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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Type IV Polymer-Modified Asphalt Cement for Use in Pavement Construction[1]

This standard is issued under the fixed designation D 5892; 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.

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 Materials[2]

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 Cup[4]

D 113 Test Method for Ductility of Bituminous Materials[2]

D 140 Practice for Sampling Bituminous Materials[2]

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]

D 4957 Test Method for Apparent Viscosity of Asphalt Emulsion Residues and Non-Newtonian Bitumens by Vacuum Capillary Viscometer[2]

D 5546 Test Method for Solubility of Polymer-Modified Asphalt Materials in 1,1,1-Trichloroethane[2]

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[5]

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:

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.

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

6.1 *Summary of the Separation Test*:

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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.

[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 trichloroethylane,%	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.

6.1.1 *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± 5°C (325 ± 10°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 Sheffield Industries, P.O. Box 351, New London, CT 06320. 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 ± 5°C (325± 10°F).

6.1.3.3 *Freezer*, capable of maintaining − 6.7 ± 5°C (20± 10°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 ± 5°C (325 ± 10°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 ± 5°C (20 ± 10°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 ± 5°C (325 ± 10°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.

6.2 *Summary of the Elastic Recovery Test*:

6.2.1 *Scope*—The elastic recovery of a polymer-modified asphalt cement is evaluated by the percentage of recoverable

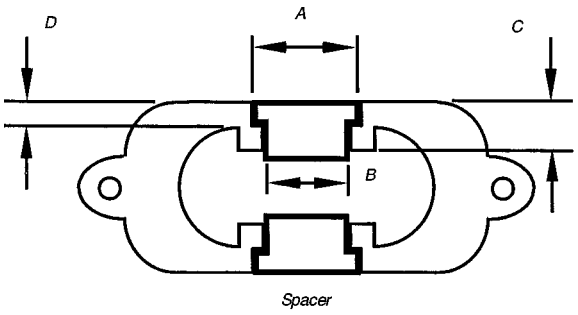
strain measured after elongation during a conventional ductility test. Unless otherwise specified, the test shall be made at 25 ± 0.5°C (77 ± 0.9°F) and with a speed of 5 cm/min ±5 %. This is not intended to be a performance-based specification. It was developed to provide a reference for specifying polymer-modified asphalts and reflects the properties of currently available commercial products.

6.2.2 *Significance and Use*—Polymer-modified asphalts are identified by measurement of the recoverable strain after elongation in a conventional ductility apparatus, as outlined in Test Method D 113.

6.2.3 *Apparatus*:

6.2.3.1 *Mold*—The mold shall be similar in design to that described for use in the ductility test (Test Method D 113, Fig. 1), (see Fig. 1) except that the sides of the mold assembly, parts a and a′, shall have straight sides producing a test specimen with a cross-sectional area of 1 cm^2.

6.2.3.2 *Water Bath*—The water bath shall be maintained at the specified test temperature, varying not more than 0.1°C (0.18°F) from this temperature. The volume of water shall be not less than 10 ± 1.0 L, and the specimen shall be immersed to a depth of not less than 10 ± 0.5 cm and shall be supported on a perforated shelf not less than 5 cm from the bottom of the bath.



A	36.5 ± 0.1 mm
B	30 ± 0.1 mm
C	17 ± 0.1 mm
D	10 ± 0.1 mm

NOTE 1—(*A*) 36.5 ± 0.1 m, (*B*) 30± 0.1 mm, (*C*) 17 ± 0.1 mm, and (*D*) 10 ± 0.1 mm.

FIG. 1 Mold—Bituminous Materials in Tension

6.2.3.3 *Testing Machine*—For pulling the briquette of bituminous material apart, any apparatus may be used that is so constructed that the specimen will be immersed in water continuously, as specified, while the two clips are pulled apart at uniform speed without undue vibration.

6.2.3.4 *Thermometer*—An ASTM 63C or 63F thermometer shall be used.

6.2.3.5 *Scissors*—Any type of conventional scissors capable of cutting polymer-modified asphalt at the test temperature may be used.

6.2.4 *Procedure*:

6.2.4.1 Prepare the test specimens, and condition as prescribed by Test Method D 113.

6.2.4.2 Elongate the test specimen at the specified rate to a deformation of 10 cm.

6.2.4.3 Immediately cut the test specimen into two halves at the midpoint using scissors. Keep the test specimen in the water bath in an undisturbed condition for 1 h.

6.2.4.4 After the 1 h time period, move the elongated half of the test specimen back into position near the fixed half of the test specimen so that the two pieces of polymer just touch. Record the length of the test specimen as *X*.

6.2.5 *Report*—Calculate the percent recovery by the following procedure:

$$\text{recovery, \%} = \frac{10 - X}{10} \times 100 \quad (1)$$

6.2.6 *Precision and Bias*—No statement is made regarding either the precision or bias of the elastic recovery test procedure for determining the recoverable strain since the result states merely whether there is conformance to the criteria for success specified in the procedure (Note 3).

NOTE 3—A new procedure for elastic recovery is currently being drafted and will be included in this specification, complete with its precision and bias, once determined.

7. Keywords

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