin**] (AASHTO: 3 g glycerin to 5 g dextrin or talc)? ..... \_\_\_\_\_
  - AASHTO: Dow-Corning Silicone Stop-Cock Grease? ..... \_\_\_\_\_
  - AASHTO: Castor-oil-Versamid 900 (100:1 mixture by weight, heated and stirred)? ..... \_\_\_\_\_
  - Other release agent that give comparable results (Identify: \_\_\_\_\_) ..... \_\_\_\_\_
- Water Bath
  - Maker: \_\_\_\_\_
  - AASHTO: Depth of bath not less than 50 mm? ..... \_\_\_\_\_
  - Specimens immersed to a depth of at least 25 mm (**ASTM: 10 cm**)? ..... \_\_\_\_\_
  - ASTM: Perforated shelf at least 5 cm from bottom of bath?** ..... \_\_\_\_\_
  - Bath capable of maintaining temperature within  $0.5^{\circ}\text{C}$  ( $1.0^{\circ}\text{F}$ ) (**ASTM:  $0.1^{\circ}\text{C}$  ( $0.18^{\circ}\text{F}$ )**)? ..... \_\_\_\_\_
  - Volume of water not less than 10 L? ..... \_\_\_\_\_
  - AASHTO: Free from oil, slime, or other organic growth? ..... \_\_\_\_\_
- Testing Machine
  - Maker: \_\_\_\_\_
  - Serial No. (or I.D. No.)? \_\_\_\_\_
  - Water tank covers the specimen with at least 25 mm of water above sample at start of test? ..... \_\_\_\_\_
  - ASTM: Water tank maintained within  $\pm 0.5^{\circ}\text{C}$  ( $0.9^{\circ}\text{F}$ ) of the test temperature?** ..... \_\_\_\_\_
  - Machine capable of maintaining specified speed within 5 percent (e.g.  $5.00 \pm 0.25$  cm/min.)? ..... \_\_\_\_\_
  - Machine functions without undue vibration? ..... \_\_\_\_\_
  - ASTM: Machine has means of measuring elongation in centimeters?** ..... \_\_\_\_\_
- Agents for Adjusting Specific Gravity of Test Bath (informational only) Specify: \_\_\_\_\_

COMMENTS (T301/D6084):

(T301/D6084)

# ELASTIC RECOVERY OF BITUMINOUS MATERIALS BY DUCTILOMETER

(AASHTO T301) \_\_\_\_\_  
(ASTM D6084) \_\_\_\_\_

## APPARATUS (Continued)

Date: \_\_\_\_\_

1. Thermometer
  - (a) AASHTO: ASTM 17C or 17F for tests performed at 25 °C (77 °F)? .....
  - (b) ASTM: 63C or 63F? .....
  - (c) Thermometers of appropriate range and equal accuracy to the thermometer required for the test for temperatures other than those covered by the specified thermometers? .....
  - (d) Thermometer calibrated in accordance with ASTM E77? .....
  - (e) An equivalent thermometric device that has been standardized in accordance with Test Method E220 or Test Methods E644? .....
  - (f) ASTM: If 77 °F (25 °C) penetration bath used, any thermometer or thermometric device with 0.1 °C (0.2 °F) subdivisions? .....
2. Heater
  - (a) AASHTO: Oven or hot plate (electric or gas)? .....
  - (b) ASTM: Oven capable of maintaining 135 ± 5.5 °C (275 ± 10 °F)? .....
3. Miscellaneous Equipment
  - (a) Straight edged trimmer at least 1 1/2 in. wide? .....
  - (b) Scissors capable of cutting the bituminous material at test temperature? .....

## PROCEDURE

### Sample Preparation

1. Asphalt cement heated preventing local overheating (ASTM: in covered container)? .....
2. ASTM: Heated in an oven at 135 ± 5 °C (275 ± 10 °F)? .....  
Note: Higher temperatures may be used if not sufficiently fluid at 135 °C.
3. AASHTO: If polymer modified emulsion residue tested, obtained from evaporation at 162.8 ± 2.5 °C? .....
4. ASTM: Sample strained through a 300-µm (No. 50) sieve preheated at 135 ± 5 °C (275 ± 10 °F) if it is suspected that foreign matter is present? .....  
Note: Higher viscosity samples may be strained through an 850-µm (No. 20) sieve.
5. ASTM: If the sample is an asphalt cement or a polymer-modified asphalt cement sample heated to 135 ± 5 °C (275 ± 10 °F)? .....
6. ASTM: If foreign matter is suspected to be in the sample, sample strained through a 300-µm (No. 50) sieve preheated at 135 ± 5 °C (275 ± 10 °F)? .....
7. Sample thoroughly stirred prior to pouring? .....
8. Mold assembled on plate prepared with release agent? .....
9. Interior surfaces of mold sides treated with release agent? .....
10. Mold filled by pouring a thin stream back and forth from end to end? .....
11. Mold filled until more than level full? .....
12. Disarrangement of mold parts avoided during filling? .....

COMMENTS (T301/D6084):

(T301/D6084)

# ELASTIC RECOVERY OF BITUMINOUS MATERIALS BY DUCTILOMETER

(AASHTO T301) \_\_\_\_\_  
(ASTM D6084) \_\_\_\_\_

## PROCEDURE

Date: \_\_\_\_\_

### Testing

1. Sample, mold and plate cooled at room temperature? (\_\_\_\_\_) .....
2. Cooling time  $35 \pm 5$  minutes (at room temp.)? (\_\_\_\_\_) .....
3. Placed in water bath at test temperature for 30 to 35 minutes (**ASTM:  $30 \pm 5$  minutes**).....
4. Excess material cut off with hot straight-edged putty knife or spatula? .....
5. Mold level full? .....
6. Specimen not pulled away from mold or base plate? .....
7. Sample, mold and plate placed again in water bath at test temperature? (\_\_\_\_\_) .....
8. Conditioned in water bath for  $90 \pm 5$  minutes? (\_\_\_\_\_).....
9. Mold taken off plate and side pieces of mold detached (**ASTM: without distorting or fracturing**)? .....
10. Briquette placed in testing machine?.....
11. Water in testing machine within  $0.5^{\circ}\text{C}$  ( $0.9^{\circ}\text{F}$ ) of test temperature throughout the test? .....
12. Briquette tested immediately? .....
13. **AASHTO: Clips pulled to an elongation of 20 cm** .....
14. **ASTM:  $10 \pm 0.25$  cm for Procedure A and  $20 \pm 0.25$  cm for Procedure B?** .....
15. **AASHTO: Elongation stopped and specimen held in position for five minutes?** .....
16. **ASTM: No holding time specified for Procedure A and hold for five minutes for Procedure B?** .....
17. Immediately cut into halves at the midpoint? .....
18. Specimen remains in testing machine undisturbed for 60 minutes? (\_\_\_\_\_).....
19. Carriage is moved back until the two ends of the specimen just touch? .....
20. If ends have sagged, are they carefully lifted to their original level prior to adjusting carriage? .....
21. Total length of specimen with severed ends just touching recorded in cm? .....
22. **ASTM: Test not considered normal if the sample comes in contact with the surface of the water, the bottom of the bath, or if the sample fractures before reaching elongation?** .....
23. **Is gravity adjusted if thread contacts bottom or surface and the test rerun?** .....
24. **Average of three normal tests (nearest whole percent) reported as the elastic recovery?** .....
25. **If after three tests, a normal test cannot be obtained, is it reported as being unobtainable?** .....

$$\text{Recovery, \%} = \frac{\text{Elongation}_{\text{Original}} - \text{Elongation}_{\text{EndsJustTouching}}}{\text{Elongation}_{\text{Original}}} \times 100$$

26. **Sample thermal handling history reported?** .....

COMMENTS (T301/D6084):

(T301/D6084)

**DETERMINING THE FLEXURAL CREEP  
STIFFNESS OF ASPHALT BINDER USING THE  
BENDING BEAM RHEOMETER (BBR)**

(AASHTO T313) \_\_\_\_\_  
(ASTM D6648) \_\_\_\_\_

APPARATUS

Date: \_\_\_\_\_

Manufacturer: \_\_\_\_\_ Software: \_\_\_\_\_

1. Loading Frame and Shaft
  - (a) Set of sample supports?..... \_\_\_\_\_
  - (b) Load cell mounted in line with the loading shaft?..... \_\_\_\_\_
  - (c) Loading shaft continuous with load cell and LVDT and able to apply load to midpoint of specimen? .. \_\_\_\_\_
  - (d) Loading shaft blunt-nosed with a spherical radius of  $6.25 \pm 0.30$  mm [ASTM:  $6.30 \pm 0.30$  mm]?..... \_\_\_\_\_
2. Loading System
  - (a) Capable of applying a contact load of  $35 \pm 10$  mN? ..... \_\_\_\_\_
  - (b) Rise time from  $35 \pm 10$  mN to  $980 \pm 50$  mN less than 0.5 seconds? ..... \_\_\_\_\_
  - (c) Between 0.5 and 5.0 seconds, test load of  $980 \pm 50$  mN applied & held within  $\pm 50$  mN of average test load?..... \_\_\_\_\_
  - (d) Between 5.0 and 240.0 seconds, loads within  $\pm 10$  mN from average test load?..... \_\_\_\_\_
3. Load Cell
  - (a) Minimum capacity of 2000 mN and resolution of 2.5 mN (0.0025 mN)? ..... \_\_\_\_\_
  - (b) Above the fluid level in the controlled temperature bath? ..... \_\_\_\_\_
4. Linear Variable Differential Transducer (LVDT)
  - (a) Linear range of at least 6 mm and resolution of  $2.5\mu\text{m}$  (0.0025 mm)? ..... \_\_\_\_\_
  - (b) Mounted axially with and above loading shaft?..... \_\_\_\_\_
5. Sample Supports
  - (a) Two stainless steel (or corrosion resistant metal) supports? ..... \_\_\_\_\_
  - (b) Distance between supports is  $102.0 \pm 1.0$  mm? ..... \_\_\_\_\_
  - (c) Width of each supporting area is  $9.5 \pm 0.25$  mm with contact radius of  $3.0 \pm 0.3$  mm? ..... \_\_\_\_\_
  - (d) Vertical alignment pins on each support 2 - 4 mm in diameter? ..... \_\_\_\_\_
  - (e) Front face of alignment pins  $6.75 \pm 0.25$  mm from the middle of the supports?..... \_\_\_\_\_
6. Temperature Transducer [ASTM: BBR Thermometric Device]
  - (a) Has device been calibrated (check records)? ..... \_\_\_\_\_
  - (b) Capable of measuring temperature to  $0.1^\circ\text{C}$  over the range of  $-36$  to  $0^\circ\text{C}$ ? ..... \_\_\_\_\_
  - (c) Mounted within 50 mm of the midpoint of the test specimen supports? ..... \_\_\_\_\_
7. Controlled-Temperature Fluid Bath
  - (a) Capable of maintaining a temperature between  $-36$  and  $0^\circ\text{C}$  within  $0.1^\circ\text{C}$  during testing?..... \_\_\_\_\_
  - (b) Fluctuation of  $\pm 0.2^\circ\text{C}$  from test temperature allowed due to introduction of the specimen and during isothermal conditioning? ..... \_\_\_\_\_
  - (c) Bath agitator (or circulating bath) does not cause fluctuations greater than 2.5 mN or  $2.5\mu\text{m}$ ? ..... \_\_\_\_\_

COMMENTS (T313/D6648):

(T313/D6648)



**DETERMINING THE FLEXURAL CREEP  
STIFFNESS OF ASPHALT BINDER USING THE  
BENDING BEAM RHEOMETER (BBR)**

(AASHTO T313) \_\_\_\_\_  
(ASTM D6648) \_\_\_\_\_

APPARATUS (Continued)

Date: \_\_\_\_\_

8. Data Acquisition System
- (a) Resolves load to nearest 2.5 mN, beam deflection to nearest 2.5  $\mu\text{m}$ , & temperature. to 0.1°C? ..... \_\_\_\_\_
- (b) Provides a record of load and deflection measurements at 0.0, 0.5, 8.0, 15.0, 30.0, 60.0, 120.0, and 240.0 seconds [ASTM: 8.0, 15.0, 30.0, 60.0, 120.0, and 240.0 seconds]? ..... \_\_\_\_\_
9. Test Specimen Molds
- (a) Made from aluminum [ASTM: aluminum, stainless steel, or silicone rubber]? ..... \_\_\_\_\_
- (b) Interior dimensions when assembled of  $6.35 \pm 0.05$  mm thick,  $12.70 \pm 0.05$  mm wide, and  $127 \pm 2$  mm long [ASTM:  $127 \pm 5$  mm long]? ..... \_\_\_\_\_
- (c) AASHTO: Two spacers with thicknesses that do not vary from each other by more than 0.05 mm? .... \_\_\_\_\_
- (d) ASTM: The thicknesses of the two spacers are measured with a micrometer to verify that they meet the tolerances listed above and the measurements recorded as part of the laboratory's quality control program? ..... \_\_\_\_\_
10. Sheeting
- (a) Clear plastic sheeting,  $0.12 \pm 0.04$  mm [ASTM: 0.08 to 0.15 mm] thick? ..... \_\_\_\_\_
- (b) ASTM: Silicone coated release paper for metal molds (Optional)? ..... \_\_\_\_\_
- (1) 4.0 to 5.0 mils thick? ..... \_\_\_\_\_
- (2) Coated on both sides? ..... \_\_\_\_\_
- (c) ASTM: If silicone molds are used, silicone rubber sheeting for lining the glass plate? ..... \_\_\_\_\_
- (d) Sheeting not distorted from hot asphalt or pulled away from the mold during cooling? ..... \_\_\_\_\_
11. Release Agents
- (a) For coating the end pieces of the mold, one of the following.
- (1) AASHTO: A mixture of glycerin and talc or Kaolin (50/50 w/w) is suitable? ..... \_\_\_\_\_
- (2) ASTM: A mixture of glycerin and Dextrin, talc, or Kaolin? ..... \_\_\_\_\_
- (3) ASTM: Petroleum-based grease? ..... \_\_\_\_\_
- (4) ASTM: A mixture of Versamid and mineral oil? ..... \_\_\_\_\_
- (5) ASTM: Other materials that do not affect the properties of the binder? ..... \_\_\_\_\_
- Note: No silicone based products shall be used.
- (b) For adhering the plastic strips to the metal mold.
- (1) AASHTO: Petroleum-based grease? ..... \_\_\_\_\_
- (2) ASTM: Any of the materials in the section above? ..... \_\_\_\_\_
12. Bath Fluid
- (a) Not absorbed by or does not affect the properties of the binder? ..... \_\_\_\_\_
- (b) Optically clear and density not exceeding  $1.05 \text{ g/cm}^3$  at test temperature? ..... \_\_\_\_\_
- (c) Any fluid including ethanol, methanol, or glycol-methanol solution (60% glycol, 15% methanol, 25% H<sub>2</sub>O) [ASTM: and stabilized isopropanol] but no silicone fluids or fluids containing silicone? ..... \_\_\_\_\_

