Designation: D8159 – 18

Standard Test Method for Automated Extraction of Asphalt Binder from Asphalt Mixtures[1]

This standard is issued under the fixed designation D8159; 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 test method covers the quantitative determination of asphalt binder content in asphalt mixtures and pavement specimens, using the automated computer controller or human-machine interface system (HMI), to perform a solvent extraction for specification acceptance, service evaluation, quality control, and research.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.4 An ILS is being conducted according to Practice E691 and will be available on or before December 2018. Therefore, this standard should not be used for acceptance or rejection of a material for purchasing purposes.

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *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]

D979/D979M Practice for Sampling Bituminous Paving Mixtures

D1461 Test Method for Moisture or Volatile Distillates in Asphalt Mixtures

D1856 Test Method for Recovery of Asphalt From Solution by Abson Method

D2042 Test Method for Solubility of Asphalt Materials in Trichloroethylene

D2872 Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)

D3666 Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing

D5404/D5404M Practice for Recovery of Asphalt from Solution Using the Rotary Evaporator

D5444 Test Method for Mechanical Size Analysis of Extracted Aggregate

D5546 Test Method for Solubility of Asphalt Binders in Toluene by Centrifuge (Withdrawn 2017)[3]

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 *AASHTO Standard:*[4]

R 47 Standard Practice for Reducing Samples of Hot Mix Asphalt (HMA) to Testing Size

3. Summary of Test Method

3.1 The asphalt paving mixture is extracted using the automated extraction equipment, using only the following solvent types: tetrachloroethylene, trichloroethylene, or methylene chloride. The asphalt binder content is calculated by the arithmetic difference between the mass of the moisture-free mixture and the mass of the extracted aggregate and mineral matter. This test method is used for quantitative determination

[1] This test method is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.25 on Analysis of Asphalt Mixtures.

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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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, http://www.transportation.org.

of asphalt binder in asphalt mixtures. The asphalt binder content is expressed as mass percent of moisture-free mixture (Pb).

4. Significance and Use

4.1 This test method is used for quantitative determination of asphalt binder in asphalt mixtures and asphalt pavement samples for specification acceptance, service evaluation, control, and research.

4.2 Aggregates obtained by this method may be used for sieve analysis using Test Method D5444. Extracted asphalt binder from this test method may be recovered using Test Method D1856 or Practice D5404/D5404M.

NOTE 1—The quality of results produced by this standard is dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of Specification D3666 are generally considered capable of competent and objective testing, sampling, inspection, etc. Users of this standard are cautioned that compliance with Specification D3666 alone does not completely ensure reliable results. Reliable results depend on many factors; following the suggestions of Specification D3666 or some similar acceptable guidance provides a means of evaluating and controlling some of those factors.

5. Apparatus

5.1 *Automated Extraction Unit,* consisting of a fully automated system with a process flow chart equivalent to the one reported in Fig. 1.

5.1.1 The automated extraction system shall be composed of the following components:

5.1.2 *Washing Chamber (Fig. 1, #1)*—Stainless steel washing chamber fitted with an ultrasonic device, a heating system, a rotating washing drum, and a closing door with a safety lock.

5.1.3 *Inspection Window (Fig. 1, #3)*—Transparent window, allowing monitoring of the color of the solvent flowing from the washing chamber to the centrifuge.

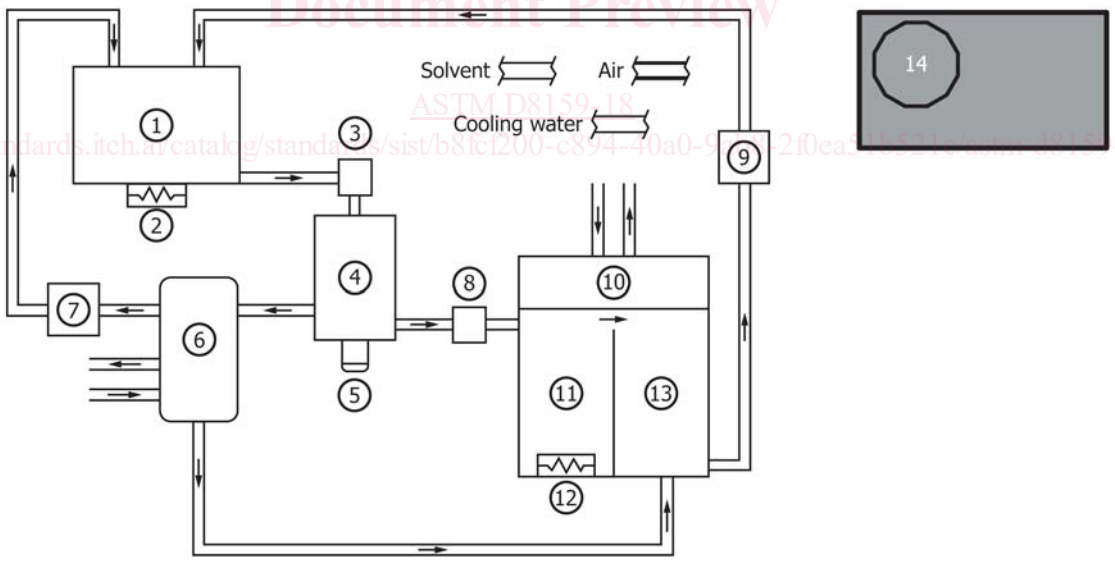
5.1.4 *Centrifuge (Fig. 1, #4)*—Stainless steel centrifuge casing with cover and safety lock. Internal centrifuge spindle capable of accommodating a cup with appropriate geometry and rotating at a speed suitable to ensure the separation between mineral filler passing the designated drum mesh sieve and solvent consistent with Section 6. To remove mineral filler from the cup after the centrifugation process, a special inlay paper is required inside the cup prior to start of extraction.

