Designation: D7741/D7741M – 11 (Reapproved 2017)

Standard Test Method for Measurement of Apparent Viscosity of Asphalt-Rubber or Other Asphalt Binders by Using a Rotational Handheld Viscometer[1]

This standard is issued under the fixed designation D7741/D7741M; 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 The use of high-viscosity asphalt binders like asphalt-rubber is becoming more common in the United States and worldwide. Specifications such as Specification D6114 note the need for field control of the apparent viscosity and require the use of a field production rotational viscometer. The testing of asphalt-rubber binder for use in asphalt-rubber hot mix and for asphalt-rubber membrane is necessary to ensure consistent mix properties that will ensure good performance of these materials. Logistics of field applications limits the use of conventional laboratory controls and testing equipment. This test, using a handheld rotational viscometer can be conducted in either the field or laboratory to determine the apparent viscosity of asphalt-rubber and other high-viscosity binders for field production control and to assess the uniformity of the binder produced or for other related purposes.

1.2 Asphalt-rubber binder consists of a blend of paving grade asphalt cement and crumb rubber as described in Specification D6114. Other high-viscosity asphalt binders may consist of asphalts modified with polymer or fiber, or both. Testing is performed following the specified reaction time, if any, within the production process. Control of the raw materials is separate from the test.

1.3 The values stated in SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; each system shall be used independently of the other. Combining values from the two systems may result in noncompliance with the standard.

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.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D6114 Specification for Asphalt-Rubber Binder

3. Significance and Use

3.1 This test is primarily used for field production control of asphalt-rubber (A-R) and other high-viscosity binders; however, the test can also be used in a laboratory setting.

3.2 A handheld rotational viscometer is used to measure the apparent viscosity of a completed blend of A-R or high-viscosity binder. A rotor (spindle), turning at constant speed, is inserted in the liquid binder to be measured. The resistance to movement of the spindle (torque) caused by the viscosity of the surrounding liquid is measured using a special mechanism to obtain direct readings in Pa·s or cP.

NOTE 1—Spindle generally made of stainless steel, although another metal such as brass could be used.

3.3 The measured apparent viscosity is used to control the production of the A-R or other high-viscosity binder, to assess the uniformity of the binder produced or for other related purposes.

3.4 As the spindle turns in the A-R or other high-viscosity binder, it has a tendency to "drill" into the sample (i.e., for A-R, the spindle spins the rubber particles out of the measurement area). Consequently, the apparent viscosity drops to reflect only the liquid phase of the high-viscosity binder. Therefore, the peak viscosity measurement value is recorded to reflect the viscosity of the blended material.

[1] This test method is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.44 on Rheological Tests.

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[2] 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. Apparatus

4.1 *Viscometer*—Handheld, rotational-type viscometer (see Fig. 1). The viscometer shall be equipped with a level bubble to ensure proper orientation of the viscometer in the sample to be tested. Spindle (rotor) speed typically 62.5 rpm, however may vary with different manufacturers.

4.2 *Spindle (Rotor)*—Diameter – 24 ± 1.1 mm. [1.0 ± 0.05 in.]; Height – 53 ± 0.1 mm [2 ± .005 in.] or equivalent (see Fig. 2).

4.3 *Thermometer*—Digital with metal jacket probe, 1-°C [2-°F] precision.

4.4 *Sample Can*—4-L [1-gal] metal can with wire bale.

4.5 *Viscosity Standard Oils*—Calibrated in absolute viscosity in Pa·s [centipoises cP] and in the range of 1.0 to 5.0 Pa·s [1000 to 5000 cP].

4.6 *Controllable Heat Source,* such as a hot plate, gas stove or burner, etc., to maintain the test temperature of the A-R or high-viscosity binder sample during viscosity measurement.

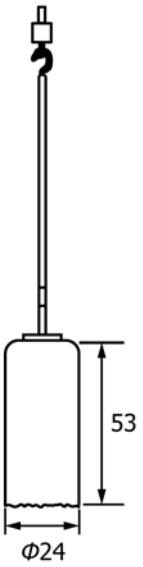

FIG. 2

FIG. 1

4.7 *Viscometer Holder*—Clean metal can or some type of frame where the viscometer can be stored between tests.

5. Calibration Verification

5.1 Calibration of the rotational viscometer shall be verified prior to use at each site per manufacturer's instructions using the reference viscosity standard oils.