COMMENTS (T313/D6648):

(T313/D6648)

**DETERMINING THE FLEXURAL CREEP  
STIFFNESS OF ASPHALT BINDER USING THE  
BENDING BEAM RHEOMETER (BBR)**

(AASHTO T313) \_\_\_\_\_  
(ASTM D6648) \_\_\_\_\_

CALIBRATION AND VERIFICATION APPARATUS

Date: \_\_\_\_\_

1. Compliance (thick) Beam
  - (a) Dimensions of  $6.4 \pm 0.1$  mm thick,  $12.7 \pm 0.25$  mm wide and  $127 \pm 5$  mm long?..... \_\_\_\_\_
  - (b) **ASTM: Dimensions of  $6.4 \pm 0.3$  mm thick,  $12.7 \pm 0.3$  mm wide, and  $127 \pm 5$  mm long?**..... \_\_\_\_\_
  - (c) **ASTM: When used to measure thickness of test specimens, compliance beam thickness measured to the nearest 0.01 mm?** ..... \_\_\_\_\_
  
2. Performance (thin) Beam
  - (a) Dimensions of  $1.3 \pm 0.3$  mm thick,  $12.7 \pm 0.1$  mm wide, and  $127 \pm 5$  mm long?..... \_\_\_\_\_
  - (b) Manufacturer provides certificates with elastic modulus reported to 3 significant figures, thickness to 0.01 mm and width to 0.05 mm? ..... \_\_\_\_\_
  - (c) Dimensions used to calculate the modulus during overall system check?..... \_\_\_\_\_
  
3. Standard Masses
  - (a) One or more masses totaling  $100.0 \pm 0.2$  g for verifying load cell?..... \_\_\_\_\_
  - (b) Two masses of  $2.0 \pm 0.2$  g for verifying load cell? ..... \_\_\_\_\_  
*AASHTO note: a coin may be used if the mass is confirmed to be  $2.0 \pm 0.2$  g.*
  - (c) Four equal masses of known mass  $\pm 0.2$  g for calibration of load cell? ..... \_\_\_\_\_
  - (d) Two or more masses of known mass  $\pm 0.2$  g for conducting overall system check?..... \_\_\_\_\_
  - (e) All above masses verified at least once every three years? ..... \_\_\_\_\_
  
4. Stepped-thickness gauge block
  - (a) Of known dimensions and used to verify the calibrations of the LVDT (**ASTM: thickness measured to  $\pm 5 \mu\text{m}$** )?..... \_\_\_\_\_
  
5. Thermometer [**ASTM: Calibrated Thermometric Device**]
  - (a) Calibrated in accordance with E77 at least once per year? ..... \_\_\_\_\_
  - (b) Has a suitable range and a resolution of  $0.1^\circ\text{C}$ ?..... \_\_\_\_\_
  - (c) Either of the following:
    - (1) A partial immersion liquid-in-glass thermometer with an ice point? ..... \_\_\_\_\_
    - (2) An electronic thermometer of equal accuracy and resolution [**ASTM: a thermometric device based upon a platinum or thermistor sensor**]? ..... \_\_\_\_\_

*Note: A suitable liquid-in-glass thermometer is an ASTM 133C-00. ASTM 62C thermometers are generally standardized as total immersion and should not be used for this test method unless specifically standardized as total immersion.*

COMMENTS (T313/D6648):

(T313/D6648)

**DETERMINING THE FLEXURAL CREEP  
STIFFNESS OF ASPHALT BINDER USING THE  
BENDING BEAM RHEOMETER (BBR)**

(AASHTO T313) \_\_\_\_\_  
(ASTM D6648) \_\_\_\_\_

PROCEDURE

Date: \_\_\_\_\_

1. Supports, loading head, and bath fluid cleaned of any particulates and coatings, if any? ..... \_\_\_\_\_
2. Bath brought to selected test temperature and stabilized (within 0.1°C)? ..... \_\_\_\_\_

Verification and Standardization

1. Displacement transducer (LVDT), load cell, temperature detector, performance of overall system, air-bearing, and contact load verified daily before conducting tests (steps 2, 3, 4, 5, 7, and 8) [ASTM: and verification of zero load cell reading performed (step 6)]? ..... \_\_\_\_\_  
*Note: Verifications and calibrations may be combined at the option of the manufacturer*

2. Verification of Calibration of the Displacement Transducer (LVDT)
  - (a) Stepped gage block of known dimensions used? ..... \_\_\_\_\_
  - (b)  $100 \pm 0.2$  g mass applied to the loading shaft and the rise of the steps measured? ..... \_\_\_\_\_
  - (c) Agreement of  $\pm 5 \mu\text{m}$  (0.005 mm) [ASTM:  $\pm 15 \mu\text{m}$  (0.015 mm)] at each step between measured values and certified dimensions? ..... \_\_\_\_\_
  - (d) If values differ by more than  $\pm 5 \mu\text{m}$  (ASTM:  $\pm 15 \mu\text{m}$ ), is further calibration conducted? ..... \_\_\_\_\_  
*Note: If tolerance cannot be met after calibration, the lab should discontinue use and consult the manufacturer*

Known Values (mm) (from certificate)	Measured Values (mm)	Within 0.005 mm [ASTM: 0.015 mm]?

3. Verification of Air-Bearing
  - (a) Thin beam placed on the supports and a  $35 \pm 10$  mN load applied with the zero load regulator? ..... \_\_\_\_\_
  - (b) Reading of the LVDT observed? (LVDT reading: \_\_\_\_\_) ..... \_\_\_\_\_
  - (c) Shaft lifted upwards approximately 5 mm and immediately falls back & contacts beam when released? (LVDT reading: \_\_\_\_\_) ..... \_\_\_\_\_
  - (d) Beam removed and shaft adjusted to approximate midpoint of vertical travel using zero load regulator? ..... \_\_\_\_\_
  - (e) An approximately 2 g weight added to the loading shelf? ..... \_\_\_\_\_
  - (f) Shaft slowly falls downward? ..... \_\_\_\_\_

*Note: If not, too much friction is present in the air bearing. The shaft should be cleaned and clearance of the LVDT adjusted to reduce friction. If maintenance does not reduce friction, discontinue use and consult the manufacturer.*

COMMENTS (T313/D6648):

(T313/D6648)

**DETERMINING THE FLEXURAL CREEP  
STIFFNESS OF ASPHALT BINDER USING THE  
BENDING BEAM RHEOMETER (BBR)**

(AASHTO T313) \_\_\_\_\_  
(ASTM D6648) \_\_\_\_\_

PROCEDURE (Continued)

Date: \_\_\_\_\_

Verification and Standardization (Continued)

4. Verification of Load Cell: Contact Load

- (a) Load shaft rested against compliance beam? ..... \_\_\_\_\_
- (b)  $20 \pm 10$  mN load applied to the beam using the zero load regulator? ..... \_\_\_\_\_
- (c)  $2.0 \pm 0.2$  g mass added to loading platform? ..... \_\_\_\_\_
- (d) Load display shows an increase of  $20 \pm 5$  mN? ..... \_\_\_\_\_
- (e) A second  $2.0 \pm 0.2$  g mass added and load display increases by another  $20 \pm 5$  mN? ..... \_\_\_\_\_
- (f) If not, calibration conducted? ..... \_\_\_\_\_

*Note: If tolerance cannot be met after calibration, the lab should discontinue use and consult the manufacturer*

5. Verification of Load Cell: Test Load

- (a) Load shaft rested against compliance beam? ..... \_\_\_\_\_
- (b)  $20 \pm 10$  mN load applied to the beam using the zero load regulator? ..... \_\_\_\_\_
- (c) 100 g mass added to the loading platform? ..... \_\_\_\_\_
- (d) Load display shows an increase of  $981 \pm 5$  mN? ..... \_\_\_\_\_
- (e) If not, calibration conducted? ..... \_\_\_\_\_

*Note: If tolerance cannot be met after calibration, the lab should discontinue use & consult manufacturer*

6. **Verification of Zero Load Cell Reading**

- (a) Thick steel beam placed on the loading platform? ..... \_\_\_\_\_
- (b) A 100 g mass placed on the platform? ..... \_\_\_\_\_
- (c) Reading of the LVDT observed? (LVDT reading \_\_\_\_\_) This is the test starting position. .... \_\_\_\_\_
- (d) Thick steel beam and 100 g mass removed? ..... \_\_\_\_\_
- (e) Loading shaft adjusted to the test starting position while free floating? ..... \_\_\_\_\_
- (f) The load indicated is  $0 \pm 5$  mN? ..... \_\_\_\_\_

*Note: If the tolerance cannot be met after calibration, the lab should discontinue use and consult the manufacturer.*

7. Daily Overall Systems Performance Check

- (a) Thin beam placed on the sample supports and manufacturer's instructions followed? ..... \_\_\_\_\_
- (b) 50.0 or  $100.0 \pm 0.2$  g mass applied to the beam? ..... \_\_\_\_\_
- (c) An additional 100 to  $300 \pm 0.2$  g applied (depending on the manufacturer's instructions)? ..... \_\_\_\_\_
- (d) Calculated modulus within 10% of the modulus reported by the manufacturer of the BBR? ..... \_\_\_\_\_
- (e) Reported value from Manufacturer's certificate: \_\_\_\_\_
- (f) Reported value from Performance Check: \_\_\_\_\_

*Note: If not, the performance of the BBR shall be considered suspect, and the manufacturer should be consulted.*

COMMENTS (T313/D6648):

(T313/D6648)

**DETERMINING THE FLEXURAL CREEP  
STIFFNESS OF ASPHALT BINDER USING THE  
BENDING BEAM RHEOMETER (BBR)**

(AASHTO T313) \_\_\_\_\_  
(ASTM D6648) \_\_\_\_\_

PROCEDURE (Continued)

Date: \_\_\_\_\_

Verification and Standardization (Continued)

8. Verification of Calibration of the Temperature Detector
- (a) Temperature verified each day and whenever the test temperature is changed? .....
  - (b) Thermometer immersed in bath close to the thermal detector? .....
  - (c) Calibrated thermometer reading agrees with the thermal detector within  $\pm 0.1^\circ \text{C}$ ? .....
  - (d) If not, is calibration conducted? .....
9. Verification of front-to-back alignment of the loading shaft (*Assessors: Check Records*)
- (a) **AASHTO:** Alignment checked every 6 months? .....
  - (b) **ASTM:** Alignment checked when installed, disturbed, or the alignment is thought to be suspect?....
  - (c) Checked by one of the following means:
    - (1) Checked with an alignment gauge supplied by the manufacturer? .....
    - (2) Checked by measurement as follows? .....
      - 1. 25-mm long strip of white paper slightly narrower than the beam taped to the thick beam with scotch tape? .....
      - 2. With the frame out of bath, beam placed on the supports with a small piece of carbon paper placed atop white paper near beam midpoint? .....
      - 3. With the air pressure applied to air bearing, shaft pushed downward to make an imprint on the paper? .....
      - 4. Distance between the center of the imprint and the two edges of the beam measured with vernier calipers? .....
      - 5. Difference between measurements 1.0 mm or less? .....
- Note: If the alignment does not meet the specification, the manufacturer should be consulted.*

Preparation of Molds (either of the following)

1. Metal molds (AASHTO and ASTM)
- (a) **ASTM:** Visually inspected to verify molds are free of nicks, dings, and burrs? .....
  - (b) Very thin layer of petroleum-based grease used to hold plastic strips to the aluminum? .....
  - (c) Molds assembled correctly using O-rings? .....
  - (d) Air bubbles eliminated between plastic film and aluminum [**ASTM:** with firm finger pressure]? .....
  - (e) Inside faces of the two end pieces covered with glycerol-talc mixture? .....
  - (f) Mold assembly kept at room temperature until asphalt is poured? .....
2. **Silicone molds (ASTM only)**
- (a) Any remaining binder, grease, or other residue wiped out of the molds with a clean, dry cloth? .....  
*Note: A cloth moistened with an essentially residue free solvent (e.g. acetone or heptane) is satisfactory for this purpose. If a solvent is used to wipe down the molds, allow the molds to dry at ambient temperature for at least 10 minutes prior to use.*
  - (b) Assembled correctly according to Figure 5? .....
  - (c) Metal molds used for referee testing? .....

