

Appendix A

Standard Specification for Performance Graded Asphalt Binder

AASHTO Designation: MP1-98^{1,2}

1. Scope. This specification covers asphalt binders graded by performance. Grading designations are related to the average 7-day maximum pavement design and minimum pavement design temperatures.

Note 1 -- For asphalt cements graded by penetration at 25°C, see M20. For asphalt cements graded by viscosity at 60°C, see M226.

Note 2 -- Guide PP5 provides information on the evaluation of modified asphalt binders.

Note 3 -- Guide PP6 provides information for determining the performance grade of an asphalt binder.

2. Referenced Documents

2.1 AASHTO Standards:

MP2	Specification for Superpave Volumetric Mix Design
MP3	Superpave Software . Volumetric Mix Design TP1 Determining the Flexural Creep Stiffness Of Asphalt Binder Using the Bending Beam Rheometer (BBR)
TP3	Determining the Fracture Properties of Asphalt Binder in Direct Tension (DT)
TP5	Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)
PP5	Laboratory Evaluation of Modified Asphalt Systems
PP6	Grading or Verifying the Performance Grade of an Asphalt Binder
PP28	Designing Superpave HMA
M20	Specification for Penetration Graded Asphalt Cement

M226	Specification for Viscosity Graded Asphalt Cement
PPI	Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)
T40	Sampling Bituminous Materials
T44	Solubility of Bituminous Materials in Organic Solvents
T48	Flash and Fire Points by Cleveland Open Cup
T55	Water in Petroleum Products and Bituminous Materials
T201	Kinematic Viscosity of Asphalts
T202	Viscosity of Asphalts by Vacuum Capillary Viscometer
T240	Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin Film Oven Test)

2.2 ASTM Standards:

D8	Standard Definitions of Terms Relating to Materials for Roads and Pavements
D5546	Standard Test Method for Solubility of Polymer Modified Asphalt Materials in 1,1,1, Trichloroethane
D4402	Viscosity Determinations of Unfilled Asphalt Using the Brookfield Thermosel Apparatus

3. Terminology

3.1 Definitions

3.1.1 Definitions for many terms common to asphalt cement are found in ASTM D8.

3.1.2 asphalt binder -- an asphalt-based cement that is produced from petroleum residue either with or without the addition of non-particulate organic modifiers.

¹This standard is based on SHRP Product 1001.

² Approved in October 1993, this provisional standard was first published in January 1994.

4. Ordering Information - When ordering under this specification, include in the purchase order the performance grade of asphalt binder required from Table 1 (e.g. PG 52-16 or PG 64-34).

4.1 Asphalt binder grades may be selected by following the procedures described in MP2 and PP28.

5. Materials and Manufacture

5.1 Asphalt cement shall be prepared by the refining of crude petroleum by suitable methods, with or without the addition of modifiers.

5.2 Modifiers may be any organic material of suitable manufacture, used in virgin or recycled condition, and that is dissolved, dispersed or reacted in asphalt cement to enhance its performance.

5.3 The asphalt binder shall be homogeneous, free from water and deleterious materials, and shall not foam when heated to 175 °C.

5.4 The asphalt binder shall be at least 99.0 percent soluble as determined by T44 or D5546.

5.4 This specification is not applicable for asphalt binders in which fibers or other discrete particles are larger than 250 µm in size.

5.4 The grades of asphalt binder shall conform to the requirements given in Table 1.

6. Sampling - The material shall be sampled in accordance with Method T 40.

7. Test Methods - The properties outlined in 5.3, 5.4 and 5.6 shall be determined in accordance with T44, T48, T55, T240, PPI, TP1, TP3, TP5 and ASTM D4402.

8. Inspection and Certification - Inspection and certification of the material shall be agreed upon between the purchaser and the seller. Specific requirements shall be made part of the purchase contract. The seller shall provide material handling and storage procedures to the purchaser for such asphalt binder grade certified.

9. Rejection and Rehearing - If the results of any test do not conform to the requirements of this specification, retesting to determine conformity is performed as indicated in the purchase order or as otherwise agreed upon between the purchaser and the seller.

10. Key Words - Asphalt binder, asphalt cement, modifier, performance specifications, rheology, direct tension, pressure aging, flash point.

