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Standard Specification for Performance Graded Asphalt Binder[1]

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1. Scope

1.1 This specification[2] covers asphalt binders graded by performance. Grading designations are related to the average seven-day maximum pavement design temperature, and minimum pavement design temperature.

NOTE 1—For asphalt cements graded by penetration at 25°C, see Specification D 946. For asphalt cements graded by viscosity at 60°C see Specification D 3381.

NOTE 2—Proposed Practice P 249 provides non-mandatory information for determining the performance grade of an asphalt binder.

2. Referenced Documents

2.1 *ASTM Standards:*

D 8 Terminology Relating to Materials for Roads and Pavements[3]

D 92 Test Method for Flash and Fire Points by Cleveland Open Cup[4]

D 95 Test Method for Water in Petroleum Products and Bituminous Materials by Distillation[4]

D 140 Practice for Sampling Bituminous Materials[4]

D 946 Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction[3]

D 2042 Test Method for Solubility of Asphalt Materials in Trichloroethylene[3]

D 2170 Test Method for Kinematic Viscosity of Asphalts (Bitumens)[2]

D 2171 Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer[2]

D 2872 Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)[3]

D 3381 Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction[3]

D 4402 Method for Viscosity Determinations of Unfilled Asphalts Using the Brookfield Thermosel Apparatus[5]

D 5546 Test Method for Solubility of Polymer Modified Asphalt Materials in 1, 1, 1-Trichloroethane[5]

P 245 Proposed Test Method for Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)[6]

P 246 Proposed Test Method for Determining the Rheological Properties of Asphalt Binder for Specification Purposes Using a Dynamic Shear Rheometer (DSR)[6]

P 249 Proposed Practice for Grading or Verifying the Performance Grade of an Asphalt Binder[7]

P 252 Proposed Test Method for Determining the Fracture Properties of Asphalt Binder in Direct Tension (DT)[7]

2.2 *AASHTO Standards:*

PP1 Standard Practice for Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)[8]

3. Terminology

3.1 *Definitions*:

3.1.1 Definitions for many terms common to asphalt cement are found in Terminology Standard D 8.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *asphalt binder*, *n*—an asphalt-based cement that is produced from petroleum residue either with or without the addition of non-particulate, non-fibrous organic modifiers.

4. Ordering Information

4.1 When ordering under this specification, include in the purchase order the performance grade of asphalt binder required from Table 1 (for example, PG 52-16 or PG 64-34).

5. Materials and Manufacture

5.1 The asphalt binder 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.

NOTE 3—This specification is not intended to address the grading of binders containing particulate or fibrous materials.

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

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[1] This specification is under the jurisdiction of ASTM Committee D-4 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.40 on Asphalt Specifications.

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[2] This specification is based on SHRP Product 1001 and AASHTO MP1.

[3] *Annual Book of ASTM Standards*, Vol 04.03.

[4] *Annual Book of ASTM Standards*, Vol 05.01.

[5] *Annual Book of ASTM Standards*, Vol 04.04.

[6] Discontinued; see *1995 Annual Book of ASTM Standards*, Vol 04.03.

[7] Discontinued; see *1996 Annual Book of ASTM Standards*, Vol 04.03.

[8] Available from the American Association of State Highway and Transportation Officials, 444 N. Capitol St. NW, Washington, DC 20001.

TABLE 1 Performance Graded Asphalt Binder Specification

Performance Grade	PG 46	PG 52	PG 58	PG 64	PG 70	PG 76	PG 82
	–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
Average 7-day maximum Pavement Design Temperature, °C	<46	<52	<58	<64	<70	<76	<82
Minimum Pavement Design Temperature,° C[A]	> –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 Binder							
Flash Point Temp., D 92; min °C	230						
Viscosity, D 4402:[B] max. 3 Pa·s, Test Temp., °C	135						
Dynamic Shear, P 246:[C] G*/sinδ, min. 1.00 kPa 25 mm Plate, 1 mm Gap Test Temp. at 10 rad/s, °C	46	52	58	64	70	76	82
Rolling Thin Film Oven (Test Method D 2872)							
Mass Loss, max. percent	1.00						
Dynamic Shear, P 246: G*/sinδ, min. 2.20 kPa 25 mm Plate, 1 mm Gap Test Temp. at 10 rad/s,°C	46	52	58	64	70	76	82
Pressure Aging Vessel Residue (AASHTO PP1)							
PAV Aging Temperature, °C[D]	90	90	100	100	100(110)	100(110)	100(110)
Dynamic Shear, P 246: G*/sinδ, max 5000 kPa 8 mm Plate, 2 mm Gap Test Temp. at 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	34 31 28 25 22 19	37 34 31 28 25	40 37 34 31 28
Creep Stiffness, P 245:[E] S, max 300 MPa, m-value; min. 0.300 Test Temp at 60 s, °C	–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
Direct Tension, P 252:[E] Failure Strain, min. 1.0 % Test Temp. at 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	0 –6 –12 –18 –24 –30	0 – 6 –12 –18 –24	0 – 6 –12 –18 –24

[A]Pavement temperatures are estimated from air temperatures using an algorithm contained in the SUPERPAVE software program, or are provided by the specifying agency.

[B]The referee method shall be D 4402 using a #21 spindle at 20RPM, however alternate methods may be used for routine testing and quality assurance. 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 substituted for dynamic shear measurements of G*/sinδ at test temperatures where the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary or rotational viscometry (Test Methods D 2170 or D 2171).

[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 64– and above, except in desert climates, where it is 110°C.

[E]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.

5.4 The asphalt binder shall be at least 99.0 % soluble, as determined by Test Method D 5546 or Test Method D 2042. Any insoluble component shall be substantially free of fibers.

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

6. Sampling

6.1 The material shall be sampled in accordance with Practice D 140.

7. Test Methods

7.1 The properties outlined in 5.3, 5.4 and 5.5 shall be determined in accordance with Test Methods D 92, D 95, D 2042, D 2872, D 4402, D 5546, Proposed Test Methods P 245, P 246 and P 252, and AASHTO PP1.

8. Inspection and Certification

8.1 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 for each asphalt binder grade certified.

9. Rejection and Rehearing

9.1 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. Keywords

10.1 asphalt binder; asphalt cement; direct tension; flash point; modifier; performance specifications; pressure aging; rheology