COMMENTS (T313/D6648):

(T313/D6648)

**DETERMINING THE FLEXURAL CREEP  
STIFFNESS OF ASPHALT BINDER USING THE  
BENDING BEAM RHEOMETER (BBR)**

(AASHTO T313) \_\_\_\_\_  
(ASTM D6648) \_\_\_\_\_

PROCEDURE (Continued)

Date: \_\_\_\_\_

Preparation of Material

1. Asphalt binder heated in an oven set at up to 165°C [*ASTM: 168±5°C*] until sufficiently fluid to pour? ..... \_\_\_\_\_
2. *AASHTO: When testing modified binders, the oven may be set at up to 180 °C?* ..... \_\_\_\_\_
3. *ASTM: May be heated to higher temperatures if material does not pour easily when heated at 173°C. Oven temperature noted on report?* ..... \_\_\_\_\_
4. Heating time minimized?..... \_\_\_\_\_

Filling of Molds

1. Metal molds (AASHTO and ASTM)
  - (a) Sample container held 20 to 100 mm from the top of mold? ..... \_\_\_\_\_
  - (b) Mold filled by pouring stream of asphalt from one end toward other in a single pass, slightly overfilling? ..... \_\_\_\_\_
2. *Silicone molds (ASTM only)*
  - (a) *If the viscosity of the binder warrants, silicone mold preheated in a 135°C for up to 30 minutes?....* \_\_\_\_\_
  - (b) *Mold filled from the top in a slow steady manner?*..... \_\_\_\_\_
  - (c) *Entrapment of air bubbles avoided?* ..... \_\_\_\_\_
  - (d) *Mold filled to the top with no appreciable overfilling?* ..... \_\_\_\_\_

Preparation and Conditioning of Specimens

1. Samples cooled at ambient temperature for 45 to 60 minutes? ..... \_\_\_\_\_
2. Excess material cut off with a hot knife or a heated spatula? ..... \_\_\_\_\_  
*ASTM note: "Buttering" maybe be performed on the samples from stiffer grades of binder by bringing the heated trimming tool into momentary contact with the top of the specimen just enough to flatten the surface.*
3. *AASHTO: Specimens cooled in a freezer or ice bath at -5 ± 7 °C for 5 – 10 minutes?* ..... \_\_\_\_\_
4. *ASTM: Specimens cooled for no longer than 5 minutes to stiffen the specimen sufficiently to be readily demolded?* ..... \_\_\_\_\_
5. *ASTM: Not exposed to temperatures within 10°C of the test temperature?*..... \_\_\_\_\_
6. Specimens immediately demolded after cooling by disassembling the metal mold [*ASTM: or by removing the specimen from the silicone mold*]?..... \_\_\_\_\_
7. Distortion and warping of the specimens avoided? ..... \_\_\_\_\_  
*Note: If the plastic sheeting does not fully separate from the beam, the final portion of the sheeting may be removed while immersing the sample in the bath to avoid distortion.*
8. Specimens immediately submerged in the bath at test temperature? ..... \_\_\_\_\_
9. Conditioned for 60 ± 5 minutes? ..... \_\_\_\_\_
10. *ASTM: Test specimen thickness taken as 6.35 mm or measured by one of the methods in Section 13.2?.....* \_\_\_\_\_

COMMENTS (T313/D6648):

(T313/D6648)

**DETERMINING THE FLEXURAL CREEP  
STIFFNESS OF ASPHALT BINDER USING THE  
BENDING BEAM RHEOMETER (BBR)**

(AASHTO T313) \_\_\_\_\_  
(ASTM D6648) \_\_\_\_\_

PROCEDURE (Continued)

Date: \_\_\_\_\_

Testing of Specimens

1. Contact and test loads checked using the compliance beam? .....
  - (a) Using the test load regulator,  $980 \pm 50$  mN added to the thick beam? .....
  - (b) Switched to the zero load regulator, and  $35 \pm 10$  mN contact load added to the thick beam? .....
  - (c) Switched between the test and the contact load at least 4 times [*ASTM: until consistent readings are obtained*] to ensure that the loads are maintained? .....
  - (d) When switching between contact and test loads, loading shaft remains in contact with steel beam (Check by observing LVDT readings as loads are switched)? .....
  - (e) **ASTM: Successive contact load readings vary by no more than 10 mN?** .....

*Note: If the loads do not recover, the device may require cleaning or calibration of the load cell, and if it still does not work, the lab should consult the manufacturer.*
2. Specimen information entered into the test system? .....
3. Specimen placed on supports against the alignment pins? [*ASTM: if the thickness is not determined by displacement*] .....
4. Bath fluid maintained at test temperature  $\pm 0.1^\circ$  C during testing? .....
  - (a) If not, is the test rejected? .....
5. Contact load of  $35 \pm 10$  mN applied to beam? .....
  - (a) Contact load applied by gently increasing and does not exceed 45 mN? .....
  - (b) Time to apply and adjust the contact load no greater than 10 s? .....
6. Automatic test system activated and proceeds as follows: .....
  - (a)  $980 \pm 50$  mN initial seating load applied for  $1.0 \pm 0.1$  s? .....
  - (b) Load reduced to  $35 \pm 10$  mN and beam allowed to recover for  $20.0 \pm 0.1$  s? .....
  - (1) If not, is test rejected? .....
  - (c) Test load of  $980 \pm 50$  mN applied? .....
  - (d) Maintained  $\pm 50$  mN of the average test load for the first 5 s? .....
  - (e) Maintained  $\pm 10$  mN from the average of the test load from 5.0 s to 240.0 s for the remainder of the test? .....
  - (f) Test load removed and test terminated? .....
  - (g) Load on the beam returns to  $35 \pm 10$  mN at the end of the test? .....

*Note: If not, the test is invalid and the rheometer should be recalibrated.*

  - (h) Time required for rise from  $35 \pm 10$  mN preload to  $980 \pm 50$  mN test load less than 0.5 seconds? .....
7. Plot of measured load versus measured deflection generated [*ASTM: intervals of 0.5 s or less*] starting with the seating load? .....

COMMENTS (T313/D6648):

(T313/D6648)

**DETERMINING THE FLEXURAL CREEP  
STIFFNESS OF ASPHALT BINDER USING THE  
BENDING BEAM RHEOMETER (BBR)**

(AASHTO T313) \_\_\_\_\_  
(ASTM D6648) \_\_\_\_\_

REPORT

Date: \_\_\_\_\_

AASHTO

1. Date and time when test initiated & load applied? .....
2. File name of test data, name of operator, & specimen identification number? .....
3. Conditioning time for specimens.....
4. Any flags issued by software during test .....
5. Correlation coefficient,  $R^2$  for log stiffness versus log time expressed to nearest  $1 \times 10^{-7}$  .....
6. Constants A, B, & C to three significant figures .....
7. Percent difference between measured & estimated stiffness modulus.....
8. Load and deflection for times 0.0 and 0.5 seconds (to nearest 1 mN)? .....
9. Report data for time intervals of 8.0, 15.0, 30.0, 60.0, 120.0, and 240.0 seconds including:
  - (a) Loading time (nearest 0.1 sec.)? .....
  - (b) Load (nearest 1.0 mN)? .....
  - (c) Beam deflection (nearest 1  $\mu$ m)? .....
  - (d) Measured stiffness modulus (MPa to three significant figures)? .....
  - (e) Estimated stiffness modulus (MPa to three significant figures)? .....
  - (f) Estimated m value (nearest 0.001)? .....
10. Report load and deflection for times 0.0 and 0.5 seconds (to nearest 1 mN)? .....

ASTM

1. **Test Specimen Information**
  - (a) BBR file name and specimen ID number? .....
  - (b) Test specimen width and thickness (defaults are 12.70 and 6.35 mm, respectively)? .....
  - (c) Date of test? .....
  - (d) Version of software used? .....
  - (e) Calibration information.....
  - (f) Date of the last temperature, load cell, and LVDT calibrations? .....
  - (g) Load cell and LVDT calibration constants (mN/bit and  $\mu$ m/bit, respectively, to three significant figures)? .....
  - (h) Date of the last modulus and compliance checks? .....
  - (i) Measured modulus and of the steel beam and compliance of the loading system (GPa and  $\mu$ m/N, respectively to three significant figures)? .....
2. **Test Conditions**
  - (a) Time test load applied .....
  - (b) Minimum and maximum temperatures during the test (to the nearest 0.1°C)? .....
  - (c) Minimum and maximum load recorded during test (to the nearest 1 mN)? .....
  - (d) Contact load at  $t = 0$ , just prior to application of the test load (to the nearest 1 mN)? .....
  - (e) Test load after 0.5 s loading time (to the nearest 1 mN)? .....
3. **Test Results (report the following test results for time intervals of 8.0, 15.0, 30.0, 60.0, 120.0, 240.0 s)**
  - (a) Loading time in seconds (nearest 0.1 s)? .....
  - (b) Test load (mN to nearest 1 mN)? .....
  - (c) Test specimen deflection (mm to nearest 1  $\mu$ m)? .....
  - (d) Measured stiffness modulus, Eq. 3 (MPa to three significant figures)? .....
  - (e) Estimate stiffness modulus, Eq. 5 (MPa to three significant figures)? .....
  - (f) Percent difference between estimated and measured stiffness? .....
  - (g) Estimated m-value, Eq. 6 (to nearest 0.001)? .....

COMMENTS (T313/D6648):

(T313/D6648)



**DETERMINING THE FLEXURAL CREEP  
STIFFNESS OF ASPHALT BINDER USING THE  
BENDING BEAM RHEOMETER (BBR)**

(AASHTO T313) \_\_\_\_\_  
(ASTM D6648) \_\_\_\_\_

REPORT (Continued)

Date: \_\_\_\_\_

4. **Summary Data**

- (a) **Regression coefficients and  $R^2$**  ..... \_\_\_\_\_
- (b) **Average load at 0.5 s and every 0.5 s thereafter up to 240.0 s** ..... \_\_\_\_\_
- (c) **Maximum deviation of the load from 0.5 to 5.0 s (mN)?** ..... \_\_\_\_\_
- (d) **Maximum deviation of load from 5.0 to 240.0 s (mN)?** ..... \_\_\_\_\_
- (e) **Deflection at zero time (mm)?** ..... \_\_\_\_\_
- (f) **Deflection at 0.5 s (mm)?** ..... \_\_\_\_\_

COMMENTS (T313/D6648):

(T313/D6648)



**DETERMINING THE FRACTURE PROPERTIES OF  
ASPHALT BINDER IN DIRECT TENSION (DT)**

(AASHTO T314) \_\_\_\_\_  
(ASTM D6723) \_\_\_\_\_

APPARATUS

Date: \_\_\_\_\_

1. Testing System

- (a) Distance between the loading pins capable of accommodating specimens with a total length of at least 100 mm (including the plastic end tabs)? .....
- (b) If a fluid based system is used, gripping system (loading pins and platens) completely submerged under the cooling fluid at a minimum depth of 25 mm (1 in.)? .....
- (c) If an air based system is used, testing frame equipped with two columns having sufficient space between them so that an insulated temperature control chamber can be placed between the two columns? .....
- The following lines are for informational purposes only:*
- (d) *Fluid bath or an insulated environmental chamber?* .....
- (e) *Real-time load measuring and recording devices?* .....
- (f) *Real-time elongation measuring and recording devices?* .....
- (g) *Real-time temperature detection and recording devices?* .....
- (h) *Real-time data acquisition and display devices?* .....
- (i) *Electro-mechanical or servo-hydraulic loading unit capable of applying and measuring:*
  - (1) *Tension and compression forces of at least 500 N?* .....
  - (2) *Actuator travel of 20 mm (0.78 in.)?* .....
- (j) *Closed feed-back loop displacement-controlled tensile loading machine?* .....
- (k) *System stiffness at least 3 MN/m, including the load cell and loading pins?* .....
- (l) *Displacement transducer:*
  - (1) *Capable of measuring and controlling grip separation?* .....
  - (2) *Provides feedback for strain control with a displacement resolution of 1.0  $\mu$ m?* .....
- (m) *System capable of closed loop elongation control accurate to at least 1 percent of the commanded specimen elongation rate using either:*
  - (1) *Feedback from a displacement transducer mounted between the loading pins?* .....
  - (2) *A non-contact extensometer measuring elongation of the specimen?* .....
- (n) *Closed loop elongation rate control algorithm capable of real time compliance correction?* .....
- (o) *Tensile loading machine having a controlled-displacement loading frame capable of producing at least a 500 N load?* .....
- (p) *Loading frame table mounted?* .....
- (q) *Load cell having a minimum capacity of 500 N and a sensitivity of 0.1 N?* .....

2. Specimen Gripping System

- (a) Produces a self-aligning uniaxial test load? .....
- (b) Accepts the specified plastic end tabs of the specimen? .....
- (c) Consists of two grips? .....
- (d) Grips include a specially-shaped pin that is rigidly mounted to the loading platens of the testing machine? .....
- (e) One grip remains stationary while the other is displaced at the desired elongation rate? .....

COMMENTS (T314/D6723):

(T314/D6723)

**DETERMINING THE FRACTURE PROPERTIES OF  
ASPHALT BINDER IN DIRECT TENSION (DT)**

(AASHTO T314) \_\_\_\_\_  
(ASTM D6723) \_\_\_\_\_

APPARATUS (Continued)

Date: \_\_\_\_\_

3. Temperature Control Chamber
  - (a) Chamber having sufficient space for storage of at least 12 specimens (*ASTM: at least 8 specimens*) on a rack? \_\_\_\_\_
  - (b) Temperature control range for the cooling chamber (without asphalt specimens) between +6°C to -36°C with a maximum temperature fluctuation of  $\pm 0.1^\circ\text{C}$  from the desired test temperature? \_\_\_\_\_
  - (c) Maximum temperature fluctuation from the desired test temperature, caused by placing a room temperature specimen in the cooling chamber,  $\pm 0.2^\circ\text{C}$ ? \_\_\_\_\_
  - (d) Temperature gradient between grips does not exceed  $\pm 0.1^\circ\text{C}$ ? \_\_\_\_\_
  - (e) Temperature measured with a Platinum Resistance Temperature Detector (PRTD)? \_\_\_\_\_
    - (1) Located in the bath in the proximity of the test area? \_\_\_\_\_
  
4. Cooling System (either of the following)
  - (a) Air Based
    - (1) System controlled mechanically or by liquid nitrogen? \_\_\_\_\_
    - (2) Equipped with a dehumidifying system such that the formation of frost on the interior of the chamber and the test specimen does not occur? \_\_\_\_\_
    - (3) Equipped with a front-opening door for maintenance and standardization purposes and an access port allowing for the insertion of the operator's hand and forearm to position specimens? \_\_\_\_\_
    - (4) Chamber and access port designed such that changes in temperature are within  $\pm 0.2^\circ\text{C}$  when the operator's hand and forearm are inserted into or removed from the chamber? \_\_\_\_\_
    - (5) Visual access to the interior of the test chamber to permit proper mounting of the test specimens and for monitoring the test? \_\_\_\_\_
    - (6) Specimen elongation measured with an optical laser, optical glass windows on two sides of the temperature chamber so that a laser beam can be passed through the chamber without distorting the laser beam? \_\_\_\_\_
    - (7) Plexiglas, Teflon, or other plastic plates for transferring and storing test specimens in the environmental chamber? \_\_\_\_\_
    - (8) Freezer capable of maintaining a temperature of  $-15 \pm 5^\circ\text{C}$ ? \_\_\_\_\_
  - (b) Fluid Based
    - (1) Alcohols shall not be used? \_\_\_\_\_
    - (2) Aqueous mixture of 42% potassium acetate and 58% deionized water by weight? \_\_\_\_\_

COMMENTS (T314/D6723):

(T314/D6723)

**DETERMINING THE FRACTURE PROPERTIES OF  
ASPHALT BINDER IN DIRECT TENSION (DT)**

(AASHTO T314) \_\_\_\_\_  
(ASTM D6723) \_\_\_\_\_

APPARATUS (Continued)

Date: \_\_\_\_\_

5. Specimen Molds

(a) Made of aluminum? .....

