



Designation: D6084/D6084M – 21

## Standard Test Method for Elastic Recovery of Asphalt Materials by Ductilometer<sup>1</sup>

This standard is issued under the fixed designation D6084/D6084M; 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 test method assesses the elastic recovery of an asphalt material measured by the recoverable strain determined after severing an elongated briquet specimen of the material of the form described in 4.1. The specimens are pulled to a specified distance at a specified speed and at a specified temperature. Unless otherwise specified, the test shall be made at a temperature of  $25 \pm 0.5$  °C [ $77 \pm 0.9$  °F] and with a speed of  $5$  cm/min  $\pm 5$  %.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.3 **Warning**—Mercury has been designated by the United States Environmental Protection Agency and many state agencies as a hazardous material that can cause central nervous system, kidney, and liver damage. Mercury, or its vapor, may be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury-containing products. See the applicable Material Safety Data Sheet (MSDS) for details and EPA's website (<http://www.epa.gov/mercury/index.htm>) for additional information. Users should be aware that selling mercury and/or mercury-containing products in your state may be prohibited by state law.

1.4 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.

1.5 *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.*

<sup>1</sup> 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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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:<sup>2</sup>

- C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- D5/D5M Test Method for Penetration of Bituminous Materials
- D113 Test Method for Ductility of Asphalt Materials
- D1754/D1754M Test Method for Effects of Heat and Air on Asphaltic Materials (Thin-Film Oven Test)
- 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
- D6934 Test Method for Residue by Evaporation of Emulsified Asphalt
- D6997 Test Method for Distillation of Emulsified Asphalt
- D7403 Test Method for Determination of Residue of Emulsified Asphalt by Low Temperature Vacuum Distillation
- D7497 Practice for Recovering Residue from Emulsified Asphalt Using Low-Temperature Evaporative Technique
- E1 Specification for ASTM Liquid-in-Glass Thermometers
- E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves
- E77 Test Method for Inspection and Verification of Thermometers
- E644 Test Methods for Testing Industrial Resistance Thermometers
- E1137/E1137M Specification for Industrial Platinum Resistance Thermometers
- E2251 Specification for Liquid-in-Glass ASTM Thermometers with Low-Hazard Precision Liquids

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

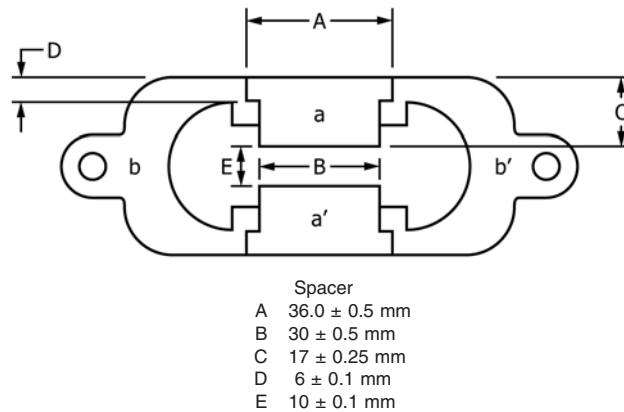


FIG. 1 Mold for Elastic Recovery Test Specimen

### 3. Significance and Use

3.1 This test method is useful in confirming that a material has been added to the asphalt to provide a significant elastomeric characteristic. It does not necessarily identify the type or amount of material added.

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.

### 4. Apparatus

4.1 *Mold*—The mold<sup>3</sup> shall be similar in design to that shown in Fig. 1. The mold shall be made of brass, 10.0 ± 0.1 mm thick, the ends *b* and *b'* being known as clips, and the parts *a* and *a'* as sides of the mold, with a brass base plate that is larger than the assembled mold. The dimensions of the assembled mold shall be as shown in Fig. 1, with the permissible variations indicated. (See Note 2.)

4.2 *Water Bath for Conditioning Specimen*—Maintain the water bath at the specified test temperature, varying not more than 0.5 °C [0.9 °F] from this temperature. The volume of water shall be not less than 10 L, and the specimen immersed to a depth of not less than 2.5 cm.