6. Sampling

6.1 The sample shall consist of at least 3 L [0.75 gal] of the completed mixture of A-R or other high-viscosity binder. Obtain the sample from an appropriate sample valve located to intercept the normal flow of material during production. Perform sampling and testing in close proximity to the plant operation to avoid undue temperature loss during handling.

6.2 Prior to sampling, draw at least 3 L [0.75 gal] from the sampling valve and discard. Then open the sample valve and draw approximately 3 L [0.75 gal] into a new, clean sample can for testing.

7. Test and Sampling Procedure

7.1 As immediately as practical, place the sample container with the drawn sample on a smooth, level support for final preparation and testing. Set the open sample container on or over the controllable heat source as appropriate

7.2 Manually stir the sample using an appropriate metal stir rod to prevent scorching or burning. Use of the temperature probe for stirring is permitted.

7.3 Continue stirring until a consistent specified test temperature is achieved. The test temperature shall be within ±2 °C [±5 °F] of the specified test temperature. The actual test temperature shall be recorded with viscosity data. Typical test temperatures are 175 °C [350 °F] or 190 °C [375 °F], or as specified.

7.4 Insert the viscometer spindle, without plugging the vent holes of the spindle, into the hot A-R or other high-viscosity binder near the edge of the sample container for about 1 min to equilibrate to the sample temperature. Then move it to the test location, approximately at the center of the sample, to make the viscosity measurement. Immerse the spindle in the A-R or other high-viscosity binder to the manufacturer's depth mark on the connecting shaft. Use the level bubble to align the spindle perpendicular to the binder surface and level the viscometer.

After immersing the viscometer spindle in the A-R or other high-viscosity binder at the test location for 5 to 10 s, engage the viscometer and take a viscosity measurement in accordance with the manufacturer's instructions. Record the viscometer peak measurement as the viscosity test reading. The time interval between stirring, immersion of the spindle, and testing shall be approximately 15 s, and in no case greater than 20 s. Three measurements shall be taken and averaged and reported as the viscosity. Between measurements the viscometer spindle should be moved away from the center (without removing it from the A-R or other high-viscosity binder sample) and the sample should be thoroughly stirred again.

7.5 To clean the spindle assembly, return the viscometer to holder with spindle suspended in a suitable solvent. Before using the spindle again, wash off the solvent and dry the spindle to avoid solvent contamination of the next sample.

8. Reporting of Results

8.1 Report the test date, test temperature in °C or °F to the nearest degree and each of the three test viscosities to the nearest 0.1 Pa·s or 100 cP. Also report the average of the three viscosities to the nearest 0.1 Pa·s or 100 cP.

NOTE 2—Other information may be reported such as: project name and/or number, location of plant, material (A-R or other high-viscosity binder), supplier, equipment model.

9. Precision and Bias

9.1 *Precision*—An interlaboratory asphalt-rubber (A-R) round-robin study was conducted to develop the precision of the test and detailed results of that study can be found in ASTM Report Number D04-1039, entitled "Interlaboratory Handheld Viscometer A-R Round Robin Study to Estimate the Precision (Repeatability and Reproducibility) of the Proposed ASTM Standard Handheld Viscometer Test Method."[3] The study was conducted in August 2010 on a construction project in the Phoenix, Arizona metropolitan area. For the purposes of that study, twelve 1-gal cans of A-R were tested in the field using the handheld viscometer at 177 °C [350 °F] in accordance with the most current ASTM handheld viscometer draft testing standard. The cans were labeled from one to twelve for purposes of distribution to five laboratories to conduct the same test conducted in the field with the same type of equipment. Two cans were selected at random and were delivered to each of the five laboratories. Each laboratory reported the three viscosity measurements that they took for each sample. From this testing along with the three test measurements taken during construction for all twelve samples, it was possible to develop the precision statements for single-operator and multi-laboratory.

9.1.1 *Single-Operator Precision Statement (Repeatability):*

9.1.1.1 Duplicate values by the same operator using the same test equipment in the shortest practical period of time shall be considered not equivalent if the difference in the two results, expressed as a percent of the mean, exceeds 12.0 %.

9.1.2 *Multi-Laboratory Precision (Reproducibility):*

9.1.2.1 The values reported by each of two laboratories, representing the arithmetic average of duplicate determinations, shall be considered not equivalent if they differ by more than 22.0 %.

9.2 *Bias*—No information can be presented on the bias of the procedure in this test method for measuring viscosity because no material having an accepted reference value is available.

10. Keywords

10.1 asphalt-rubber; handheld rotational viscometer; viscosity

[3] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D04-1039. Contact ASTM Customer Service at service@astm.org