Dimensions	1	2	3	4	5	6	7	8	9	10	11	12
Length: 99.924 to 99.975 mm?												
Width at point of contact: 26.880 to 27.120 mm?												
Width from point of contact to shoulder: 9.880 to 10.120 mm?												
Width from face to face: 5.760 to 6.240 mm?												
Thickness of mold: 5.880 to 6.120 mm?												
Inside length of base: 100.025 – 100.127 mm?												

(b) Release agent (mixture of 20 g of glycerin and 20 g of talc (USP)? .....

(c) Paper coated on both sides with 0.3 microns Teflon (*ASTM: silicone coated papers may be used*)? ...

(d) Bottom plate? .....

6. Acrylic End Tabs

(a) End tabs machined from Phenolic G-10 material? .....

Dimensions	1	2	3	4	5	6	7	8	9	10	11	12
Length: 29.4 to 30.6 mm?												
Width: 19.4 to 20.6 mm?												
Height: 5.4 to 6.6 mm?												
Hole lined with stainless ring?												
Diameter of ring: 9.95 to 10.05 mm?												

COMMENTS (T314/D6723):

(T314/D6723)

**DETERMINING THE FRACTURE PROPERTIES OF  
ASPHALT BINDER IN DIRECT TENSION (DT)**

(AASHTO T314) \_\_\_\_\_  
(ASTM D6723) \_\_\_\_\_

APPARATUS (Continued)

Date: \_\_\_\_\_

7. Data Acquisition Systems

- (a) Load and elongation monitored with a data acquisition system such that they can be resolved to 1 percent of the failure load and elongation, respectively? .....
- (b) Once the test has started, data acquisition system detects the point in time when the load starts to change as a result of elongation in the sample? .....
- (c) Data acquisition and display system displays a stress-strain curve in units of stress (MPa) versus percent strain? .....
- (d) If an x-y recorder is used, the units may be in volts but the test file shall contain the calibration factor in MPa/Volt and percent strain/volt for both x and y axes? .....
- (e) Display device displays the strain failure once the test is complete, .....
- (f) Stress and strain displayed to the nearest 0.1 percent? .....
- The following lines are for informational purposes only:*
- (g) *If the data acquisition component consists of an IBM-compatible computer:*
  - (1) *Does it have three A/D channels: one for load, one for elongation, and one for temperature?* .....
  - (2) *Data stored in ASCII format?* .....

8. Miscellaneous

- (a) Calibrated liquid-in-glass thermometer of suitable range with subdivisions of 0.1°C for verification of the temperature transducer? .....
- Note:** The thermometric device used for calibration of the temperature transducer (at least once per year) can be different than a liquid-in-glass thermometer used for daily verification (not specified by the test method, but a common laboratory practice). In this case, the uncertainty requirement applies to the thermometer used for calibration, not a daily verification. The laboratory should have evidence that the device used for calibration meets this requirement.
- (1) Uncertainty less than  $\pm 0.033^\circ\text{C}$  (can be found on certificate)? .....
- [AMRL Policy: AAP will accept  $0.04^\circ\text{C}$  for liquid-in-glass thermometers, please write the finding as informational if the uncertainty is less than or equal to  $0.04^\circ\text{C}$ .]
- (b) Forced-air convection oven capable of maintaining  $160 \pm 5^\circ\text{C}$  for heating the asphalt? .....
- (c) Varsol, mineral spirits, or a degreasing spray cleaner formulated for use on asphalt for cleaning molds, end tabs, and plates? .....
- (d) Cotton cleaning cloths for wiping molds, end tabs, and plates? .....

COMMENTS (T314/D6723):

(T314/D6723)

**DETERMINING THE FRACTURE PROPERTIES OF  
ASPHALT BINDER IN DIRECT TENSION (DT)**

(AASHTO T314) \_\_\_\_\_  
(ASTM D6723) \_\_\_\_\_

CALIBRATION AND VERIFICATION

Date: \_\_\_\_\_

1. Load Cell and Displacement Transducer
  - (a) Verified at least every 6 months and whenever measurements are suspect (check records of verification for agreement with certificate values)? ..... \_\_\_\_\_
  - (b) Verification standard having a spring rate of approximately 135 N/m used? ..... \_\_\_\_\_
  - (c) Supplied by manufacturer along with stress-strain characteristics? ..... \_\_\_\_\_
  - (d) Equipment on which the force and elongation for the spring was determined NIST traceable? ..... \_\_\_\_\_

Note: this usually relates to the initial calibration of the DTT at the factory, with a subsequent determination of the spring properties on that DTT. There is no requirement for the spring itself to be NIST-traceable.
2. Verification of the Elongation Rate
  - (a) Performed in conjunction with the load cell and displacement transducer verification? ..... \_\_\_\_\_
  - (b) Measurements made at -18°C? ..... \_\_\_\_\_
  - (c) Elongation plotted as a function of elapsed time? ..... \_\_\_\_\_
  - (d) Resulting plot a straight line with a slope of 1.00 mm/min.? ..... \_\_\_\_\_
3. Verification of the Temperature Detector
  - (a) Performed at least once per year [*ASTM: at least every six months*]? ..... \_\_\_\_\_
  - (b) Output from the RTD compared to a calibrated liquid-in-glass thermometer [*ASTM: a NIST-traceable RTD digital thermometer may be used*]? ..... \_\_\_\_\_
  - (c) Calibrated at each temperature used? ..... \_\_\_\_\_
  - (d) Direct contact between RTD and temperature calibration device? ..... \_\_\_\_\_
  - (e) If not agreeing within  $\pm 0.1^\circ\text{C}$ , correction applied or further calibration or maintenance performed? .. \_\_\_\_\_

PROCEDURE

1. Preparation of Sample
  - (a) If binder is unaged, sample obtained in accordance with T40 [*ASTM: D140*]? ..... \_\_\_\_\_
  - (b) AASHTO: Sample degassed prior to testing as described in R28? [ASTM: this is still in the ASTM PAV specification and should be performed for ASTM testing as well] ..... \_\_\_\_\_
  - (c) Sample heated until sufficiently fluid to pour? ..... \_\_\_\_\_
  - (d) Specimen forming surfaces of the two mold plates coated with the release agent such that no part of the metal surface is exposed? ..... \_\_\_\_\_
  - (e) Single precut sheet of release paper placed on the bottom plate of the mold? ..... \_\_\_\_\_
  - (f) Side plates (coated with release agent) and plastic end tabs assembled on the bottom of the plate? ..... \_\_\_\_\_
  - (g) AASHTO: Assembly placed into an oven for no more than 3 minutes? ..... \_\_\_\_\_
  - (h) **ASTM: Mold assembly placed in sand bath (preheated in the oven) in oven for  $7 \pm 2$  min?** ..... \_\_\_\_\_
  - (i) Oven set at the same temperature the sample was heated to for pouring? ..... \_\_\_\_\_
  - (j) Hot asphalt binder poured into the mold starting from one end of the cavity and moving across the cavity in a single pass? ..... \_\_\_\_\_
  - (k) Specimen poured in a continuous stream to avoid entraining air bubbles or gaps? ..... \_\_\_\_\_
  - (l) Sample poured until asphalt is slightly above the top surface of the mold? ..... \_\_\_\_\_
  - (m) AASHTO: Pouring operation completed as quickly as possible to avoid excessive drop in temperature of the asphalt? ..... \_\_\_\_\_
  - (n) **ASTM: Only two molds heated and poured at a time** ..... \_\_\_\_\_
  - (o) **ASTM: Molds allowed to anneal in sand bath for  $5 \pm 1$  min before being placed on the bench top?** ..... \_\_\_\_\_
  - (p) Entire assembly allowed to cool on a bench top at ambient temperature for 30 to 60 minutes? ..... \_\_\_\_\_
  - (1) Specimen not quenched to achieve an ambient temperature? ..... \_\_\_\_\_

COMMENTS (T314/D6723):

(T314/D6723)

**DETERMINING THE FRACTURE PROPERTIES OF  
ASPHALT BINDER IN DIRECT TENSION (DT)**

(AASHTO T314) \_\_\_\_\_  
(ASTM D6723) \_\_\_\_\_

PROCEDURE (Continued)

Date: \_\_\_\_\_

2. Trimming of the Specimen

- (a) Excess asphalt binder trimmed off with a straightedge heated to approximately 165°C so that the asphalt binder is flush with the top of the mold? ..... \_\_\_\_\_
- (b) Care taken during the trimming operation so that:
  - (1) The asphalt binder is not pulled away from the mold? ..... \_\_\_\_\_
  - (2) The bond between the plastic end tabs and the asphalt binder is not damaged? ..... \_\_\_\_\_
- (c) Debris and extraneous asphalt binder removed from holes or slots in the plastic end tabs? ..... \_\_\_\_\_
- (d) Specimen allowed to sit at ambient temperature for 10 to 15 minutes? ..... \_\_\_\_\_

3. Demolding and Conditioning of the Specimen

- (a) Two side plates of an unused aluminum mold placed in cooling bath or air chamber and cooled to test temperature for use as holders when transferring specimens? ..... \_\_\_\_\_
- (b) Bottom plate of an unused aluminum mold placed upside down on the work bench and two release papers placed so that they overlap lengthwise and cover the plate? ..... \_\_\_\_\_
- (c) Specimen and the two side plates gently slid towards one edge of the bottom plate until the side plate nearest to the edge is halfway across the edge? ..... \_\_\_\_\_
- (d) Overhanging side plate pivoted downwards and separated using gentle pressure? ..... \_\_\_\_\_
- (e) Just released side plate replaced? ..... \_\_\_\_\_
- (f) Specimen slid, with both sides in place, to the other edge of the bottom plate? ..... \_\_\_\_\_
- (g) Demolding procedure repeated except one plate removed completely and one cold side plate from bath or chamber mounted on that side? ..... \_\_\_\_\_
- (h) Other side plate demolded and other cold side plate from bath or chamber mounted? ..... \_\_\_\_\_
- (i) Cold specimen mold assembly turned upside down and placed on the transfer plate? ..... \_\_\_\_\_
- (j) Inverted mold assembly perpendicular to the transfer plate covered with release papers? ..... \_\_\_\_\_
- (k) Bottom plate (now on top) removed from upside down specimen assembly by sliding plate off assembly? ..... \_\_\_\_\_
- (l) Release paper gently removed while holding the two plates? ..... \_\_\_\_\_
- (m) Specimen, along with the two cold side plates, immediately placed into the cooling bath or chamber onto one of the trays? ..... \_\_\_\_\_
- (n) Specimen side plates removed after a two minute cool-down period? ..... \_\_\_\_\_
- (o) Specimen flipped in test bath or chamber so that the trimmed side is up? ..... \_\_\_\_\_
- (p) Transfer plate with release paper never placed in bath? ..... \_\_\_\_\_
- (q) Cooling bath stabilized to within  $\pm 0.1^\circ \text{C}$  of the test temperature? ..... \_\_\_\_\_
- (r) Specimen conditioned at the test temperature for  $60 \pm 10$  [ASTM:  $60 \pm 5$ ] minutes? ..... \_\_\_\_\_

COMMENTS (T314/D6723):

(T314/D6723)

**DETERMINING THE FRACTURE PROPERTIES OF  
ASPHALT BINDER IN DIRECT TENSION (DT)**

(AASHTO T314) \_\_\_\_\_  
(ASTM D6723) \_\_\_\_\_

PROCEDURE (Continued)

Date: \_\_\_\_\_

4. Test Procedure for Fluid Bath Cooling Systems
  - (a) Specimen mounted on the load frame using tongs [AASHTO: rubber tipped tongs]?..... \_\_\_\_\_
  - (b) Seating of the specimen checked by running the tongs lightly along the end tabs? ..... \_\_\_\_\_
  - (c) Either the following software controlled or manual set up procedures followed? ..... \_\_\_\_\_
    - (1) Software automatically removes the slack between the specimen and the loading pins, zeroes the strain, and starts the test when load reaches a value  $2 \pm 0.3$  N? ..... \_\_\_\_\_
    - (2) Manual set up:
      1. Thumb wheel moved until  $2 \pm 0.3$  N is shown on the monitor? ..... \_\_\_\_\_
      2. Seating of the specimen checked with the tongs once again to avoid erroneous readings? ..... \_\_\_\_\_
      3. Slack again removed until a load of  $2 \pm 0.3$  N obtained? ..... \_\_\_\_\_
      4. Strain quickly zeroed and test started? ..... \_\_\_\_\_
    - (3) Strain rate set to 3 percent per minute (an elongation rate of 1 mm/minute)? ..... \_\_\_\_\_
  
5. Test Procedure for Forced Air Cooling Systems
  - (a) Specimen mounted on the pins using the environmental chamber hand access port after conditioning? \_\_\_\_\_
  - (b) Specimen mounted using rubber surgeon's gloves, taking care not to touch the asphalt binder and not to open the chamber door? ..... \_\_\_\_\_
  - (c) If a washer is used to secure the end tabs to the pins:
    - (1) Made from silicone rubber or foam? ..... \_\_\_\_\_
    - (2) 5 to 10 mm thick with an outer diameter of approximately 10 mm? ..... \_\_\_\_\_
    - (3) Easily fit onto the pins? ..... \_\_\_\_\_
  - (d) Preload applied to the specimen which results in an elongation sufficient to develop a 1 to 2 N load? . \_\_\_\_\_
  - (e) Movement stopped and the load relaxed until it is no longer detachable? ..... \_\_\_\_\_
  - (f) Desired strain rate selected and specimen loaded to failure? ..... \_\_\_\_\_
  
