~~Designation:D6373–99~~ Designation: D 6373 – 07$^{\epsilon 1}$

Standard Specification for Performance Graded Asphalt Binder[1]

This standard is issued under the fixed designation D 6373; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε[1] NOTE—Editorial corrections were made throughout in February 2008.

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.~~ covers asphalt binders graded by performance. Grading designations are related to the average seven-day maximum pavement design temperature, and minimum pavement design temperature. This specification contains Table 1 and Table 2. Table 2 incorporates Practice D 6816 for determining the critical low cracking temperature using a combination of Test Method D 6648 and Test Method D 6723 test procedures. If no table is specified, the default is Table 1.

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 P249~~ 2—AASHTO R 29 provides non-mandatory information for determining the performance grade of an asphalt binder.

2. Referenced Documents

2.1 *ASTM Standards:* [3]

D 8 Terminology Relating to Materials for Roads and Pavements
D 92 Test Method for Flash and Fire Points by Cleveland Open Cup Tester
D 95 Test Method for Water in Petroleum Products and Bituminous Materials by Distillation
D 140 Practice for Sampling Bituminous Materials
D 946 Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
D 2042 Test Method for Solubility of Asphalt Materials in Trichloroethylene
D 2170 Test Method for Kinematic Viscosity of Asphalts (Bitumens)
D 2171 Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer
D 2872 Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)
D 3381 Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction
D 4402~~Method for Viscosity Determinations of Unfilled Asphalts Using the Brookfield Thermosel Apparatus~~ Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
D 5546~~Test Method for Solubility of Polymer Modified Asphalt Materials in 1, 1, 1-Trichloroethane~~[5] Test Method for Solubility of Asphalt Binders in Toluene by Centrifuge
~~P245Proposed Test Method for Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)~~ D 6521 Practice for Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)
D 6648 Test Method for Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)
~~P246Proposed Test Method for Determining the Rheological Properties of Asphalt Binder for Specification Purposes Using a Dynamic Shear Rheometer (DSR)~~[6] D 6723 Test Method for Determining the Fracture Properties of Asphalt Binder in Direct Tension (DT)
~~P249Proposed Practice for Grading or Verifying the Performance Grade of an Asphalt Binder~~ D 6816 Practice for Determining

~~[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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[1] This specification is under the jurisdiction of ASTM Committee D04 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] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* ~~, Vol 04.03.~~ volume information, refer to the standard's Document Summary page on the ASTM website.

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~~
Dynamic Shear, D 7175:[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~~
Dynamic Shear, D 7175: 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 (AASHTOPP1)~~							
Pressure Aging Vessel Residue (Practice D 6521)							
~~PAV Aging Temperature, °C[D]~~	~~90~~	~~90~~	~~100~~	~~100~~	~~100(110)~~	~~100(110)~~	~~100(110)~~
PAV Aging Temperature, °C[D]	90	90	100	100	100	100	100
~~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~~
Dynamic Shear, D 7175: 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~~
Creep Stiffness, D 6648:[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~~
Direct Tension, D 6723:[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 ~~SU~~ LTP~~ERPAVE~~ Bind 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. If the binder is too stiff to test with the No. 21 Spindle, the No. 27 spindle shall be used. The spindle size and shear rate shall be reported. 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) or rotational viscometry.

[D]The PAV aging temperature [illegible]

TABLE 2 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, D 7175:^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, D 7175: 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 (Practice D 6521)							
PAV Aging Temperature, °C^D	90	90	100	100	100	100	100
Dynamic Shear, D 7175: 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
Critical Low Cracking Temperature, D 6816,:^E PASS Test Temp °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 LTPP Bind 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. If the binder is too stiff to test with the No. 21 Spindle, the No. 27 spindle shall be used. The spindle size and shear rate shall be reported. 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 viscometry (Test Methods D 2170 or D 2171) or rotational viscometry.

^D The PAV aging temperature is based on simulated climatic conditions and is one of three temperatures 90°C, 100°C or 110°C. Normally the PAV aging temperature is 100°C for PG 58–xx and above. However, in desert climates, the PAV aging temperature for PG 70–xx and above may be specified as 110°C

^E For verification of grade, at a minimum perform D 6648 at the test temperature and at the test temperature minus 6°C, and D 6723 at the test temperature. Testing at additional temperatures for D 6648 may be necessary if 300 MPa is not bracketed at the initial two test temperatures. Compare the failure stress from D 6723 to the calculated induced thermal stress as per D 6816. If the failure stress exceeds the induced thermal stress, the asphalt binder is deemed a "PASS" at the specification temperature. If the creep stiffness and m-value data are unobtainable because the binder is too soft at the test temperature, the asphalt binder will be deemed to pass at that grade temperature if it meets the critical low cracking temperature requirements at the test temperature minus 6°C.