Performance Grades

Max. Design Temp.	PG 46			PG 52							PG 58					PG 64						PG 70						PG 76					PG 82				
Min. Design Temp.	-34	-40	-46	-10	-16	-22	-28	-34	-40	-46	-16	-22	-28	-34	-40	-10	-16	-22	-28	-34	-40	-10	-16	-22	-28	-34	-40	-10	-16	-22	-28	-34	-10	-16	-22	-28	-34
Original																																					
≥230 °C	**Flash Point**																																				
≤ 3 Pa-s @ 135 °C	**Rotational Viscosity**																																				
≥ 1.00 kPa	**DSR G*/sin δ** (Dynamic Shear Rheometer)																																				
	46			52							58					64						70						76					82				
(Rolling Thin Film Oven) RTFO, Mass Change ≤ 1.00%																																					
≥ 2.20 kPa	**DSR G*/sin δ** (Dynamic Shear Rheometer)																																				
	46			52							58					64						70						76					82				
(Pressure Aging Vessel) PAV																																					
20 hours, 2.10 MPa	90			90							100					100						100(110)						100(110)					100(110)				
≤ 5000 kPa	**DSR G*sin δ** (Dynamic Shear Rheometer) Intermediate Temp. = [(Max. + Min.)/2] + 4																																				
	10	7	4	25	22	19	16	13	10	7	25	22	19	16	13	31	28	25	22	19	16	34	31	28	25	22	19	37	34	31	28	25	40	37	34	31	28
S ≤ 300 MPa m ≥ 0.300	**BBR S (creep stiffness) & m-value** (Bending Beam Rheometer)																																				
	-24	-30	-36	0	-6	-12	-18	-24	-30	-36	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	0	-6	-12	-18	-24
If BBR m-value ≥ 0.300 and creep stiffness is between 300 and 600, the Direct Tension failure strain requirement can be used in lieu of the creep stiffness requirement.																																					
ε_f ≥ 1.00%	**DTT** (Direct Tension Tester)																																				
	-24	-30	-36	0	-6	-12	-18	-24	-30	-36	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	0	-6	-12	-18	-24

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Flash Point

Used to determine the temperature at which asphalt binder fumes first may flash or spark. For common paving asphalt binders, this temperature is usually 230°C or higher. May also be used to determine the fire point (temperature at which the asphalt binder ignites and burns).

Rotational Viscosity

Used to measure viscosity (kinematic) at high temperatures (i.e., 135°C). Used in mix designs to provide representative temperatures for mixing and compaction of asphalt mixtures. Operates as a rotating cylinder within a fixed sample cylinder (within a thermal-controlled chamber). Resistance to flow is measured as the torque applied to a spring and converted to viscosity.

Dynamic Shear Rheometer

Also known as an oscillatory shear rheometer. Is used to measure the flow properties of liquid asphalt binders at intermediate (i.e., 20°C) to high (i.e., 64°C) temperatures. Works by applying a sinusoidal shear stress to produce a resulting shear strain. The complex shear modulus (G*) is a ratio of the applied shear stress (τ) to the resulting shear strain (γ). The phase angle, δ , (related to the time lag between input and output signals) provides a relative indication of the viscous and elastic behavior of the asphalt binder. Materials with a phase angle of 90 degrees are completely viscous; while materials with a phase angle of 0 degrees are completely elastic. At intermediate temperatures, such as 20°C, asphalt binders are said to be viscoelastic (phase angle near 45 degrees).

Rolling Thin Film Oven

The RTFO simulates the aging that occurs in an HMA mixing facility as thin films of binder are exposed to heat and air. A sample is poured into a cylindrical bottle and rotated horizontally at 163°C. As the bottle rotates and air is blown over the sample, new thin films are exposed simulating the binder coating on the aggregate during mixing. Lighter oils are driven off and some oxidation occurs. A mass change determination is made and because RTFO-aged asphalt binder is approximately 2-3 times the viscosity of the unaged asphalt binder, it is tested to determine whether the desirable viscoelastic properties have been maintained.

Pressure Aging Vessel

One of the limitations of some of the older grading systems is the inability to simulate actual aging conditions of asphalt binder as it goes through production, mixing placement and, particularly, long-term aging. After mixing and placement, further oxidation will occur over the service life of the pavement. The PAV was refined during the Strategic Highway Research Program (SHRP) to subject asphalt binders to the long-term aging expected after approximately 5-15 years of service in an asphalt pavement. Asphalt binders are exposed to high temperature (usually 100°C) and air pressure (2.10 MPa) for 20 hours to simulate long-term aging.

Bending Beam Rheometer

Used to measure the flow properties of liquid asphalt binders at low (i.e., -12°C) temperatures. Is analogous to the DSR which is not used at low temperatures because of the torque capability of the equipment. Operates on engineering beam principles. A fixed static load is applied to an asphalt binder beam of known dimensions. The resulting deflection is measured and the flexural stiffness reported as a function of time. Provides an indication of the low temperature stiffness and cracking potential of an asphalt binder.

Direct Tension Tester

Used to measure failure properties of an asphalt binder at low (i.e., -12°C) temperatures. Provides an indication of the failure stress and strain of an asphalt binder. The Direct Tension Test may be used as a referee test when the m-value from BBR results passes but the estimated stiffness fails and is between 300 and 600 MPa. If the average strain value from the DTT was 1% or more, it could be assumed the binder was sufficiently elastic at the tested low temperature to meet the requirements of the low temperature grade. More recently, the Direct Tension is being implemented as one test in the determination of low temperature critical cracking. Data from the DT and BBR tests are used with commercially available software to estimate the critical cracking temperature (CCT) of an asphalt binder.

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