6. If Testing for Compliance to AASHTO M320 / ASTM D6373
  - (a) Strain rate selected that gives an effective gage section elongation rate of  $1.00 \pm 0.01$  mm/min? ..... \_\_\_\_\_
  - (b) If the test specimen fails outside of the gage area of the specimen, test discarded? ..... \_\_\_\_\_
  
7. Failure Identification
  - (a) If fracture occurs, strain at failure recorded as the strain at peak load (maximum stress)? ..... \_\_\_\_\_
  - (b) If the specimen does not fracture, strain at failure recorded as the strain corresponding to the maximum stress? ..... \_\_\_\_\_
  - (c) If the asphalt binder can be stretched to 10 percent without fracture, test stopped and the failure strain recorded as "greater than 10 percent"? ..... \_\_\_\_\_
  - (d) If the specimen fails in the throat section, noted that failure occurred in the throat? ..... \_\_\_\_\_
  
8. Cleaning
  - (a) If end tabs are to be reused, soaked in solvent or sprayed with a degreasing cleaner, and wiped with a soft cloth? ..... \_\_\_\_\_
  - (b) AASHTO: Washed with a detergent soap solution to remove any oil film residue? ..... \_\_\_\_\_
  - (c) ASTM: Given a final wipe with an acetone-soaked cloth? ..... \_\_\_\_\_

COMMENTS (T314/D6723):

(T314/D6723)



**DETERMINING THE FRACTURE PROPERTIES OF  
ASPHALT BINDER IN DIRECT TENSION (DT)**

(AASHTO T314) \_\_\_\_\_  
(ASTM D6723) \_\_\_\_\_

CALCULATIONS AND REPORT

Date: \_\_\_\_\_

1. Calculations

- (a) Is the failure stress computed by the following equation?..... \_\_\_\_\_  
 $\sigma_f = P_f / A$  where  $A = 36 \times 10^{-6} \text{m}^2$
- (b) Is the failure strain computed by the following equation?..... \_\_\_\_\_  
 $\epsilon_f = \sigma_f / L_e$  where  $L_e = 33.8 \text{ mm}$
- (c) Total of six specimens tested?..... \_\_\_\_\_
- (d) Two specimens with lowest values of failure stress, strain, and energy discarded?..... \_\_\_\_\_
- (e) Mean and standard deviation values for the four remaining failure values calculated? ..... \_\_\_\_\_

2. Report

- (a) The test temperature to the nearest 0.1°C?..... \_\_\_\_\_
- (b) The rate of elongation to the nearest 0.01 mm/min.? ..... \_\_\_\_\_
- (c) The failure strain to the nearest 0.01 percent [*ASTM: average failure strain and standard deviation*]?..... \_\_\_\_\_
- (d) The failure stress to the nearest 0.01 Mpa [*ASTM: average failure stress and standard deviation*]?... \_\_\_\_\_
- (e) The peak load to the nearest N? ..... \_\_\_\_\_

COMMENTS (T314/D6723):

(T314/D6723)



**DETERMINING THE RHEOLOGICAL  
PROPERTIES OF ASPHALT BINDER  
USING A DYNAMIC SHEAR RHEOMETER (DSR)**

(AASHTO T315) \_\_\_\_\_  
(ASTM D7175) \_\_\_\_\_

APPARATUS

Date: \_\_\_\_\_

Manufacturer: \_\_\_\_\_

Software: \_\_\_\_\_

Model: \_\_\_\_\_

1. Metal Test Plates
  - (a) One set of plates  $8.00 \pm 0.02$  mm in diameter? .....
  - (b) One set of plates  $25.00 \pm 0.05$  mm in diameter? .....
  - (c) Base plates are either flat or have a raised portion a minimum of 1.5 mm high with the same radius as the upper plate? .....
  - (d) Plates are concentric with each other when mounted in the DSR? .....
2. Environmental Chamber
  - (a) If air is used as a media, is a suitable drier included to prevent condensation of moisture and/or formation of ice on the plates? .....
  - (b) Controls the temperature of the specimen to an accuracy of  $0.1^{\circ}\text{C}$ ? .....
  - (c) Chamber completely encloses top and bottom plates? .....
  - (d) If a liquid circulating bath is used, is the flow rate of the bath media not changed once the temperature settings have been adjusted to the desired value? .....
  - (e) Are media lines periodically inspected, cleaned, and replaced if necessary to remove obstructions? ....
3. Temperature Controller
  - (a) Capable of maintaining specimen temperatures within  $\pm 0.1^{\circ}\text{C}$  for test temperatures ranging from 3 to  $88^{\circ}\text{C}$  [ASTM: 4 to  $88^{\circ}\text{C}$ ]? .....
4. Internal Temperature Measurement Device [AASHTO: Platinum Resistance Thermometer]
  - (a) Mounted within the environmental chamber as an integral part of the DSR and in closer proximity to the fixed plate? .....
  - (b) Range of 3 to  $88^{\circ}\text{C}$  [ASTM: 4 to  $88^{\circ}$ ]? .....
  - (c) Resolution of  $0.1^{\circ}\text{C}$ ? .....
  - (d) Provides a continuous readout of temperature during the mounting, conditioning, and testing of the specimen? .....

*Note: Platinum resistance detectors meeting DIN Standard 43760 (Class A) or equal are recommended. The PRT shall be calibrated as an integral unit with its respective meter or electronic circuitry.*
5. Loading Device
  - (a) Applies a sinusoidal oscillatory load to the specimen at a frequency of  $10.0 \pm 0.1$  rad/s? .....
  - (1) If other frequency, accurate to 1 percent? ..... Specify Frequency: \_\_\_\_\_
  - (b) Stress controlled \_\_\_\_\_ or strain controlled \_\_\_\_\_? .....
  - (c) AASHTO: If strain controlled, torque accurate to  $100 \mu\text{rad}$  or if stress controlled, torque accurate to  $10 \text{ mN}\cdot\text{m}$ ? .....
  - (d) AASHTO: Total system compliance at  $100 \text{ N}\cdot\text{m}$  torque less than  $2 \text{ mrad}/\text{N}\cdot\text{m}$ ? .....
  - (e) Manufacturer provides a certificate certifying that the frequency, stress, and strain are controlled and measured with an accuracy of 1% or less in the range of this measurement? .....

COMMENTS (T315/D7175):

(T315/D7175)

**DETERMINING THE RHEOLOGICAL  
PROPERTIES OF ASPHALT BINDER  
USING A DYNAMIC SHEAR RHEOMETER (DSR)**

(AASHTO T315) \_\_\_\_\_  
(ASTM D7175) \_\_\_\_\_

APPARATUS (Continued)

Date: \_\_\_\_\_

6. *AASHTO Only: Control and Data Acquisition System*
- (a) Provides a record of temperature to 0.1 °C? .....
  - (b) Provides a record of frequency to 1 percent? .....
  - (c) Provides a record of torque to 10 mN•m? .....
  - (d) Provides a record of deflection angle to 100 µrad? .....
  - (e) Measures and records  $G^*$ , in the range of 100 Pa to 10 MPa, to an accuracy of 1.0 % or less? .....
  - (f) Measures and records phase angle, in the range of 0 to 90°, to an accuracy of 0.1 °? .....
7. **Silicone Rubber Molds (Optional)**
- (a) Thickness greater than 5 mm? .....
  - (b) *AASHTO: Diameter of cavity approximately equal to diameter of upper test plate? .....*
  - (c) *AASHTO: For a 25-mm test plate with a 1-mm gap: mold cavity approximately 18 mm in diameter and 2.0 mm deep? .....*
  - (d) *AASHTO: For an 8-mm test plate with a 2-mm gap: mold cavity approximately 8 mm in diameter and 2.5 mm deep? .....*  
AMRL: The mold must be large enough for excess material.
8. **Specimen Trimmer**
- (a) Straight edged? .....
  - (b) *AASHTO: at least 4 mm wide? .....*
9. **Wiping Material**
- (a) Clean cloth, paper towels, cotton swabs, or other suitable material for wiping test plates? .....
10. **Cleaning Solvents**
- (a) Mineral oil, citrus-based solvents, mineral spirits, toluene, or similar solvent for cleaning the plates? ..
  - (b) *AASHTO: Acetone for removing solvent residue from the surfaces of the plates? .....*
  - (c) *ASTM: An organic solvent that does not leave a residue, such as heptane, acetone, or ethyl alcohol may be used for removing solvent residue from the test plates? .....*

COMMENTS (T315/D7175):

(T315/D7175)

**DETERMINING THE RHEOLOGICAL  
PROPERTIES OF ASPHALT BINDER  
USING A DYNAMIC SHEAR RHEOMETER (DSR)**

(AASHTO T315) \_\_\_\_\_  
(ASTM D7175) \_\_\_\_\_

APPARATUS (Continued)

Date: \_\_\_\_\_

11. Reference Thermometer

- (a) Either a NIST-traceable liquid-in-glass or a NIST-traceable electronic thermometer used to verify the portable thermometer? .....
- (b) **ASTM: Maintained in the laboratory as a temperature standard?** .....
- (c) Liquid-in-glass thermometer
  - (1) Partial immersion NIST-traceable with a suitable range [**ASTM: range between 0 and 88°C**] and subdivisions of 0.1°C .....
  - (2) With an ice point and calibrated in accordance with ASTM test method E563? .....
  - (3) Optical viewing device for use with the thermometer that enhances readability and minimizes parallax (optional)? .....
  - (4) **ASTM: Verified at least once a year?** .....
- (d) Electronic Thermometer [**ASTM: Digital Temperature Measurement Device**]
  - (1) With an accuracy of  $\pm 0.05^{\circ}\text{C}$  and a resolution of  $0.01^{\circ}\text{C}$ ? .....
  - (2) Calibrated at least annually using a NIST-traceable reference standard in accordance with ASTM test method E77? .....

*Note: Platinum resistance detectors meeting DIN Standard 43760 (Class A) or equal are recommended. The PRT shall be calibrated as an integral unit with its respective meter or electronic circuitry.*

12. Portable Thermometer [**ASTM: Portable Temperature Measurement Device**]

- (a) Standardized and consisting of a resistive detector, associated electronic circuitry, and digital readout? .....
- (b) Thickness less than 2.0 mm such that it can be inserted between the test plates? .....
- (c) If the reference thermometer is used as the portable thermometer, does it fit within the dummy specimen as required? .....

CALIBRATION AND VERIFICATION

1. Test Plate Diameters

- (a) **AASHTO: Measured to the nearest 0.01 mm?** .....
- (b) **ASTM: Measured to the nearest 0.02 mm (at the average of 3 different locations 120° apart)?** .....
- (c) Maintained in a log of measurements so the measurements are clearly identified with specific plates? .....
- (d) **AASHTO: Actual measured dimensions entered into the DSR software for use in calculations?** .....
- (1) **AASHTO: If the top and bottom plates differ in diameter, the smaller of the two measured diameters entered?** .....

2. Portable Thermometer

- (a) Verified using the laboratory reference thermometer at least every six months? .....
  - (b) Temperatures taken over a range with approximately 6°C increments? .....
  - (c) If difference is 0.1°C or more, are corrections written in log as part of the lab quality control program? .....
- AASHTO Note: If the difference is 0.5°C or more, the portable thermometer may need to be recalibrated or replaced.**

COMMENTS (T315/D7175):

(T315/D7175)

**DETERMINING THE RHEOLOGICAL  
PROPERTIES OF ASPHALT BINDER  
USING A DYNAMIC SHEAR RHEOMETER (DSR)**

(AASHTO T315) \_\_\_\_\_  
(ASTM D7175) \_\_\_\_\_

CALIBRATION AND VERIFICATION (Continued)

Date: \_\_\_\_\_

3. DSR Test Specimen Temperature
- (a) Recorded to the nearest 0.1°C..... \_\_\_\_\_
  - (b) If the difference between portable thermometer and DSR controller is 0.1°C or more, is a temperature correction [*ASTM: offset*] determined by using the portable thermometer in a silicone wafer or an asphalt binder or other polymer dummy sample (silly putty is NOT recommended)? ..... \_\_\_\_\_
  - (c) Temperatures taken over a range with approximately 6°C increments? ..... \_\_\_\_\_
  - (d) Does the temperature vary by not more than 0.1°C over 5 minutes before a reading is taken? ..... \_\_\_\_\_
  - (e) Is the difference (temperature correction) either plotted vs. the temperature measured by the portable thermometer or incorporated into the instrument software?..... \_\_\_\_\_
4. DSR Torque Transducer
- (a) **ASTM: verified each time the temperature offset is verified?** ..... \_\_\_\_\_  
*Note: A newly installed or reconditioned DSR should be verified weekly until acceptable verification has been demonstrated. Data should be maintained in a control chart where the measurements are plotted versus date.*
  - (b) Reference fluid or manufacturer supplied fixtures used to verify the transducer at least every 6 months and whenever the calibration is suspect? ..... \_\_\_\_\_
    - (1) Reference fluid
      - 1. Complex viscosity measured with DSR within 3% of the capillary viscosity of the reference fluid as reported by the manufacturer? ..... \_\_\_\_\_
      - 2. Complex viscosity calculated as  $G^*$  divided by the angular frequency in rad/s? ..... \_\_\_\_\_
      - 3. Reference fluid not used as a method of verifying the phase angle? ..... \_\_\_\_\_
      - 4. When used at 10 rad/s, reference fluid only used at 64°C and above [*ASTM: used between 58 and 64°C*]? ..... \_\_\_\_\_
    - (2) Fixtures
      - 1. Used to verify the DSR angular displacement and torque transducers (if fixtures are available)? ..... \_\_\_\_\_