5.1.5 *Solvent Pump (Fig. 1, #9)*—Capable of transferring the solvent from the clean solvent tank to the washing chamber.

5.1.6 *Condenser (Fig. 1, #6)*—Stainless steel tank with built-in cooling coil for water cooling to condense solvent.

5.1.7 *Pump, Air or Vacuum (Fig. 1, #7)*—Solvent-resistant pump, able to circulate air and solvent vapors during the drying cycle. The circulation of the air ensures that the solvent vapors are extracted from the specimen and released in the condenser.

5.1.8 *Recovery Module*—Composed of two chambers and integrated cooling system, capable of adequately recovering solvent from an asphalt mixture. One chamber shall serve as a binder and solvent solution storage chamber, and the other serving as a clean solvent storage and recovery chamber. All chambers shall have the capability to allow transfer of solvent through the extraction process.



1. Washing chamber
2. Washing chamber heating system
3. Inspection window
4. Centrifuge
5. Centrifuge motor
6. Condenser
7. Vacuum or air pump
8. Outlet valve
9. Solvent pump
10. Integrated cooling system
11. Extracted binder and solvent solution tank
12. Distillation unit heating system for collection and partial solvent recovery
13. Clean solvent tank
14. Human-machine interface (HMI)

FIG. 1 Schematic Drawing of Automated Extraction Unit

5.1.8.1 *Solvent Recovery and Binder Storage Chamber,* fitted with heating system to distill solvent, fill level indicators to prevent heating when chamber is empty, and an outlet tap.

5.1.8.2 *Clean Solvent Storage and Recovery Chamber,* fitted with integrated cooling system, fill level indicator, outlet tap, and mechanism to allow solvent distillate to flow or be transferred back to washing chamber.

5.2 *Washing Drum (*Fig. 2*)*—A stainless steel washing drum able to contain the specimen. The cylindrical wall is made of mesh having an aperture of one of the following mesh sizes: 0.063 mm, 0.075 mm, or 0.090 mm. The mesh shall be interchangeable and resistant to wear and impacts from the aggregates during the test. The drum shall have a closing system (lid). The connection between the parts of the drum and the closing lid will ensure the sealing with regards to fine particles. (Any aperture should be smaller than the mesh filtering grade.)

NOTE 2—Washing drum mesh aperture can be selected according to individual user requirements for sieve size at which the mineral filler is separated from the recovered aggregate.

5.3 *Centrifuge Cup (*Fig. 3*)*—A stainless steel cup to collect mineral filler. Centrifuge cup capacity is either 200 g or 300 g.

NOTE 3—Centrifuge cup geometry varies; refer to manufacturer for appropriate centrifuge cup specifications.

5.4 Inlay paper for centrifuge cup shall meet the following specifications: weight: 40 g/m^2; pH neutral. Inlay paper size specifications are per manufacturer recommendation. See Note 4.

NOTE 4—Inlay paper suggested size: 383 by 205 mm. Other inlay paper types and sizes may be applicable; check with manufacturer before use.

5.5 *Oven,* capable of maintaining the temperature at 110 ± 5 °C.

5.6 *Pan,* capable of containing the specimen for the heating procedure.

5.7 *Balance,* readable to 0.1 g and capable of measuring the mass of specimen and container. The balance shall conform to the requirement of Guide D4753, Class GP2.

6. Reagents and Materials

6.1 *Purity of Reagents*—Unless otherwise indicated, all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society,

FIG. 3 Centrifuge Cup with Inlay Paper, to Collect Mineral Filler During Extraction (Placed Empty with Inlay Paper Inserted Prior to Extraction into Centrifuge Chamber in Fig. 1, #4)

where such specifications are available.[5] Other grades may be used if the reagent is of sufficiently high purity to permit its use without reducing the efficiency of extraction or damaging the equipment. For certain solvents, stabilization agents may be added to maintain required solvent quality based on manufacturer recommendations.

6.2 *Solvent*—One of the following solvents shall be used. No other solvents are approved for use in this procedure.

6.2.1 *Tetrachloroethylene,* reagent grade at initial filling. This solvent type must maintain solvent alkalinity above 7 ppm NaOH equivalent and pH value above 7.2. The solvent alkalinity and pH shall be verified once per week or at an interval selected at the discretion of the user based on machine usage and material type, or per manufacturer recommendations.

6.2.2 *Trichloroethylene,* reagent grade at initial filling. This solvent type must maintain solvent alkalinity above 7 ppm NaOH equivalent and pH value above 7.2. The solvent

[5] Reagent Chemicals, American Chemical Society Specifications, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

FIG. 2 Washing Drum with Lid, to be Filled with Asphalt Mixture Prior to Extraction (Fits into Washing Chamber in Fig. 1, #1)