



Designation: D 6114 – 97 (Reapproved 2002)

## Standard Specification for Asphalt-Rubber Binder<sup>1</sup>

This standard is issued under the fixed designation D 6114; 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-rubber binder, consisting of a blend of paving grade asphalt cements, ground recycled tire (that is, vulcanized) rubber and other additives, as needed, for use as binder in pavement construction. The rubber shall be blended and interacted in the hot asphalt cement sufficiently to cause swelling of the rubber particles prior to use.

NOTE 1—It has been found that at least 15 % rubber by weight of the total blend is usually necessary to provide acceptable properties of asphalt-rubber.

1.2 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only.

1.3 The following precautionary caveat pertains to the test method portions only, Sections 4 and 5 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.* Specific precautionary statements are given in 4.3.2.

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

- D 5 Test Method for Penetration of Bituminous Materials
- D 36 Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
- D 93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
- D 140 Practice for Sampling Bituminous Materials

<sup>1</sup> 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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<sup>2</sup> 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.

- D 946 Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
- D 1754 Test Method for Effects of Heat and Air on Asphaltic Materials (Thin-Film Oven Test)
- D 1864 Test Method for Moisture in Mineral Aggregate Used on Built-Up Roofs
- D 2196 Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield type) 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 5329 Test Methods for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements
- D 5644 Test Methods for Rubber Compounding Materials—Determination of Particle Size Distribution of Recycled Vulcanizate Particulate Rubber

### 3. Materials

3.1 *Asphalt Cement*—The asphalt cement shall meet the requirements of Specification D 946 or Table 1 or 3 of Specification D 3381. Acceptable grades shall be able to produce the properties of Table 1 of this specification when interacted with ground recycled tire rubber.

#### 3.2 *Ground Recycled Tire Rubber*:

3.2.1 The ground recycled tire rubber shall contain less than 0.75 % moisture by weight and shall be free flowing. The specific gravity of the rubber shall be  $1.15 \pm 0.05$ . The ground recycled tire rubber shall contain no visible nonferrous metal particles and no more than 0.01 % ferrous metal particles by weight.

3.2.2 For use in hot mix binders, the fiber content shall not exceed 0.5 % by weight of ground recycled tire rubber. However for use in binders for spray applications, fiber content shall not exceed 0.1 % by weight. Up to 4 % by weight of mineral powder (such as talc) is permitted to prevent sticking and caking of the rubber particles. Other foreign contaminating materials (see Note 2) shall be less than 0.25 % by weight.

**TABLE 1 Physical Requirements for Asphalt-Rubber Binder**

Binder Designation <sup>A</sup>		Type I	Type II	Type III
Apparent Viscosity, 175°C (347°F):cP	min	1500	1500	1500
Modified Test Method <b>D 2196</b> , Method A, (see <b>5.4</b> ) <sup>B,C</sup>	max	5000	5000	5000
Penetration, 25°C (77°F) 100g, 5 s:	min	25	25	50
1/10 mm (Test Method <b>D 5</b> )	max	75	75	100
Penetration, 4°C (39.2°F), 200g, 60 s:	min	10	15	25
1/10 mm (Test Method <b>D 5</b> )				
Softening Point: °C (°F)	min	57.2 (135)	54.4 (130)	51.7 (125)
(Test Method <b>D 36</b> )				
Resilience, 25°C (77°F): %	min	25	20	10
(Test Method <b>D 5329</b> )				
Flash Point: °C (°F)	min	232.2 (450)	232.2 (450)	232.2 (450)
(Test Method <b>D 93</b> )				
Thin-Film Oven Test Residue (Test Method <b>D 1754</b> ) <sup>D</sup>	.....	.....	.....	.....
Penetration Retention, 4°C (39.2°F): % of original (Test Method <b>D 5</b> )	min	75	75	75

<sup>A</sup> See Appendix for recommended climate guidelines for usage.

<sup>B</sup> Either digital or dial reading Brookfield viscometers may be used - record peak measurement.