PROCEDURE

1. Preparation of Apparatus
- (a) Surfaces of the test plates inspected, and any plates with jagged or rounded edges or deep scratches discarded? ..... \_\_\_\_\_
  - (b) Any asphalt binder residue cleaned from the plates with an organic solvent and wiped with a cotton swab or a soft cloth dampened with acetone [*ASTM: a reagent that does not leave residue*]? ..... \_\_\_\_\_
  - (c) If necessary, a cotton swab or soft cloth used to ensure that no moisture condenses on the plates? ..... \_\_\_\_\_
  - (d) Test plates mounted on test fixtures and tightened firmly? ..... \_\_\_\_\_
  - (e) **ASTM: test plates visually checked to ensure that they are parallel?** ..... \_\_\_\_\_
  - (f) Temperature selected according to the grade of the asphalt binder or according to the preselected testing schedule? ..... \_\_\_\_\_
  - (g) DSR allowed to stabilize within  $\pm 0.1^\circ\text{C}$  of test temperature? ..... \_\_\_\_\_
  - (h) Zero gap level established through one of the following methods at test temperature or in the middle of the testing range? ..... \_\_\_\_\_
    - (1) Removable test plate manually spun and gap closed until plate stops spinning? ..... \_\_\_\_\_
    - (2) Gap closed until the plates contact each other and the normal force is approximately zero? ... \_\_\_\_\_
    - (3) Instrument zeroed automatically according to the manufacturer's procedures? ..... \_\_\_\_\_

COMMENTS (T315/D7175):

(T315/D7175)

**DETERMINING THE RHEOLOGICAL  
PROPERTIES OF ASPHALT BINDER  
USING A DYNAMIC SHEAR RHEOMETER (DSR)**

(AASHTO T315) \_\_\_\_\_  
(ASTM D7175) \_\_\_\_\_

PROCEDURE (Continued)

Date: \_\_\_\_\_

2. Preparation of Sample

- (a) *AASHTO: For PAV-aged material, if the sample is also being tested for T314, is the sample degassed according to R28?*..... \_\_\_\_\_  
*Note: if the sample is not also being tested under T314, the degassing procedure is optional for T315. ....*
- (b) Heated until sufficiently fluid to pour while minimizing heating time? ..... \_\_\_\_\_
- (c) Heating at temperatures over 163°C [*ASTM: 135°C*] avoided (may be necessary for some highly modified or heavily aged binders)?..... \_\_\_\_\_
- (d) Sample covered and stirred occasionally? ..... \_\_\_\_\_
- (e) Plates preheated to the following temperatures to promote adhesion of the asphalt binder? ..... \_\_\_\_\_
- (1) 25-mm plates: to test temperature or lowest test temperature if testing performing a sweep? .. \_\_\_\_\_
- (2) 8-mm plates: to between 34 and 46°C? ..... \_\_\_\_\_
- (f) Test specimen prepared through one of the following methods? ..... \_\_\_\_\_
- (1) Pouring the binder into a mold that will form a pellet similar to the size of the test plate? ..... \_\_\_\_\_
1. Allowed to cool in the mold at room temperature and then mounted on the upper or lower test plates?..... \_\_\_\_\_
2. Molds covered during cooling to prevent contamination?..... \_\_\_\_\_
- a. Lower plate: specimen removed from the mold and centered on the plate? ..... \_\_\_\_\_
- b. Upper plate: specimen in the mold pressed gently on the center of the upper plate, and then the mold removed?..... \_\_\_\_\_
- Note: Solvents should not be used to clean the molds. If removing the specimen from the mold becomes difficult, discard the mold.*
3. Cooled on a flat laboratory bench surface at room temperature (not chilled)?..... \_\_\_\_\_
- Note: chilling is permitted for extremely soft grades that do not readily detach from the mold (PG 46-34, 52-34, 58-34 for example). These grades should not be chilled for more than 10 minutes in a refrigerator or freezer.*
4. Direct transfer used if the binder does not easily detach from the mold at room temperature?..... \_\_\_\_\_
5. *ASTM: surface of the specimen is not trimmed?* ..... \_\_\_\_\_
6. *ASTM: Testing completed within two hours of pouring the asphalt binder into the mold?* ..... \_\_\_\_\_
- (2) Pouring approximately 15 mm [*ASTM: 15 to 20 mm*] above the surface of the removable test plate [*AASHTO: only when using a DSR designed for removal of the plates without affecting the zero setting*]? ..... \_\_\_\_\_
1. Approximately 2-mm [*ASTM: a small portion*] left uncovered around the perimeter?..... \_\_\_\_\_
2. *AASHTO: Specimen allowed to harden before plate is mounted in the DSR?*..... \_\_\_\_\_
3. *ASTM: Plate mounted in the DSR immediately?*..... \_\_\_\_\_
- Note an eye dropper or syringe may be used to transfer the hot binder to the plate.*
- (3) Direct transfer of hot binder to plates using a glass or metal rod, spatula, or similar tool? ..... \_\_\_\_\_
1. Once transferred, are the plates immediately moved together and the sample trimmed? ..... \_\_\_\_\_
- (g) Enough binder used that trimming of the specimen is required?..... \_\_\_\_\_
- (h) Excess binder trimmed flush with the plates using a heated trimming tool? ..... \_\_\_\_\_
- (i) Trimming tool neither excessively hot (burns the sample) nor too cold (snags or damages the edge)?.. \_\_\_\_\_
- (j) Immediately after trimming, test plates moved together until the gap between plates equals the test gap plus enough to create a bulge?..... \_\_\_\_\_
- (k) Gap decreased by enough to create a bulge?..... \_\_\_\_\_
- Note: Procedures to determine the appropriate gap setting can be found in the test methods.*

COMMENTS (T315/D7175):

(T315/D7175)

**DETERMINING THE RHEOLOGICAL  
PROPERTIES OF ASPHALT BINDER  
USING A DYNAMIC SHEAR RHEOMETER (DSR)**

(AASHTO T315) \_\_\_\_\_  
(ASTM D7175) \_\_\_\_\_

PROCEDURE (Continued)

Date: \_\_\_\_\_

3. Testing of Specimens

- (a) Temperature controller set to desired test temperature including any offset? ..... \_\_\_\_\_
- (1) **AASHTO:** If conducting a temperature sweep, testing started at the midrange test temperature? ..... \_\_\_\_\_
- (2) **ASTM:** If testing is to be performed at multiple temperatures, is testing started at the lowest test temperature for 25 mm plates, or the highest test temperature for 8 mm plates? ..... \_\_\_\_\_
- (b) Test temperature maintained within 0.1°C for at least 10 minutes [ASTM: 5 to 10 minutes] (may be different for different binders)? ..... \_\_\_\_\_
- Note: The method for determining the correct thermal equilibration time is described in the test methods.*
- (c) Test performed in either strain controlled or stress controlled mode? ..... \_\_\_\_\_
- (1) Strain controlled
1. Strain value determined according to the value of the complex modulus ( $G^*$ )? ..... \_\_\_\_\_
  2. Strain controlled within 20% of the target value? ..... \_\_\_\_\_
  3. When testing for compliance to Specification M320, appropriate strain value selected from Table 2? ..... \_\_\_\_\_
- (2) Stress controlled
1. Stress value determined according to the value of the complex modulus ( $G^*$ )? ..... \_\_\_\_\_
  2. Stress controlled within 20% of the target value? ..... \_\_\_\_\_
  3. When testing for compliance to Specification M320, appropriate strain value selected from Table 3? ..... \_\_\_\_\_

Table 2 – Target Strain Values		
Material	Target, %	Range, %
Original	12	9 to 15
RTFO Residue	10	8 to 12
PAV Residue	1	0.8 to 1.2

Table 3 – Target Stress Levels		
Material	Target, kPa	Range, kPa
Original	0.12	0.09 to 0.15
RTFO Residue	0.22	0.18 to 0.26
PAV Residue	50.0	40.0 to 60.0

- (d) Specimen conditioned by applying the required strain for 8 to 16 cycles at a frequency of 10 rad/s? .... \_\_\_\_\_
- (e) Test measurement obtained by recording data for an additional 8 to 16 cycles? ..... \_\_\_\_\_
- (f) Data obtained for the second 8 to 16 cycles reduced to produce a value for the  $G^*$  and phase angle? ... \_\_\_\_\_
- Multiple measurements may be obtained to verify that the sample is properly prepared.*
- See Section 11.5 for details.*
- (g) Data acquisition system automatically acquires and reduces the data when properly activated? ..... \_\_\_\_\_
- (h) When conducting tests at more than one frequency, testing started at the lowest frequency and increased? ..... \_\_\_\_\_
- (i) Testing initiated immediately after preparing and trimming the specimen? ..... \_\_\_\_\_
- (j) All testing completed within 4 hours of pouring the specimens? ..... \_\_\_\_\_

COMMENTS (T315/D7175):

(T315/D7175)

**DETERMINING THE RHEOLOGICAL  
PROPERTIES OF ASPHALT BINDER  
USING A DYNAMIC SHEAR RHEOMETER (DSR)**

(AASHTO T315) \_\_\_\_\_  
(ASTM D7175) \_\_\_\_\_

REPORTING

Date: \_\_\_\_\_

1. Interpretation of Results (Linearity)

*Note: This section is not mandatory for the laboratory assessment of the test method.*

- (a) Load or strain amplitude gradually increased (strain sweep)? ..... \_\_\_\_\_
- (b) Results obtained and plotted to define linear region? ..... \_\_\_\_\_
- (c) Graph of complex shear modulus,  $G^*$ , (kPa) vs. strain (%) generated? ..... \_\_\_\_\_
- (d) Linear region defined as 95% [ASTM: 90%] or more of zero-strain value? ..... \_\_\_\_\_

2. AASHTO Report Required Information

- (a) Identification and description of the material tested including name code, and source? ..... \_\_\_\_\_
- (b) If the stress or strain levels in tables 2 and 3 are exceeded, is that noted on the test report? ..... \_\_\_\_\_
- (c) The test plate diameter (nearest 0.1 mm)? ..... \_\_\_\_\_
- (d) The test gap (nearest 1  $\mu\text{m}$ )? ..... \_\_\_\_\_
- (e) The test temperature (nearest 0.1°C)? ..... \_\_\_\_\_
- (f) The test frequency (nearest 0.1 rad/s)? ..... \_\_\_\_\_
- (g) The strain amplitude (nearest 0.01%) or torque (nearest  $\text{mN}\cdot\text{m}$ )? ..... \_\_\_\_\_
- (h) The complex modulus ( $G^*$ ) for the 10 measurements (kPa to 3 significant figures)? ..... \_\_\_\_\_
- (i) The phase angle ( $\delta$ ) for the second ten cycles (nearest 0.1 degrees)? ..... \_\_\_\_\_
- (j)  $G^* / \sin\delta$  to the nearest 0.01 kPa or  $G^* \sin\delta$  to the nearest whole number, as appropriate? ..... \_\_\_\_\_

3. ASTM Report Required Information

- (a) Sample identification information? ..... \_\_\_\_\_
- (b) Operator's name? ..... \_\_\_\_\_
- (c) Date of Test ..... \_\_\_\_\_
- (d) Time of test? ..... \_\_\_\_\_
- (e) Test temperature (nearest 0.1 °C)? ..... \_\_\_\_\_
- (f) Temperature correction, if offset was applied (nearest 0.1 °C)? ..... \_\_\_\_\_
- (g) The complex modulus ( $G^*$ ) (kPa to 3 significant figures)? ..... \_\_\_\_\_
- (h) The phase angle (nearest 0.1 degrees)? ..... \_\_\_\_\_
- (i) For unaged and RTFO aged binders:  $G^*/\sin\delta$ ? ..... \_\_\_\_\_
- (j) For PAV aged binders:  $G^*\sin\delta$ ? ..... \_\_\_\_\_
- (k) Indicates whether the specimen passes or fails the specification? ..... \_\_\_\_\_
- (l) The strain amplitude (to 3 significant figures)? ..... \_\_\_\_\_

COMMENTS (T315/D7175):

(T315/D7175)



# **VISCOSITY DETERMINATIONS OF ASPHALT BINDER USING ROTATIONAL VISCOMETER**

(AASHTO T316)

APPARATUS

Date: \_\_\_\_\_

Manufacturer: \_\_\_\_\_ Model: \_\_\_\_\_

1. Tester
  - (a) Rotational viscometer?..... \_\_\_\_\_
  - (b) Level (both torque transducer and thermal chamber if separate)? ..... \_\_\_\_\_
  - (c) Cylindrical spindles of various sizes? ..... \_\_\_\_\_
  - (d) Capable of measuring torque?..... \_\_\_\_\_
2. Temperature Controller
  - (a) Capable of maintaining test temperatures within 1.0°C? ..... \_\_\_\_\_
  - (b) Temperature range from 60 to 165°C or greater? ..... \_\_\_\_\_
3. Calibration and Standardization
  - (a) Has accuracy of rotary transducer been checked using a certified reference fluid (Newtonian fluid) of known viscosity over full range of expected test temperatures?..... \_\_\_\_\_
    - (1) Viscosity measured within  $\pm 2$  percent of the reference fluid or rotary transducer recalibrated? ..... \_\_\_\_\_
  - (b) Has accuracy of temperature controller been checked with a NIST traceable measuring device?..... \_\_\_\_\_

PROCEDURE

1. Rotational viscometer and temperature controller turned on?..... \_\_\_\_\_
2. Sample holder, sample chamber and spindle preheated according to manufacturer's recommendation?..... \_\_\_\_\_
3. Temperature controller set to desired test temperature?..... \_\_\_\_\_
4. Required amount of asphalt binder as recommended by manufacturer heated until sufficiently fluid to pour? .... \_\_\_\_\_
5. When temperature controller reaches desired temperature, asphalt added to sample chamber? ..... \_\_\_\_\_
6. Sample chamber inserted into temperature controller unit? ..... \_\_\_\_\_
7. Preheated spindle inserted and attached using coupling?..... \_\_\_\_\_
8. Spindle gently lowered into sample?..... \_\_\_\_\_
9. Asphalt covers the upper conical portion of the spindle?..... \_\_\_\_\_
10. Asphalt brought to desired temperature within 30 minutes? ..... \_\_\_\_\_
11. Viscometer speed set to 20 rpm, display set to read Pascal seconds (Pa•s)? ..... \_\_\_\_\_
12. Sample equilibrated at desired test temperature for at least 10 minutes? ..... \_\_\_\_\_
13. Spindle rotation begun during the 10 minute equilibration period? ..... \_\_\_\_\_
14. After the asphalt has reached the specified temperature and equilibrated and once viscosity readings have stabilized, test started?..... \_\_\_\_\_
15. Viscosity measured at one minute intervals for three minutes?..... \_\_\_\_\_
16. If observed torque is out of range (check manufacturer's instructions for out of range torque) for selected spindle and speed, spindle or speed changed according to manufacturer's instructions? ..... \_\_\_\_\_
17. If a different spindle is used, the test restarted with a new sample? ..... \_\_\_\_\_
18. Viscosity is reported as average of three readings?..... \_\_\_\_\_
19. Report includes test temperature to nearest 1.0°C?..... \_\_\_\_\_

COMMENTS (T316):

(T316)

# **VISCOSITY DETERMINATION OF ASPHALT AT ELEVATED TEMPERATURES USING A ROTATIONAL VISCOMETER**

(ASTM D4402)

APPARATUS

Date: \_\_\_\_\_

Manufacturer: \_\_\_\_\_ Model: \_\_\_\_\_

1. Rotational Viscometer .....
  - (a) Capable of measuring torque required to rotate selected apparatus-measuring geometry at constant speed and temperature while submerged in asphalt. ....
  - (b) Contains Platinum Resistance Thermometer with a probe of three- or four- wire design conforming to E1137 and calibrated as a unit in accordance with E644, for calibrating the temperature controller?....
2. Apparatus-Measuring Geometry (Spindles) (may be of various shapes and sizes) .....
3. Temperature Controlled Thermal Chamber Heater .....
  - (a) Maintains sample of asphalt at the test temperature? .....
4. Sample Chamber (reusable or disposable) .....
5. Temperature Controller .....
  - (a) Capable of maintaining test temperatures within  $\pm 1.0^{\circ}\text{C}$  ( $\pm 2.0^{\circ}\text{F}$ )? .....
  - (b) Temperature range from 38 to 260°C (100 to 500°F)? .....
6. Balance readable to 0.1 g .....

