MIXING AND COMPACTION TEMPERATURE OF ASPHALT CEMENTS

1.0 SCOPE

1.1 This test method describes the procedures used to determine mixing and compaction temperatures for bituminous mixtures using penetration grade asphalt cements and to be used for laboratory mix designs using the Marshall or Superpave mix design methods.

1.2 For performance grade asphalt cements, the supplier's recommended mixing and compaction temperatures are to be used.

1.3 For penetration-viscosity grade asphalt cements, the mixing temperature is defined as the temperature where the asphalt cement will attain a viscosity of 170 mm^2/s. At this temperature the asphalt should provide complete coverage of the aggregate at the lowest possible temperature. The compaction temperature is defined as the temperature where the asphalt cement will attain a viscosity of 280 mm^2/s. The bituminous mixture immediately prior to compaction with the Marshall apparatus shall be at the compaction temperature.

2.0 APPLICABLE DOCUMENTS

2.1 ASTM D2170 Standard Test Method for Kinematic Viscosity of Asphalts

2.2 ASTM D2171 Standard Test Method for Viscosity of Asphalts by Capillary Viscometer

2.3 ASTM D70 Standard Test Method for Specific Gravity and Density of Semi-Solid Bituminous Materials

2.4 ASTM D4311 Standard Test Method for Determining Asphalt Volume Correction to a Base Temperature

3.0 PROCEDURE

3.1 Determine kinematic viscosity in mm^2/s at 135ºC (ASTM D2170).

3.2 Determine absolute viscosity in Pa.s at 60ºC (ASTM D2171).

3.3 Determine specific gravity at 15.6ºC (ASTM D70).

3.4 Convert the absolute viscosity at 60ºC (in Pa.s) to viscosity at 60◦C (in mm^2/s) by using the following formulas:

$$specific\ gravity\ @\ 15.6°C\ x\ 0.970 = specific\ gravity\ @\ 60°C$$

$$\frac{Pa.s\ x\ 10}{specific\ gravity @ 60°C} x\ 100 = Visc. @ 60°C, mm^2/s\ (cSt)$$

4.0 CALCULATIONS

4.1 Determine mixing and compaction temperatures using the following formula:

$$Compaction\ Temperature = 60 - \frac{(Log\ visc. @\ 60°C - Log\ 280)}{m}$$

$$Mixing\ Temperature = 60 - \frac{(Log\ visc. @\ 60°C - Log\ 170)}{m}$$

$$m = \frac{(Log\ visc. @\ 60°C - Log\ kin. visc. @\ 135°C)}{(60 - 135)}$$

Note: Both the kinematic and absolute viscosities must be in mm^2/s.

4.2 Conversely, the mixing and compaction temperatures can be determined graphically. Plot the value for kinematic viscosity (mm^2/s at 135ºC) and the absolute viscosity (mm^2/s, 60ºC) on the ASTM Kinematic Viscosity vs. Temperature data chart (see attached). Draw a straight line through these two points. The temperature at which the line crosses 280 mm^2/s is the compaction temperature, and the temperature at which the line crosses 170 mm^2/s is the mixing temperature.

5.0 REPORT

5.1 Report the mixing and compaction temperatures for mix design purposes to the nearest degree C.

Example:
Absolute Viscosity @ 60°C: 77.6 Pa.s
Specific Gravity @ 15.6 °C: 1.037
Kinematic Viscosity @ 135°C: 250 mm^2/s

- Calculate Absolute Viscosity @ 60°C = 77,146 mm^2/s
- Plot viscosities in mm^2/s at 60°C and 135°C
- Draw line and determine compaction (at 280 mm^2/s) and mixing (mm^2/s) temperatures

Mixing and Compaction Temperatures