For LV series models, use spindle 3 at 12 rpm.

For RV and HA series models, use spindle 3 at 20 rpm.

<sup>C</sup> Rion or Haake-type high range rotational viscometers may also be used (with Rotor No. 1) when correlated with Brookfield measurements, as may other rotational viscometers. However Brookfield shall be the referee method.

<sup>D</sup> RTFO Residue (See Test Method **D 2872**) may be substituted for TFOT Residue, except TFOT shall be the referee method in cases of dispute.

NOTE 2—Other foreign contaminants include, but are not limited to, materials such as glass, sand, wood, etc.

3.2.3 It is recommended that no rubber particles should be retained on the 2.36 mm (No. 8) sieve. Rubber gradation should be agreed upon between purchaser and asphalt-rubber supplier for the specific mixture applications (see **Note 3**).

NOTE 3—It has been found that rubber gradation may affect the physical properties and performance of hot paving mixtures using asphalt-rubber binder.

### 3.3 Asphalt-Rubber:

3.3.1 The asphalt-rubber shall be an interacted blend of paving grade asphalt cement and ground recycled tire rubber. Other additives not cited herein including other types of scrap rubber are permitted.

3.3.2 The asphalt-rubber shall not foam when heated to 175°C (347°F).

3.3.3 The asphalt-rubber blend shall conform to the physical requirements of **Table 1**. This table was developed to provide a reference for specifying asphalt-rubber binder. The tests are intended to measure the degree of modification of the asphalt cement by the ground recycled tire rubber. **Table 1** is not intended to be a performance-based specification.

## 4. Procedure

### 4.1 Ground Recycled Tire Rubber:

4.1.1 Determine moisture content according to Test Method **D 1864**, except that oven temperature shall be  $105 \pm 5^\circ\text{C}$  ( $221 \pm 9^\circ\text{F}$ ).

4.1.2 Detect and separate out ferrous metal particles by thoroughly stirring a magnet through a 50 g sample. Weigh captured particles. Determine nonferrous metal content by visual inspection.

4.1.3 Perform sieve analysis according to Test Method **D 5644**

4.1.4 The method of determining fiber content shall be specified as agreed between the supplier and user.

### 4.2 Asphalt-Rubber Sampling:

4.2.1 Sample containers and handling shall be in accordance with Practice **D 140**.

4.2.2 Representative samples shall be taken from a sample valve or tap on the agitated tank in accordance with Practice **D 140**, unless otherwise directed.

### 4.3 Preparation of Pre-Blended Asphalt-Rubber Samples for Acceptance Testing:

4.3.1 *Sample Melting and Heating*—Loosen the cover of the original sample container to relieve pressure, then place the container in a preheated forced-draft oven and maintain oven temperature as required to heat sample to test temperature (see **Note 4**). After 1 h or when the asphalt-rubber material begins to liquify, remove cover. Stir with a spatula as required to avoid localized overheating of sample and to achieve uniform sample temperature. Replace cover and repeat these steps as needed.

NOTE 4—Only those samples which will be tested for viscosity at 175°C (347°F) need to be heated to 175°C (347°F). To provide specimens for other **Table 1** acceptance tests, it is sufficient to thoroughly liquify the pre-blended asphalt-rubber.

4.3.2 Immediately prior to testing or pouring test specimens, stir the sample thoroughly with a spatula to achieve visually uniform distribution of rubber particles within the binder. Pour the asphalt-rubber into suitable molds and containers for making such tests as desired. Prepare and condition acceptance specimens according to the respective selected test methods (see **Table 1**). (**Warning**—The sample may contain ground rubber particles that tend to float or settle. It is therefore very important that samples be poured or tested as soon as possible after stirring to provide representative test specimens through-out which the rubber particles are uniformly dispersed.)

4.3.3 The pre-blended sample shall be raised to temperature, stirred, tested for viscosity or poured for other acceptance tests, or both, within 4 h of time of placement in heated oven.