4.3 *Testing Machine*—For elongating the briquet of asphalt material, any apparatus may be used that is so constructed that the specimen will be continuously immersed in water, while the two clips are pulled apart at a uniform speed, as specified, without undue vibration. A variation of ±5 % is permissible. The water in the tank of the testing machine shall cover the specimen both above and below it by at least 2.5 cm, and shall be maintained within ±0.5 °C [0.9 °F] of the test temperature.

<sup>3</sup> The sole source of supply of the apparatus known to the committee at this time is Humboldt Manufacturing Company, 7300 W. Agatite Ave., Chicago, IL 60656. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,<sup>1</sup> which you may attend.

The testing machine shall incorporate a means by which the elongation can be measured in centimetres. (See Note 3.)

4.4 *Thermometer*—A thermometer for monitoring the temperature of the water bath. The thermometer shall be one of the following:

4.4.1 A liquid-in-glass thermometer of suitable range with subdivisions and maximum scale error of 0.1 °C [0.2 °F] which conforms to the requirements of Specification E1. The thermometer shall be standardized in accordance with one of the methods in Test Method E77.

4.4.2 A liquid-in-glass thermometer of suitable range with subdivisions and maximum scale error of 0.1 °C [0.2 °F] which conforms to the requirements of Specification E2251. The thermometer shall be standardized in accordance with one of the methods in Test Method E77.

4.4.3 A platinum resistance thermometer (PRT) with a probe which conforms to the requirements of Specification E1137/E1137M. The PRT shall have a three- or four-wire configuration and the overall sheath length shall be at least 50 mm [2 in.] greater than the immersion depth. The PRT system (probe and readout) shall be standardized in accordance with Test Methods E644. Corrections shall be applied to ensure measurements within 0.1 °C [0.2 °F].

4.4.4 A metal-sheathed thermistor with a sensor substantially similar in construction to the PRT probe described in 4.4.3. The thermistor system (sensor and readout) shall be standardized in accordance with Test Methods E644. Corrections shall be applied to ensure measurements within 0.1 °C [0.2 °F].

4.5 *Scissors*—Any type of conventional scissors capable of cutting the bituminous material at the test temperature.

4.6 *Oven*—An oven capable of maintaining 135 ± 5 °C [275 ± 10 °F].

4.7 *Sieves*—300-µm [No. 50] and 850-µm [No. 20] sieves, 75 mm [3 in.] in diameter, in accordance with Specification E11.

4.8 *Release Agent*—A mixture such as glycerin with Dextrin, talc, or Kaolin (china clay), or 1 g Versamid Resin per 100 g castor oil (not generic mineral oil), used to coat the bottom and sides of the mold to prevent the specimen from

sticking to the mold. Other materials may be used for this purpose if they have been shown not to affect the physical properties of the test specimen.

4.9 *Trimming Tool*—A straight-edged putty knife or spatula.

NOTE 2—Clips for the mold are the same as specified in Fig. 1 of Test Method **D113**.

NOTE 3—The testing machine may be the same as specified in Test Method **D113**.

NOTE 4—In those cases where the elastic recovery specimens are conditioned in the standard penetration bath at 25 °C [77 °F], the thermometer as prescribed for Test Method **D5/D5M** may be used.

## 5. Sample Preparation

5.1 *Emulsified Asphalt Residue*—If the sample is a residual product recovered from emulsified asphalt by means of the methods described in Test Methods **D6934**, **D6997**, **D7403**, or Practice **D7497**, stir the heated residue and immediately pour portions of the residue into suitable molds for making the required tests. If it is suspected that there is foreign matter in the residue, pour the material through a 300- $\mu\text{m}$  [No. 50] sieve that has been preheated at 135  $\pm$  5 °C [275  $\pm$  10 °F] prior to pouring into the test molds. (See **Note 5**.)

5.2 *Unaged Sample*—If the sample is an asphalt binder, carefully heat the sample in a covered container to prevent local overheating until it has become sufficiently fluid to pour. Use an oven set at 135  $\pm$  5 °C [275  $\pm$  10 °F] for sample heating. If it is suspected that the sample contains foreign matter, strain the melted sample through a 300- $\mu\text{m}$  [No. 50] sieve that has been preheated at 135  $\pm$  5 °C [275  $\pm$  10 °F]. (See **Note 6**.)