*Note to Assessors: The standard lists a PRT requirement which is confusing. The requirement is actually for the PRT which is inside of the thermosel itself. Check manufacturers specifications if unsure.*

CALIBRATION AND STANDARDIZATION

1. Viscometer zeroed before use, or as needed, or both, according to manufacturer's instructions? .....
2. Accuracy of viscometer checked at least annually using a certified reference fluid of known viscosity at various temperatures, using the method described by the supplier of the reference fluid? .....
3. Reference fluid certified to be Newtonian in behavior over full range of expected test temperatures and shear rates? .....
4. Reference fluid certified at a temperature within 50°C (90°F) of the temperature(s) to be used during the test? .....
5. If measured viscosity is not within  $\pm 2\%$  of the certified value, is the viscometer recalibrated? .....
6. Accuracy and stability of temperature controller checked at least every 6 months? .....
7. Temperature checked using asphalt sample or high flash point oil equilibrated to within 50°C (90°F) of test temperature(s)? .....
8. Sample temperature measured to within  $\pm 0.1^{\circ}\text{C}$  ( $\pm 0.2^{\circ}\text{F}$ ) using NIST traceable measuring device as described in Method E644? .....
9. Temperature set point offset accordingly? .....

COMMENTS (D4402):

(D4402)

# **VISCOSITY DETERMINATION OF ASPHALT AT ELEVATED TEMPERATURES USING A ROTATIONAL VISCOMETER**

(ASTM D4402)

PROCEDURE

Date: \_\_\_\_\_

1. Manufacturer's instructions for the operation of the instrument followed?.....
  2. Instrument warmed up for at least 5 minutes before any calibrations or analyses conducted?.....
  3. Temperature controller set to desired temperature, taking into account any offset? .....
  4. Apparatus-measuring geometry selected to produce torque between 10 and 98% of instrument capacity at selected speed?.....  
Note: Measurements will generally be more accurate at higher torque readings.
  5. Preferably, sample chamber and apparatus-measuring geometry preheated until temperature has equilibrated for at least 15 min (Filled Asphalts: this is mandatory)?.....
  6. Volume of sample added to sample chamber as specified by manufacturer for apparatus-measuring geometry used (Filled Asphalts: and thoroughly stirred)? .....
  7. Sufficient sample volume to ensure measuring portion of apparatus-measuring geometry completely immersed without overfilling sample chamber? .....
  8. Manufacturer's instructions followed to ensure accurate sample volume?.....
  9. Selected apparatus-measuring geometry inserted into sample and coupled to viscometer? .....
  10. Manufacturer's instructions followed to ensure proper alignment?.....
  11. Sample brought to desired temperature within 30 min and allowed to equilibrate at the desired test temperature for at least 10 min before beginning the measurements (Filled Asphalts: and rotation started immediately)? .....
  12. Rotation started at a speed that will develop a resisting torque between 10 and 98% of the full scale instrument capacity? .....
  13. Speed maintained and sample allowed to equilibrate for an additional 5 min? .....
  14. Temperature does not deviate by more than  $\pm 1.0^{\circ}\text{C}$  ( $\pm 2.0^{\circ}\text{F}$ ) during this conditioning period?.....
  15. Viscosity or torque measured at 1-min intervals for a total of three min?.....
  16. Steps 11 through 15 repeated for each test temperature required (Filled Asphalts: A new, freshly stirred sample is required for each test temperature)?.....
  17. If torque readings are above 98% of instrument capacity at the lowest temperature either of the following performed?  
 (a) Speed of rotation increased and the test continued?.....  
 (b) Steps 5 through 15 repeated with a smaller diameter geometry and appropriate sample volume?.....
  18. If torque reading is below 10% of instrument capacity at the highest temperature either of the following performed?  
 (a) Speed of rotation increased and the test continued?.....  
 (b) Steps 5 through 15 repeated with a larger diameter geometry and appropriate sample volume?.....
  19. If viscosity units not read out directly by instrument, torque readings multiplied by the appropriate factor to obtain viscosity values? .....
  20. Arithmetic average of three readings calculated and rounded to three significant figures?.....
  21. If digital output displayed in centipoises (cP), result multiplied by 0.001 to obtain value in Pascal seconds (Pa·s)?.....
  22. For instruments that offer automation, results of a 3-min integration accepted? .....
- Note: Filled asphalts refer to asphalt with a powdered limestone additive and are used

COMMENTS (D4402):

(D4402)

**RESIDUE OF SPECIFIED PENETRATION****(D243)**APPARATUS

Date: \_\_\_\_\_

1. Heating (air) bath
  - (a) Cast iron (or equivalent)?.....
  - (b) Inner diameter or top opening 71.4 mm (2 3/16 in.)? .....
  - (c) Outer diameter of top opening 90.5 mm (3 9/16 in.)?.....
  - (d) Inner diameter of bottom opening: 84.1 mm (3 5/16 in.)?.....
  - (e) Total height: 38.1 mm (1.5 in.)? .....
  - (f) Height from top bolt shank to the bottom of the bath at least 6.4 mm (.25 in.)?.....
  - (g) Flange thickness 3.2 mm (1/8 in.)? .....
  - (h) Opening 1.6 mm (1/16 in.) larger than container? .....
2. Hot Plate
  - (a) Bunsen burner under plate on ring stand with pressure regulator?.....
  - or (b) Conventional type hot plate with rheostat? .....
3. Thermometer and Support
  - (a) ASTM 11F or 11C thermometer used?.....
  - (b) Suitable thermometer support? .....
  - (c) Thermometer equidistant from container sides? .....
  - (d) Bottom of bulb less than 6.4 mm (1/4 in.) above can bottom, but not touching can bottom either? .....
4. Container
  - (a) 70 mm diameter, 45 mm deep (6 oz. ointment box)?.....

PROCEDURE

1. Sample as received thoroughly stirred and agitated before removing test sample?.....
2. Container (6 oz. ointment box) tared? .....
3. Test sample of 100.00 ± 0.10 g weighed into container? .....
4. Container placed in air bath?.....
5. Thermometer supported centered less than 1/4 inch from bottom?.....
6. Test sample heated rapidly without foaming to 249°C (480°F)? .....
7. During evaporation, temperature maintained between 249 and 260°C (480 and 500°F)? .....
8. Sample stirred occasionally with thermometer to avoid local overheating?.....
9. All hardened bitumen fluxed during heating and stirring? .....
10. When thought that residue has reached required penetration, bitumen on thermometer that can be readily scraped off returned to container? .....
11. Container cooled and weighed?.....
12. Penetration of residue determined by D5 (AASHTO T49) using evaporation container? .....
13. If penetration of residue is greater than required, all water removed from the container and the surface of the test sample? .....
14. Steps 4 through 13 repeated until penetration of residue within 15 of 100? .....
15. Percentage of residue by weight calculated? .....
16. Reported as percentage of residue of penetration (determined), stating first the specified penetration, and second the penetration actually determined or calculated by interpolation for the sample tested? .....

COMMENTS (D3289):

(D3289)

# **SPECIFIC GRAVITY OF SEMI-SOLID AND SOLID BITUMINOUS MATERIALS BY NICKEL CRUCIBLE**

(D3289)

## APPARATUS

Date: \_\_\_\_\_

1. Crucible made of nickel, high-form, 30 mL capacity, approximately 43 mm high x 41 mm diameter [AMRL:  $\pm 2$  mm]? .....
2. Constant temperature bath:  $\pm 0.1^{\circ}\text{C}$  ( $\pm 0.2^{\circ}\text{F}$ )? .....
3. Freshly boiled distilled water? .....
4. Thermometer with graduations of at least  $0.1^{\circ}\text{C}$  ( $0.2^{\circ}\text{F}$ ) [such as ASTM 63C or 63F] or any thermometric device of equal accuracy? .....
5. Thermometer calibrated? .....
6. 600 mL Griffin low-form beaker? .....
7. Balance, Class B (0.001 g)? .....
8. Basket for suspending crucible from balance? .....
9. Pan straddle? .....

## PROCEDURE

1. Basket Preparation
  - (a) Crucible placed in wire basket? .....
  - (b) Basket suspended from arm of balance? .....
  - (c) Weight of empty crucible + basket in air ( $W_1$ ) determined to 0.001 g? .....
  - (d) Beaker filled with distilled water and placed on pan straddle? .....
    - (1) Freshly boiled distilled water? .....
    - (2) Water temperature  $25 \pm 1^{\circ}\text{C}$ ,  $15.0 \pm 1^{\circ}\text{C}$ , or  $15.6 \pm 1^{\circ}\text{C}$ ? .....
    - (3) 600 mL Griffin low-form beaker? .....
  - (e) Basket containing crucible suspended from balance arm so that crucible immersed in water? .....
  - (f) Weight of empty crucible + basket immersed in water determined ( $W_2$ )? .....
  - (g) Crucible removed from basket and dried? .....
2. Specimen Preparation
  - (a) Materials melted:
    - (1) Temperature no more than  $55^{\circ}\text{C}$  or  $100^{\circ}\text{F}$  above the softening point for tar? .....
    - (2) Temperature no more than  $110^{\circ}\text{C}$  or  $200^{\circ}\text{F}$  above the softening point for asphalt? .....
    - (3) Heated no more than 30 minutes? .....
  - (b) Crucible heated:
    - (1) In oven for 10 minutes? .....
    - (2) Oven at  $120^{\circ}\text{C}$  ( $250^{\circ}\text{F}$ )? .....
  - (c) Crucible nearly filled with melted material? .....
  - (d) Sample cooled to ambient temperature for at least 40 minutes? .....
3. Weighing
  - (a) Steps 1(b) - 1(d) performed? .....
  - (b) Weight of sample + crucible + basket in air determined ( $W$ )? .....
  - (c) Weight of sample + crucible + basket immersed in water determined ( $W_3$ )? .....
    - (1) Sample in crucible tempered for at least 30 minutes in water bath at  $25 \pm 1^{\circ}\text{C}$ ,  $15.0 \pm 1^{\circ}\text{C}$ , or  $15.6 \pm 1^{\circ}\text{C}$ ? .....
    - (2) Weighed in bath in 600 mL Griffin low-form beaker? .....
    - (3) Freshly boiled distilled water? .....
    - (4) Water temperature  $25 \pm 0.1^{\circ}\text{C}$ ,  $15.0 \pm 0.1^{\circ}\text{C}$ , or  $15.6 \pm 0.1^{\circ}\text{C}$ ? .....
4. Calculation
  - (a) Sp. Gr. =  $(W - W_1) / [(W - W_1) - (W_3 - W_2)]$ ? .....

COMMENTS (D3289):

(D3289)

# TOUGHNESS AND TENACITY OF BITUMINOUS MATERIALS

(D5801)

## APPARATUS

Date: \_\_\_\_\_

Tension Head	1	2	3	4	5	6
Polished metal, hemispherical head?						
Radius 11 mm (7/16 in.)?						
Stem diameter 6.4 mm (1/4 in.)?						
Stem length approximately 33 mm (1 5/16 in.) [AMRL: $\pm 3$ mm]						
Threaded and fitted with a lowering screw?						
Fitted with a small pin?						
Spider						
Stem moves freely and parallel to the axis?						
Groove for the pin on the stem?						
Three equidistant and notched arms?						

1. Container
  - (a) 55 mm diameter, 35 mm deep (3-oz ointment box)? .....
2. Testing Machine
  - (a) Maker : .....
  - (b) Serial Number (or other ID): .....
  - (c) Capable of maintaining a rate of 50 cm/min. (20in./min) to within 2%? .....
  - (d) Capable of recording the force vs. elongation curve? .....
  - (e) Maximum capacity of at least 45 kg (100 lb) (Polymer modified asphalts: 90 kg (200 lb))? .....
  - (f) Holds the sample container firmly in place? .....
  - (g) Minimum effective pull length of 61 cm (24 in.) after installing the sample holder? .....
3. Water Bath
  - (a) Maker: .....
  - (b) Capable of maintaining a temperature at  $25 \pm 0.1^\circ\text{C}$  ( $77 \pm 0.18^\circ\text{F}$ )? .....
  - (c) Perforated shelf not less than 50 mm (2 in.) from the bottom of the bath? .....
  - (d) Perforated shelf not less than 100 mm (4 in.) below the liquid level? .....
4. Oven capable of maintaining temperature at  $163 \pm 5.5^\circ\text{C}$  ( $325 \pm 10^\circ\text{F}$ )? .....
5. Thermometer
  - (a) ASTM 63C or 63F? .....  
Note: If a  $77^\circ\text{F}$  ( $25^\circ\text{C}$ ) penetration bath is used, any thermometer or thermometric device with  $0.1^\circ\text{C}$  ( $0.2^\circ\text{F}$ ) subdivisions may be used
  - (b) Calibrated? .....

