Designation: D 6373 – 07ε1

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.

ε1 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. 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—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 Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer

D 5546 Test Method for Solubility of Asphalt Binders in Toluene by Centrifuge

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)

D 6723 Test Method for Determining the Fracture Properties of Asphalt Binder in Direct Tension (DT)

D 6816 Practice for Determining Low-Temperature Performance Grade (PG) of Asphalt Binders

D 7175 Test Method for Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer

2.2 *AASHTO Standards:*[4]

AASHTO R 29 Grading or Verifying the Performance Grade of an Asphalt Binder

AASHTO M 320 Standard Specification for Performance-Graded Asphalt Binder

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.

[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* volume information, refer to the standard's Document Summary page on the ASTM website.

[4] Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, http://www.transportation.org.

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, 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
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, 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 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]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. 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 creep stiffness and m-value requirements at the test temperature minus 6°C.

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.

4. Ordering Information

4.1 When ordering under this specification, include in the purchase order the performance grade (PG) of asphalt binder required and the table used (for example, PG 52-16, Table 1 or PG 64-34, Table 2). If no table is specified, the default is Table 1.

5. Materials and Manufacture

5.1 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 that is 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.

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 or Table 2.

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, Practice D 6521, Test Method D 6648, Test Method D 6723, Practice D 6816, and Test Method D 7175.

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

APPENDIX

(Nonmandatory Information)

X1. SUMMARY OF DIFFERENCES BETWEEN SPECIFICATION D 6373 AND AASHTO M 320–05

X1.1 This specification was originally developed under the sponsorship of the American Association of State Highway and Transportation Officials (AASHTO) as part of the Strategic Highway Research Program (SHRP). ASTM's version of this specification (Specification D 6373) was modeled after, and is similar to the comparable AASHTO specification (AASHTO M-320, formerly known as PP 1).

X1.1.1 The 2007 revision of the ASTM specification includes several changes that bring the ASTM and AASHTO standards into closer alignment. To help the user understand the relationship between these standards, and in the interest of promoting further harmonization, the remaining differences are summarized below. Note that ASTM and AASHTO may use slightly different formats and section numbering, so this summary is intended for general information only. Please consult the corresponding ASTM and AASHTO standards to determine the exact differences.

X1.2 Differences in the Scope Section (Section 1 in both standards)

X1.2.1 There are minor editorial differences in the first sentence.

X1.3 Differences in the Referenced Documents Section (Section 2 in both standards)

X1.3.1 In most cases, the ASTM Standard references ASTM documents, while the AASHTO Standard references AASHTO documents. The correspondence between the referenced documents is given in the following table. These differences occur in the referenced document section (Section 2), as well as within the body of each standard.

ASTM Standard	AASHTO Standard	Subject
D 8	...	Terminology
D 92	T 48	Flash Point
D 95	T 55	Water Content
D 140	T 40	Sampling
D 946	M 20	Penetration Graded Specification
D 2042	T 44	Solubility by Filtration
D 2170	T 201	Kinematic Viscosity
D 2171	T 202	Absolute VIscosity
D 2872	T 240	Rolling Thin Film Oven Test
D 3381	M 226	Viscosity Graded Specification
D 4402	T 316	Rotational Viscosity
D 5546	–	Solubility by Centrifuge
D 6373	M 320	Performance Graded Specification
D 6521	R 28	Pressure Aging Vessel
D 6648	T 313	Bending Beam Rheometer
D 6723	T 314	Direct Tension

D 6816	PP 42	Low Temperature Grade
D 7175	T 315	Dynamic Shear Rheometer
	PP 28/ R 35	Volumetric Design
	R 29	Verifying/Grading
	M 323	Volumetric Mix Design

X1.4 Differences in the Terminology Section (Section 3 in both standards)

X1.4.1 The ASTM definition of asphalt binder includes the requirement that any modifiers be "non-fibrous." The AASHTO standard does not include this requirement.

X1.5 Differences in the Ordering Information Section (Section 4 in both standards)

X1.5.1 The AASHTO standard indicates that M 323 or R 35 may be used to select asphalt grades. The ASTM standard does not include a comparable statement.

X1.6 Differences in the Materials and Manufacture Section (Section 5 in both standards)

X1.6.1 Both ASTM and AASHTO require the binder to be 99.0 % soluble. However the ASTM standard requires that "any insoluble component shall be substantially free of fibers." The AASHTO standard does not include this requirement.

X1.6.2 AASHTO indicates in Section 5.5 "This specification is not applicable for asphalt binders in which fibers or other discrete particles are larger than 250 micron in size." ASTM does not include this statement, but provides similar guidance in Note 3: "This specification is not intended to address the grading of binders containing particulate or fibrous materials."

X1.7 Differences in Other Sections

X1.7.1 Sections 6, 7, 8, 9, and 10 are essentially identical, except for any referenced documents as noted above.

X1.7.2 The AASHTO standard does not include this Appendix

X1.8 Differences in the Body of Table 1 and Table 2 (these comments apply to both tables)

X1.8.1 ASTM defines the required gap for each of the DSR measurements, while AASHTO does not.

X1.8.2 ASTM uses the term "mass loss" while AASHTO uses the term "mass change."

X1.9 Differences in the Footnotes for Table 1 and Table 2 (these comments apply to both tables)

X1.9.1 In note A, AASHTO provides additional options for determining the grade selection temperature, while ASTM does not.

X1.9.2 In note B, ASTM gives testing guidance for the rotational viscosity test, while AASHTO does not.

X1.9.3 In note C there is a minor difference in wording.

X1.9.4 AASHTO adds note D: "G*/sinδ = high temperature stiffness and G* sinδ = intermediate temperature stiffness." ASTM does not have this note.

X1.9.5 AASHTO adds note E: "The mass change shall be less than 1.00 percent for either a positive (mass gain) or negative (mass loss) change." ASTM does not have this note.

X1.9.6 AASHTO Note F is the same as ASTM note D

X1.9.7 AASHTO Note G is the same as ASTM note E, except that ASTM gives guidance for when the binder is too soft to be properly tested.