



Standard Specification for Type IV Polymer-Modified Asphalt Cement for Use in Pavement Construction¹

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1. Scope

1.1 This specification covers asphalt cements that have been modified by the addition of an appropriate polymer for use in pavement construction. It was developed to provide a reference for specifying polymer-modified asphalt and reflects the properties of currently available commercial products. This specification is not intended to be a performance-based specification.

1.2 This specification covers asphalt cements that have been modified by dispersing non-crosslinked styrene-butadiene-styrene (SBS) block copolymers. However, any polymer may be used that will give the required test results when blended with the desired asphalt.

1.3 The following safety hazards caveat pertains only to the test methods portion, Section 6, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

- D 5 Test Method for Penetration of Bituminous Materials²
- D 36 Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)³
- D 92 Test Method for Flash and Fire Points by Cleveland Open Cup⁴
- D 113 Test Method for Ductility of Bituminous Materials²
- D 140 Practice for Sampling Bituminous Materials²
- D 1754 Test Method for Effect of Heat and Air on Asphaltic Materials (Thin-Film Oven Test)²
- D 2170 Test Method for Kinematic Viscosity of Asphalts (Bitumens)²
- D 2872 Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)²

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² Annual Book of ASTM Standards, Vol 04.03.

³ Annual Book of ASTM Standards, Vol 04.04.

⁴ Annual Book of ASTM Standards, Vol 05.01.

D 4957 Test Method for Apparent Viscosity of Asphalt Emulsion Residues and Non-Newtonian Bitumens by Vacuum Capillary Viscometer²

D 5546 Test Method for Solubility of Polymer-Modified Asphalt Materials in 1,1,1-Trichloroethane²

D 6084 Test Method for Elastic Recovery of Bituminous Materials by Ductilometer²

E 11 Specification for Wire-Cloth and Sieves for Testing Purposes⁵

3. Manufacture

3.1 The asphalt cement used to prepare the polymer-modified asphalt cement shall be prepared by the refining of crude petroleum by suitable means.

3.2 Polymer-modified asphalt Types A through F represent different grades of asphalt and different levels of polymer used in their manufacture.

4. Physical Requirements

4.1 The polymer-modified asphalt cement shall be homogeneous and free from water and shall not foam when heated to 175°C (347°F).

4.2 The polymer-modified asphalt cement shall conform to the requirements of Table 1.

4.3 The polymer modifier and asphalt cement shall be preblended and dispersed uniformly prior to use.

5. Methods of Sampling and Testing

5.1 Sample and test the polymer-modified asphalt cement in accordance with the following Test Methods and Practice:

5.1.1 *Sampling*—Practice D 140.

5.1.2 *Penetration*—Test Method D 5.

5.1.3 *Viscosity at 60°C (140°F)*—Test Method D 4957.

5.1.4 *Viscosity at 135°C (275°F)*—Test Method D 2170.

5.1.5 *Flash Point, Cleveland Open Cup*—Test Method D 92.

5.1.6 *Rolling Thin-Film Oven Test*—Test Method D 2872.

5.1.7 *Thin-Film Oven Test*—Test Method D 1754.

5.1.8 *Solubility of Polymer-Modified Asphalt Cement in 1,1,1-Trichloroethane*—Test Method D 5546.

5.1.9 *Elastic Recovery*—Test Method D 6084.

⁵ Annual Book of ASTM Standards, Vol 14.02.

TABLE 1 Physical Property Requirements for Type IV Polymer-Modified Asphalt

Designation	IV-A		IV-B		IV-C		IV-D		IV-E		IV-F	
	min	max	min	max	min	max	min	max	min	max	min	max
Penetration at 25°C (77°F), 100 g, 5 s,	90		75		65		50		50		35	
Viscosity, 60°C (140°F), 1 s ⁻¹ Pa.s (poise) ^A	125 (1250)		400 (4000)		250 (2500)		600 (6000)		450 (4500)		800 (8000)	
Viscosity, 135°C (275°F), mm ² /s (cSt)		3000		3000		3000		3000		3000		3000
Flash point COC, °C (°F)	232 (450)		232 (450)		232 (450)		232 (450)		232 (450)		232 (450)	
Solubility in trichloroethane, %	99.0		99.0		99.0		99.0		99.0		99.0	
Separation difference in ring-and-ball softening point between top and bottom, °C (°F) ^B	report		report		report		report		report		report	
Tests on RTFOT Residue ^C												
Elastic recovery, 25°C (77°F), 10 cm elongation, %	60		70		60		70		60		70	
Penetration, 4°C (39.2°F), 200 g, 60 s	20		20		15		15		10		10	

^A Modified Koppers tubes.