COMMENTS (D5801):

(D5801)

# TOUGHNESS AND TENACITY OF BITUMINOUS MATERIALS

(D5801)

## PROCEDURE

Date: \_\_\_\_\_

1. Sample Preparation
  - (a) Heated in loosely covered container in an oven at 163° C (325° F)?.....
  - (1) Uniform temperature and sufficiently fluid to pour? .....
  - (2) Local overheating prevented?.....
  - (b) Sample stirred without incorporating air bubbles?.....
  - (c) 36 ± 0.5 g poured into each of three sample containers? .....
  - (d) Tension head mounted in spider and immediately placed in each container? .....
  - (e) Tension head lowered until asphalt level is approximately 1 mm below diameter of the head? .....
  - (f) Container, tension head, and spider assemblies placed in a 163° C (325°F) oven for 15 minutes? .....
  - (g) Containers removed and tension heads lowered until the asphalt is level with the diameter of the head? .....
  - (h) Cooled at room temperature for 75 ± 5 minutes?.....
  - (i) Placed in a 25° C (77° F) water bath for 75 ± 5 minutes?.....
  
2. Toughness and Tenacity Test
  - (a) Chart pen zeroed and testing machine prepared? .....
  - (b) Sample container removed from water bath and immediately placed in testing machine? .....
  - Note: The centering spider may be removed before the sample is placed in the machine
  - (c) Room temperature at 25 ± 3° C (77 ± 5° F)? .....
  - (d) Transfer time less than 3 minutes? .....
  - Note: Water may be left in the container to prevent surface cooling
  - (e) Tension head pulled from the sample at 50 cm/min. (20 in/min.)? .....
  - (f) Force vs. elongation curve recorded?.....
  - (g) Test continued until one of the following?.....
    - (1) Asphalt column breaks? .....
    - (2) Force returns to zero? .....
    - (3) Extension limit of the machine is reached?.....
  
3. Report
  - (a) Three values averaged (Newton-meters or inch-pounds) for toughness and tenacity?.....
  - (b) If one breaks prematurely, that sample is considered invalid and the two valid values are averaged? .....
  - Note: Toughness is calculated as the complete area under the curve before the end of the test (total work required to separate the specimen). Tenacity is calculated as the area under the curve excluding the initial resistance (work required to stretch the specimen after the initial resistance is overcome.)

COMMENTS (D5801):

(D5801)

**MULTIPLE STRESS CREEP AND RECOVERY (MSCR) OF  
ASPHALT BINDER USING A DYNAMIC SHEAR RHEOMETER**

**(D7405)**APPARATUS

Date: \_\_\_\_\_

1. Apparatus and materials for running ASTM test method D7175? .....
2. Manufacturer-supplied certificate stating that full torque is achieved within 0.003 seconds from the start of the loading cycle? .....

PROCEDURESample Preparation

1. Samples prepared in accordance with ASTM D7175? .....
- Note: This test may be run on a specimen previously used for ASTM D7175.*

Procedure

1. Specimen allowed to reach thermal equilibrium at the desired test temperature as in ASTM D7175? .....
  2. If the specimen was previously used for ASTM D7175, allowed to remain unloaded for at least 1 minute before starting the creep recovery test? .....
  3. Specimen loaded at a constant creep stress of 0.100 kPa for 1.00 seconds? .....
  4. Creep cycle reaches full torque achieved within 0.003 seconds from the start of the cycle? .....
  5. After creep stress is applied, specimen is allowed to recover (zero stress) for 9.00 seconds? .....
  6. Stress and strain recorded at least every 0.10 seconds during the creep cycle? .....
  7. Stress and strain recorded at least every 0.45 seconds during the recovery cycle? .....
  8. One of the following:
    - (a) Data points at 1.00 and 10.00 seconds explicitly recorded? .....
    - (b) DSR software extrapolates prior data to determine the strain value at the required time? .....
  9. If data points are extrapolated, data shall include a measured data point no more than 0.05 s prior to 1.00 seconds, and no more than 0.30 seconds prior to 10.00 seconds? .....
  10. Creep and recovery cycle described above repeated nine more times? .....
  11. No rest period allowed between cycles? .....
  12. Ten more creep and recovery cycles repeated at a load of 3.200 kPa? .....
  13. No rest period allowed between 0.100 kPa and 3.200 kPa loading cycles? .....
  14. For each of the twenty loading cycles, is the following recorded? .....
- (a) Initial strain value at the beginning of the creep portion of each cycle (denoted  $\epsilon_0$ )? .....
  - (b) Strain value at the end of the creep portion (after 1.0 s) of each cycle (denoted  $\epsilon_c$ )? .....
  - (c) The adjusted strain value at the end of the creep portion (after 1.0 s) of each cycle ( $\epsilon_1 = \epsilon_c - \epsilon_0$ )? .....
  - (d) The strain value at the end of the recovery portion (after 10.0 s) of each cycle (denoted  $\epsilon_r$ )? .....
  - (e) The adjusted strain value at the end of the recovery (after 10.0 s) of each cycle ( $\epsilon_{10} = \epsilon_r - \epsilon_0$ )? .....

COMMENTS (D7405):

(D7405)



**MULTIPLE STRESS CREEP AND RECOVERY (MSCR) OF  
ASPHALT BINDER USING A DYNAMIC SHEAR RHEOMETER**

**(D7405)**PROCEDURE (Continued)

Date: \_\_\_\_\_

Calculations - are the following calculations done according to the test method?.....

1. Percent recovery for each of the ten cycles at 0.100 kPa ( $\epsilon_r(100, N)$ )? .....
2. Percent recovery for each of the ten cycles at 3.200 kPa ( $\epsilon_r(3200, N)$ )? .....
3. Average percent recovery at 0.100 kPa ( $R_{100}$ )? .....
4. Average percent recovery at 3.200 kPa ( $R_{3200}$ )? .....
5. Percent difference in recovery between 0.100 kPa and 3.200 kPa ( $R_{diff}$ )? .....
6. Non-recoverable creep compliance ( $J_{nr}(100, N)$ ) for each of the ten cycles at 0.100 kPa? .....
7. Non-recoverable creep compliance ( $J_{nr}(3200, N)$ ) for each of the ten cycles at 3.200 kPa? .....
8. Average non-recoverable creep compliance at 0.100 kPa ( $J_{nr100}$ )? .....
9. Average non-recoverable creep compliance at 3.200 kPa ( $J_{nr3200}$ )? .....
10. Percent difference in non-recoverable creep compliance between 0.100 kPa and 3.200 kPa ( $J_{nr-diff}$ )? .....

Report - does report include the following information?

1. Sample identification information? .....
2. Test temperature, to the nearest 0.1°C? .....
3. Average percent recovery at 0.100 kPa,  $R_{100}$ , to the nearest 0.1%? .....
4. Average percent recovery at 3.200 kPa,  $R_{3200}$ , to the nearest 0.1%? .....
5. Percent difference between average recovery at 0.100 kPa and 3.200 kPa,  $R_{diff}$ , to the nearest 0.1%? .....
6. Non-recoverable creep compliance at 0.100 kPa,  $J_{nr100}$ , to three significant figures? .....
7. Non-recoverable creep compliance at 3.200 kPa,  $J_{nr3200}$ , to three significant figures? .....
8. Percent difference between non-recoverable creep compliance at 0.100 kPa and 3.200 kPa,  $J_{nr-diff}$ , to nearest 0.1%? .....

COMMENTS (D7405):

(D7405)



**SOLUBILITY OF ASPHALT MATERIALS IN N-PROPYL BROMIDE****(D7553)**APPARATUS

Date: \_\_\_\_\_

1. Gooch Crucibles
  - (a) Glazed surface throughout except bottom exterior unfinished? .....
  - (b) Approximately 44 mm at the top tapering to 36 mm at the bottom [AMRL:  $\pm 2$  mm]? .....
  - (c) Approximate depth of 20 to 30 mm? .....
2. Filtration Assembly
  - (a) Heavy walled filter flask with side tube, capacity 250 to 500 mL? .....  
**Note:** any other assemblies permitting vacuum filtration with a Gooch crucible may be used.
  - (b) Glass fiber pads with a diameter of 32 to 34 mm, fine porosity, fast flow rate,  
 1.5  $\mu$ m particle retention? .....
3. Suction Assembly
  - (a) Satisfactory assembly? .....
4. N-Propyl Bromide Solvent
  - (a) N-Propyl Bromide, Technical grade (conforming to ASTM D6368)? .....
5. Desiccator
  - (a) Satisfactory design and charged with effective desiccant? .....
6. Drying Oven
  - (a) Maintains temperature at  $110 \pm 5^\circ\text{C}$  ( $230 \pm 9^\circ\text{F}$ )? .....
7. Miscellaneous Items
  - (a) Suitable container for weighing and dissolving sample? .....
  - (b) Class A balance (readable to 0.0001 g) available? .....
  - (c) Policeman (optional)? .....

PREPARATION OF THE GOOCH CRUCIBLE

1. New filter pad placed in crucible and dried in oven at  $110 \pm 5^\circ\text{C}$  for 15 min  
 (no wetting and seating required)? .....
2. Cooled in a desiccator for  $30 \pm 5$  and weighed to the nearest 0.0001 g? .....
3. Stored in a desiccator until ready to use? .....

COMMENTS (D7553):

(D7553)

**SOLUBILITY OF ASPHALT MATERIALS IN N-PROPYL BROMIDE****(D7553)**PROCEDURE

Date: \_\_\_\_\_

1. If the sample is not fluid is it heated with care to prevent local overheating? .....
2. Sample stirred occasionally and the entrapment of air avoided?.....
3. Sample heated at any temperature not more than 100°C above softening point? .....
4. Approximately 2 g [AMRL:  $\pm 0.5$  g] of sample placed in tared (nearest 0.001 g) container? .....
5. Container with sample allowed to cool and then weighed to nearest 1 mg (0.001 g)? .....
6. 100 mL of solvent added to container, flask stoppered, and then container agitated as necessary until the sample is dissolved? .....
7. Solvent added in small portions with constant agitation?.....
8. Lumps completely digested and container sides free of undissolved sample? .....
9. Container stoppered and set aside for at least 15 min?.....
- Note:** for referee testing, flask and solution shall be placed in a water bath at  $38.0 \pm 0.3^\circ\text{C}$  for 1 hour before filtering. Please discuss with laboratory if necessary.
10. Crucible placed in filter tube and wetted?.....
11. Asphalt solution decanted through filter with light suction? .....
12. If insoluble matter is visible:
  - (a) Retained in container until solution has drained through filter?.....
  - (b) Container washed with solvent and insoluble matter transferred to crucible?.....
  - (c) Container and policeman (if used) rinsed?.....
  - (d) Insoluble matter washed until the filtrate is substantially colorless?.....
  - (e) Strong suction applied to remove remaining solvent?.....
13. Crucible removed and bottom washed free of dissolved matter? .....
14. Placed in oven at  $110 \pm 5^\circ\text{C}$  for at least 20 min? .....
15. Cooled in desiccator for  $30 \pm 5$  min and then weighed to nearest 0.0001 g? .....
16. Steps (14) and (15) repeated until constant mass of  $\pm 0.0003$  g obtained? .....
17. Percent insoluble reported to nearest 0.1%? .....
18. If percent insoluble is less than 1%, reported to nearest 0.01%?.....
19. If the crucible in desiccator must be left overnight, is it placed in oven for 30 min. and then cooled again in desiccator?.....

COMMENTS (D7553):

(D7553)

## DETERMINING THE CONTINUOUS GRADING TEMPERATURES AND CONTINUOUS GRADES FOR PG GRADED ASPHALT BINDERS

(D7643)

### APPARATUS

Date: \_\_\_\_\_

1. Equipment for at least one of the following: .....  
 (a) Method D7175 (Dynamic Shear Rheometer)  
**or** (b) Method D6648 (Bending Beam Rheometer)
2. Other equipment as required: .....  
 (a) Method D2872 (Rolling Thin-Film Oven)  
 (b) Method D6763 (Pressurized Aging Vessel)

### PROCEDURE

1. Two temperatures determined ( $T_1$  and  $T_2$ ) for each specification property where a  $T_C$  is to be calculated? .....  
 (a) The difference between the two temperatures is  $6^\circ\text{C}$ ?  
 (b) The two temperatures bracket the specification requirements?

**Note:** For example: A PG 64-XX tested for  $G^*/\sin\delta$  at  $64^\circ\text{C}$  and  $70^\circ\text{C}$  may give test results of 1.86 and 0.89 kPa respectively. These results bracket the specification requirement, 1.00kPa.

2. If the result of the applicable specification provides a temperature rather than a limiting property value, the temperature used as the continuous grading temperature? .....  
 (This only applies to values such as  $T_{CR}$  from Specification D6373, Table 2, where the value is calculated directly)

#### Performing Interpolation to Determine Continuous Grading Temperatures (all properties except m-value)

3. The interpolation for each of the properties calculated using linear relationship using formula below?.....

$$T_C = T_1 + [(\log_{10}(P_S) - \log_{10}(P_1)) / (\log_{10}(P_2) - \log_{10}(P_1))] * (T_2 - T_1)$$

#### Performing Interpolation to Determine Continuous Grading Temperatures (m-value only)

4. The interpolation for each of the properties calculated using arithmetic scale using formula below?.....

$$T_C = T_1 + [(P_S P_1) / (P_2 - P_1)] * (T_2 - T_1)$$

**Note:** Retain negative signs for temperatures below  $0^\circ\text{C}$ .

**Note:** Because the properties are a non-linear function of temperature, linear interpolation results in a slight error in the estimated values of  $T_C$ .

$T_C$  = Continuous grading temperature,  $^\circ\text{C}$

$T_1$  = Lower of the two test temperatures,  $^\circ\text{C}$

$P_S$  = Specification requirement for property in question; determined at the respective PG grading temperature for the respective property

$P_1$  = Test result for the specification property in question at  $T_1$

$P_2$  = Test result for the specification property in question at  $T_2$

$T_2$  = Higher of the two test temperatures

COMMENTS (D7643):

(D7643)