



# Standard Specification for Type I Polymer Modified Asphalt Cement for Use in Pavement Construction<sup>1</sup>

This standard is issued under the fixed designation D 5976; 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 ( $\epsilon$ ) 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 is not intended to be a performance-based specification.

1.2 Type I polymer-modified asphalts are typically made with styrene-butadiene or styrene-butadiene-styrene block copolymers. However, any polymer may be used that will give the required test results when blended with the desired asphalt.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *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<sup>2</sup>
- D 36 Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)<sup>3</sup>
- D 92 Test Method for Flash and Fire Points by Cleveland Open Cup<sup>4</sup>
- D 113 Test Method for Ductility of Bituminous Materials<sup>2</sup>
- D 140 Practice for Sampling Bituminous Materials<sup>2</sup>
- D 1754 Test Method for Effect of Heat and Air on Asphaltic Materials (Thin-Film Oven Test)<sup>2</sup>
- D 2042 Test Method for Solubility of Asphalt Materials in Trichloroethylene<sup>2</sup>
- D 2170 Test Method for Kinematic Viscosity of Asphalts (Bitumens)<sup>2</sup>
- D 2872 Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)<sup>2</sup>

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D-4 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.45 on Modified Asphalt Specifications.

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<sup>2</sup> Annual Book of ASTM Standards, Vol 04.03.

<sup>3</sup> Annual Book of ASTM Standards, Vol 04.04.

<sup>4</sup> Annual Book of ASTM Standards, Vol 05.01.

D 4957 Test Method for Apparent Viscosity of Asphalt Emulsion Residues<sup>2</sup> and Non-Newtonian Bitumens by Vacuum Capillary Viscometer<sup>2</sup>

E 11 Specification for Wire-Cloth Sieves for Testing Purposes<sup>5</sup>

## 3. Manufacture

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

## 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 compatible and pre-blended 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 or 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 *Ring and Ball Softening Point*—Test Method D 36.

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

5.1.7 *Rolling Thin Film Oven Test*—Test Method D 2872.

5.1.8 *Thin Film Oven Test*—Test Method D 1754.

5.1.9 *Solubility*—Test Method D 2042.

## 6. Test Methods for Type I Polymer-Modified Asphalt Binder

### 6.1 Summary of 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 portions taken from a conditioned, sealed tube of polymer-modified asphalt. The

<sup>5</sup> Annual Book of ASTM Standards, Vol 14.02.

**TABLE 1 Physical Property Requirements for Type I Polymer-Modified Asphalts**

Designation	I-A		I-B		I-C		I-D	
	min	max	min	max	min	max	min	max
Penetration, 25°C (77°F), 100 g, 5 s, dmm	100	150	75	100	50	75	40	75
Viscosity, 60°C (140°F), 1 s <sup>-1</sup> , poise <sup>A</sup>	1250		2500		5000		5000	
Viscosity, 135°C (275°F), cSt		2000		2000		2000		5000
Flash Point, COC, °C (°F)	232 (450)		232 (450)		232 (450)		232 (450)	
Solubility in trichloroethylene, %	99		99		99		99	
Separation, difference, °C (°F)		2.2 (4)		2.2 (4)		2.2 (4)		2.2 (4)
Tests on RTFOT Residue <sup>B</sup>								
Elastic recovery, 25°C (77°F), 10 cm elongation, %	60		60		60		60	
Penetration, 4°C (39.2°F), 200 g, 60 s, dmm	20		15		13		10	

<sup>A</sup>The absolute viscosity should be run in a modified Koppers or Asphalt Institute vacuum capillary viscometer. Report the viscosity at a shear rate of 1 reciprocal second.

<sup>B</sup>The thin film oven test may be used, but the rolling thin film test shall be the referee method.

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.

6.1.2 *Referenced Documents*—Test Method D 36 and Specification E 11.

6.1.3 *Apparatus*:

6.1.3.1 *Aluminum Tubes*<sup>6</sup>—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.

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 the sealed end down in the rack.

6.1.4.2 Carefully heat the sample until sufficiently fluid to pour. Care should be taken to avoid localized overheating. Strain the melted sample through a 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  $48 \pm 1$  h. At the end of the heating period, remove the rack from the oven and immediately place 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 the tube on a flat surface. Cut the tube into three equal length portions with the spatula and hammer. Discard the center portion and place the top and bottom portion of the tube into

separate beakers. Place the beakers in a  $163 \pm 5^\circ\text{C}$  ( $325 \pm 10^\circ\text{F}$ ) oven until sufficiently fluid to remove the pieces of aluminum tube.

6.1.4.5 After a through stirring, pour the top and bottom samples into appropriately marked rings for the ring and ball softening point test. Prepare the rings and apparatus as described in Test Method D 36.

6.1.4.6 The top and bottom samples 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 of the softening point between the top and bottom portions.

6.2 *Summary of Elastic Recovery Test*:

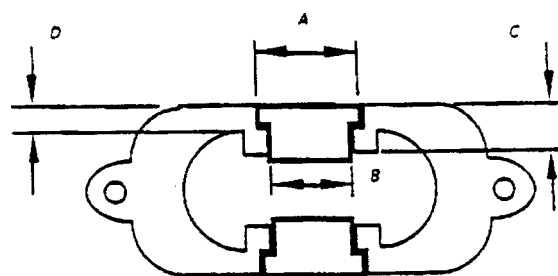
6.2.1 *Scope*—The elastic recovery of a polymer-modified asphalt cement is evaluated by the percentage of recoverable strain measured after elongation. Unless otherwise specified, the test shall be made at a temperature of  $25 \pm 0.5^\circ\text{C}$  ( $77 \pm 0.9^\circ\text{F}$ ) and with a speed of 5 cm/min  $\pm 5\%$ .

6.2.2 *Referenced Documents*—Test Method D 113 and Specification E 1.

6.2.3 *Apparatus*:

6.2.3.1 *Mold*, similar in design to that described for use in the ductility test, Test Method D 113, 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<sup>2</sup>.

6.2.3.2 *Water Bath*, maintained at the specified test temperature, varying not more than 0.1°C (0.18°F) from this temperature. The volume of water shall not be less than 10 L, and the specimen shall be immersed to a depth of not less than 10 cm



**Spacer**

<b>A</b>	<b>36.5 ± 0.1 mm</b>
<b>B</b>	<b>30 ± 0.1 mm</b>
<b>C</b>	<b>17 ± 0.1 mm</b>
<b>D</b>	<b>10 ± 0.1 mm</b>

**FIG. 1 Elastic Recovery Mold**

<sup>6</sup> Aluminum tubes suitable for this purpose may be obtained from Sheffield Industries, P.O. Box 351, New London, CT 06320, (203) 442-4451. Observations have been reported regarding leakage of asphalt from the bottom of the tube during the conditioning period. Other tubes may be required if this leakage is significant.

and shall be supported on a perforated shelf not less than 5 cm from the bottom of the bath.

6.2.3.3 *Testing Machine*, for pulling the briquet of bituminous material apart. Any apparatus may be used that is so constructed that the specimens will be immersed completely in the water as specified while the two clips are pulled apart at a 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.

6.2.4 *Procedure*:

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

6.2.4.2 Elongate the test specimen at the specified rate to a deformation of  $10 \pm 0.25$  cm.

6.2.4.3 Immediately cut the test specimen into two halves at

the midpoint using the 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 the two pieces of polymer-modified asphalt just touch. Record the length of the recombined 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*—The precision and bias of the elastic recovery test has not been determined. ASTM Subcommittee D4.44 is developing a test method.

## 7. Keywords

7.1 asphalt; polymer modified asphalt; specification

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