Table 1. Performance Graded Asphalt Binder Specification

PERFORMANCE GRADE	PG 46			PG 52						PG 58					PG 64						
	34	40	46	10	16	22	28	34	40	46	16	22	28	34	40	10	16	22	28	34	40
Average 7-day Maximum Pavement Design Temperature, °C*	<46			<52						<58					<64						
Minimum Pavement Design Temperature, °C*	>-34	>-40	>-46	>-10	>-16	>-22	>-28	>-34	>-40	>-46	>-16	>-22	>-28	>-34	>-40	>-10	>-16	>-22	>-28	>-34	>-40
ORIGINAL BINDER																					
Flash Point Temp, T48: Minimum °C	230																				
Viscosity, ASTM D4402: ^b Maximum, 3 Pa·s, Test Temp, °C	135																				
Dynamic Shear, TP5: ^c G'/sinδ ^d , Minimum, 1.00 kPa Test Temp @ 10 rad/s, °C	46			52						58					64						
ROLLING THIN FILM OVEN RESIDUE (T240)																					
Mass Loss, Maximum, percent	1.00																				
Dynamic Shear, TP5: ^c G'/sinδ ^d , Minimum, 2.20 kPa Test Temp @ 10 rad/s, °C	46			52						58					64						
PRESSURE AGING VESSEL RESIDUE (PPI)																					
PAV Aging Temperature, °C ^d	90			90						100					100						
Dynamic Shear, TP5: ^c G'/sinδ ^d , Maximum, 5000 kPa Test Temp @ 10 rad/s, °C	10	7	4	25	22	19	16	13	10	7	25	22	19	16	13	31	28	25	22	19	16
Physical Hardening ^e	Report																				
Creep Stiffness, TP1: ^f S, Maximum, 300 MPa, m - value, Minimum, 0.300 Test Temp @ 60s, °C	-24	-30	-36	0	-6	-12	-18	-24	-30	-36	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	-30
Direct Tension, TP3: ^f Failure Strain, Minimum, 1.0% Test Temp @ 1.0 mm/min, °C	-24	-30	-36	0	-6	-12	-18	-24	-30	-36	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	-30

- * Pavement temperatures are estimated from air temperatures using an algorithm contained in the LTPP Bind program, may be provided by the specifying agency, or by following the procedures as outlined in MP2 and PP28.
- ^b This requirement may be waived at the discretion of the specifying agency if the supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet all applicable safety standards.
- ^c For quality control of unmodified asphalt cement production, measurement of the viscosity of the original asphalt cement may be used to supplement dynamic shear measurements of G'/sinδ at test temperatures where the asphalt is a Newtonian fluid.
- ^d The PAV aging temperature is based on simulated climatic conditions and is one of three temperatures 90°C, 100°C or 110°C. The PAV aging temperature is 100°C for PG 58- and above, except in desert climates, where it is 110°C.
- ^e Physical Hardening — TP1 is performed on a set of asphalt beams according to Section 13.1, except the conditioning time is extended to 24 hrs ± 10 minutes at 10°C above the minimum performance temperature. The 24-hour stiffness and m-value are reported for information purposes only.
- ^f If the creep stiffness is below 300 MPa, the direct tension test is not required. If the creep stiffness is between 300 and 600 MPa the direct tension failure strain requirement can be used in lieu of the creep stiffness requirement. The m-value requirement must be satisfied in both cases.
- ^g G'/sinδ = high temperature stiffness and G^{*}sinδ = intermediate temperature stiffness

**Table 1. Performance Graded Asphalt Binder Specification
(Continued)**

PERFORMANCE GRADE	PG 70						PG 76						PG 82					
	10	16	22	28	34	40	10	16	22	28	34	10	16	22	28	34		
Average 7-day Maximum Pavement Design Temp, °C ^b	< 70						< 76						< 82					
Minimum Pavement Design Temperature, °C ^b	> -10	> -16	> -22	> -28	> -34	> -40	> -10	> -16	> -22	> -28	> -34	> -10	> -16	> -22	> -28	> -34		
ORIGINAL BINDER																		
Flash Point Temp, T48: Minimum °C	230																	
Viscosity, ASTM D4402: ^b Maximum, 3 Pa·s, Test Temp, °C	135																	
Dynamic Shear, TP5: ^c G'/sinδ, Minimum, 1.00 kPa Test Temp @ 10 rad/s, °C	70						76						82					
ROLLING THIN FILM OVEN RESIDUE (T240)																		
Mass Loss, Maximum, percent	1.00																	
Dynamic Shear, TP5: ^c G'/sinδ, Minimum, 2.20 kPa Test Temp @ 10 rad/s, °C	70						76						82					
PRESSURE AGING VESSEL RESIDUE (PPI)																		
PAV Aging Temperature, °C ^d	100(110)						100(110)						100(110)					
Dynamic Shear, TP5: ^c G'/sinδ, Maximum, 5000 kPa Test Temp @ 10 rad/s, °C	34	31	28	25	22	19	37	34	31	28	25	40	37	34	31	28		
Physical Hardening ^e	Report																	
Creep Stiffness, TP1: ^f S, Maximum, 300.0 MPa, m - value, Minimum, 0.300 Test Temp @ 60s, °C	0	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	0	-6	-12	-18	-24		
Direct Tension, TP3: ^f Failure Strain, Minimum, 1.0% Test Temp @ 1.0 mm/min, °C	0	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	0	-6	-12	-18	-24		