^B Viscosity at 135°C using Test Method D 2170 may be used in lieu of the softening point test. Viscosity variances greater than 10 % should be noted. Caution should be taken when using this test to evaluate dispersed polymer systems. Actual limits are reported when sufficient data exist to support such criteria. However, a separation test for one material may not be appropriate for other materials, giving the potential for indicating false failures in the field. The results of this test may be used as a guideline to establish field handling procedures. Large differences in separation values indicate that agitation of the material should be maintained during storage.

^C The thin-film oven test may be used, but the rolling thin-film test shall be the referee method.

6. Test Methods for Type IV Polymer-Modified Asphalt Binder

6.1 Summary of the Separation Test:

6.1.1 *Scope*—The separation of polymer and asphalt during hot storage is evaluated by comparing the ring and ball softening point of the top and bottom samples taken from a conditioned, sealed tube of polymer-modified asphalt. The conditioning consists of placing a sealed tube of polymer-modified asphalt in a vertical position in a $163 \pm 5^\circ\text{C}$ ($325 \pm 10^\circ\text{F}$) oven for a 48 h period (see Footnote B of Table 1). This is not intended to be a performance-based specification. It was developed to provide a reference for determining the relative separation properties between different types of asphalt modifiers and their respective asphalts.

6.1.2 *Significance and Use*—Polymer-modified asphalt's relative stability to separation under storage in static conditions is determined by heated oven storage without agitation.

6.1.3 Apparatus:

6.1.3.1 *Aluminum Tubes*— 25.4-mm (1-in.) diameter by 139.7-mm (5.5-in.) length blind aluminum tubes, used to hold the test sample during the conditioning.

NOTE 1—Aluminum tubes suitable for this purpose may be obtained from R/H Specialty & Machine, P.O. Box 10187, Terre Haute, IN 47801, (812) 232-0781. Observations have been reported regarding leakage of asphalt from the bottom of these tubes during the conditioning period. Other tubes may be required if this leakage is significant.

6.1.3.2 *Oven*, capable of maintaining $163 \pm 5^\circ\text{C}$ ($325 \pm 10^\circ\text{F}$).

6.1.3.3 *Freezer*, capable of maintaining $-6.7 \pm 5^\circ\text{C}$ ($20 \pm 10^\circ\text{F}$).

6.1.3.4 *Rack*, capable of supporting the aluminum tubes in a vertical position in the oven and freezer.

6.1.3.5 *Spatula and Hammer*—The spatula must be rigid and sharp to allow cutting of the tube containing the sample when at a low temperature.

6.1.4 Procedure:

6.1.4.1 Place the empty tube, with sealed end down in the rack.

6.1.4.2 Heat the sample carefully until sufficiently fluid to pour. Care should be taken to prevent localized overheating. Strain the molten sample through a 300 μm (No. 50) sieve conforming to Specification E 11. After thorough stirring, pour 50.0 g into the vertically held tube. Fold the excess tube over two times, and crimp and seal.

6.1.4.3 Place the rack containing the sealed tubes in a $163 \pm 5^\circ\text{C}$ ($325 \pm 10^\circ\text{F}$) oven. Allow the tubes to stand undisturbed in the oven for a period of 48 ± 1 h. At the end of the period, remove the rack from the oven, and place immediately in the freezer at $-6.7 \pm 5^\circ\text{C}$ ($20 \pm 10^\circ\text{F}$), taking care to keep the tubes in a vertical position at all times. Leave the tubes in the freezer for a minimum of 4 h to solidify the sample completely.

6.1.4.4 Upon removing the tube from the freezer, place it on a flat surface. Cut the tube into three equal length portions with the spatula and hammer. Discard the center section, and place the top and bottom portions of the tube into separate beakers. Place the beakers into a $163 \pm 5^\circ\text{C}$ ($325 \pm 10^\circ\text{F}$) oven until the asphalt is sufficiently fluid to remove the pieces of aluminum tube.

6.1.4.5 After thoroughly stirring, pour the top and bottom samples into appropriately marked rings for the ring-and-ball softening point test. Prepare the rings and apparatus according to Test Method D 36.

NOTE 2—Other physical and chemical residue tests may be run at this time, if desired (see Footnote B of Table 1).

6.1.4.6 The top and bottom sample from the same tube should be tested at the same time in the softening point test.

6.1.5 *Report*—Report the difference, in °C or °F, between the softening points of the respective top and bottom samples.

6.1.6 *Precision and Bias*—No statement is made regarding either the precision or bias of this test method for measuring separation since the result states merely whether there is

conformance to the criteria for success specified in the procedure.

7. Keywords

7.1 asphalt; bituminous materials; dispersed; modified; pavement construction; polymer; SBS

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