5.3 *Aged Sample*—If the sample is a conditioned residue obtained from Test Method **D1754/D1754M** or **D2872**, combine the residue into a single container, cover, and heat in an oven set at 135  $\pm$  5 °C [275  $\pm$  10 °F]. If it is suspected that the sample contains foreign matter, strain the melted sample through a 300- $\mu\text{m}$  [No. 50] sieve that has been preheated at 135  $\pm$  5 °C [275  $\pm$  10 °F]. (See **Note 6**.)

NOTE 5—In the case of higher viscosity emulsified asphalt residues or residues from lower temperature distillations that will not pass a 300- $\mu\text{m}$  (No. 50) sieve, an 850- $\mu\text{m}$  (No. 20) sieve may be used.

NOTE 6—In those cases where the samples are not sufficiently fluid to pour at 135 °C [275 °F], higher temperatures may be used. In the case of higher viscosity materials that will not pass a 300- $\mu\text{m}$  [No. 50] sieve, an 850- $\mu\text{m}$  [No. 20] sieve may be used.

## 6. Procedure

6.1 Assemble the mold on the brass plate. Thoroughly coat the surface of the plate and the interior surfaces of the sides of the mold, *a* and *a'*, with a thin layer of release agent to prevent the test material from sticking. The plate upon which the mold shall be placed shall be perfectly flat and level so that the bottom surface of the mold will be in contact throughout. After sample preparation as described in Section 5, thoroughly stir the sample and pour into the mold. In filling the mold, take care not to disarrange the pieces of the mold, thus distorting the shape. In filling, take care to pour and place material in a stream back and forth from end to end until the mold is more than level full. Allow the filled mold to cool to room temperature for 35  $\pm$  5 min. Then place in the water bath at the test

temperature for 30  $\pm$  5 min. Remove the test specimens from the water bath and immediately trim the excess material with a hot trimming tool to make the molds just level full. (See **Note 7**.)

6.2 *Keeping Specimens at Standard Temperature*—Place the trimmed specimen and mold in the water bath at the specified test temperature for 90  $\pm$  5 min prior to testing. Remove the specimen from the plate by a shearing action between specimen and plate, avoiding any bending of the test specimen. Remove the side pieces *a* and *a'*, being careful not to distort or fracture the specimen. Attach the specimen to the testing machine and immediately test the specimen.

6.3 *Testing, Procedure A*—Attach the rings at each end of the clips to the pins or hooks in the testing machine and pull the two clips apart at a uniform speed to an elongation of 10  $\pm$  0.25 cm, unless otherwise specified. Stop the elongation and immediately cut the test specimen into two halves at the midpoint using the scissors. Allow the specimen to remain in the testing machine in an undisturbed condition at the specified temperature for a period of 60 min. After the 60-min time period, carefully move the traveling carriage back to a position where the ends of the specimens just touch. If the specimen ends have sagged, carefully lift them to their original level prior to adjusting the ends to touch. Record the total length of the specimen with the severed ends just touching each other.

6.4 *Testing, Procedure B*—Attach the rings at each end of the clips to the pins or hooks in the testing machine and pull the two clips apart at a uniform speed to an elongation of 20  $\pm$  0.25 cm. Stop the elongation and maintain the specimen in this position for 5 min. Then, cut the test specimen into two halves at the midpoint using the scissors. Allow the specimen to remain in the testing machine in an undisturbed condition at the specified temperature for a period of 60 min. After the 60-min time period, carefully move the traveling carriage back to a position where the ends of the specimens just touch. If the specimen ends have sagged, carefully lift them to their original level prior to adjusting the ends to touch. Record the total length of the specimen with the severed ends just touching each other.

6.5 If the asphalt material comes in contact with the surface of the water or the bottom of the bath, the test shall not be considered normal. Adjust the specific gravity of the bath by the addition of either methyl alcohol, ethylene glycol, or sodium chloride so that the asphalt material neither comes to the surface of the water, nor touches the bottom of the bath at any time during the test, and rerun the test. If the sample fractures before reaching the specified elongation, the test shall not be considered normal.

NOTE 7—Mixing of clips and sides from different manufacturers may result in sample dimensions other than specified. Measure the width at the cross section of the assembled mold and compare to **Fig. 1**.

## 7. Calculation and Report

7.1 Calculate the percent recovery as follows:

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