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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Method for Elastic Recovery of Bituminous Materials by Ductilometer[1]

This standard is issued under the fixed designation D 6084; 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 elastic recovery of a bituminous 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 ± 0.5°C (77 ± 0.9°F) and with a speed of 5 cm/min ± 5.0 %.

1.2 The values stated in SI units are to be regarded as the standard.

1.3 *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:*

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials[2]
D 5 Test Method for Penetration of Bituminous Materials[3]
D 113 Test Method for Ductility of Bituminous Materials[3]
D 140 Practice for Sampling Bituminous Materials[3]
E 1 Specification for ASTM Thermometers[4]
E 11 Specification for Wire-Cloth Sieve for Testing Purposes[5]
E 77 Methods of Verification and Calibration of Thermometers[4]

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.

4. Apparatus

4.1 *Mold* [6]—The mold shall be similar in design to that shown in Fig. 1 . The mold shall be made of brass, the ends *b* and *b′* being known as clips, and the parts *a* and *a′* as sides of the mold. The dimensions of the assembled mold shall be as shown in Fig. 1 with the permissible variations indicated. (See Note 1.)

4.2 *Water Bath for Conditioning Specimen*—Maintain the water bath at the specified test temperature, varying not more than 0.1°C (0.18°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 10 cm and supported on a perforated shelf not less than 5 cm from the bottom of the bath.

4.3 *Testing Machine*— For elongating the briquet of bituminous material, any apparatus may be used that is so constructed that the specimen will be continuously immersed in water as specified in 6.3, while the two clips are pulled apart at a uniform speed, as specified, without undue vibration. The testing machine shall incorporate a means in which the elongation can be measured in centimetres. (See Note 2.)

4.4 *Thermometer*— A thermometer having a range as shown as follows and conforming to the requirements prescribed in Specification E 1. (See Note 3.)

Temperature Range	ASTM Thermometer No.
–8 to 32°C	63C
18 to 89°F	63F

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 ± 5.5°C (275 ± 10°F).

NOTE 1—Clips for the mold are the same as specified in Fig. 1 of Test Method D 113.

NOTE 2—The testing machine may be the same as specified in Test Method D 113.

NOTE 3—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 D 5 may be substituted in place of those shown.

5. Sample Preparation

5.1 *Asphalt Emulsion Residue*—If the sample is a residual

[1] This test method is under the jurisdiction of ASTM Committee D-4 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.44 on Rheological Tests.

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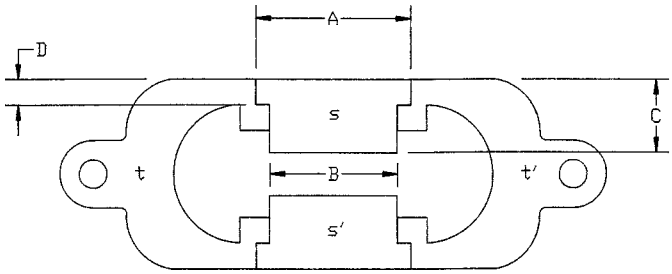
[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 04.03.

[4] *Annual Book of ASTM Standards*, Vol 14.03.

[5] *Annual Book of ASTM Standards*, Vol 14.02.

[6] 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, which you may attend.



Spacer
A 36.5 ± 0.1 mm
B 30 ± 0.1 mm
C 17 ± 0.1 mm
D 10 ± 0.1 mm

NOTE 1—Dimensions for t and t′ can be found in Test Method D 113.

FIG. 1 Mold for Ductility Test Specimen

product from the emulsion distillation test at 260°C (500°F) or a polymer modified asphalt emulsion residual product from a distillation at lower temperatures, stir the contents in the still and immediately pour portions of the residue into suitable molds for making the required tests. If it is suspected there is foreign matter in the residue, pour the material through a 300-µm (No. 50) sieve prior to pouring into the test molds. (See Note 4.)

5.2 *Ambient Sample*— If the sample is an asphalt cement or a polymer modified asphalt cement, 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 ± 5.5°C (275 ± 10°F) for sample heating. Strain the melted sample through a 300-µm (No. 50) sieve conforming to Specification E 11. (See Note 5.)

NOTE 4—In the case of higher viscosity emulsion residues or residues from lower temperature distillations that will not pass a 300-µm (No. 50) sieve, an 850-µm (No. 20) sieve may be used.

NOTE 5—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 µm (No. 50) sieve, an 850 µm (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 *a* and *a′*, of the mold with a thin layer of a mixture of glycerin and dextrin, talc, or kaolin (china clay) 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 in 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± 5 min then place in the water bath at the test temperature for 30 min. Remove the test specimens from the water bath and immediately trim the excess material with a hot putty knife or spatula to make the molds just level full. (See Note 6.)

6.2 *Keeping Specimens at Standard Temperature*—Place the trimmed specimen and mold in the water bath at the specified test temperature for 90 ± 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*—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 ± 0.25 cm unless otherwise specified. A variation of ±5 % from the speed specified will be permissible. 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. While the test is being made, 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 kept continuously at the temperature specified within 0.5°C (±0.9°F).

6.4 If the bituminous 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 or sodium chloride so that the bituminous material neither comes to the surface of the water, nor touches the bottom of the bath at any time during the test.

NOTE 6—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:

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

where:

E = original elongation of the specimen, cm, and

X = elongation of the specimen with severed ends just touching, cm.

7.1.1 Report to the nearest whole percent the average of three normal tests as the elastic recovery of the sample.

7.2 If the sample fractures before reaching the specified elongation, the test shall not be considered normal.

7.3 If a normal test is not obtainable on three tests, report the elastic recovery as being unobtainable under the conditions of the test.

7.4 It is suggested that a form sheet as shown in Fig. 2 be used to record the specific test conditions and results.

7.5 Report the sample thermal history handling information as shown in Fig. 2.

8. Precision and Bias [7]

8.1 *Precision*—Criteria for judging the acceptability of two single measurements (see Note 7) obtained by this test method are given as follows:

NOTE 7—Although this test method describes a (C5) result as the average of three single measurements, the precision estimates shown as follows are based on the analysis of single measurements. For comparing two test results, the single-operator (1*s*) and (*d*2*s*) estimates would be reduced by a factor of $1/\sqrt{3}$. The multilaboratory (1*s*) and (*d*2*s*) estimates would not change.

NOTE 8—The figures given in Column 3 are the standard deviations that have been found to be appropriate for the materials and mean values described in Columns 1 and 2 . The figures given in Column 4 are the limits that should not be exceeded by the difference between the results on two test specimens.

Materials Index	Standard Deviation[A]	Acceptable Range of Two Results[A]
Single-operator precision:		
1 (unmodified)	0.91	2.6
2 (modified)	0.56	1.6
Multilaboratory precision:		
1 (unmodified)	2.32	6.5
2 (modified)	1.71	4.8

[A] These numbers represent, respectively, the (1*s*) and (*d*2*s*) limits as described in Practice C 670.

8.2 *Bias*—Since there is no accepted reference material for determining the bias in this test method, no statement on bias is made.

9. Keywords

9.1 bituminous material; ductility; elastic; recovery

[7] This is based on the analysis of data resulting from tests by nine laboratories, each testing three replicate specimens. The conditions for this research report were as follows:

Test Temperature — 25°C
Speed — 5 cm/min
Elongation — 10 cm

Lab No.

Sample No.	1A	1B	1C	2A	2B	2C	Notes
Date:							
Test Temp.	25°C				25°C		
Speed (cm/min)	5				5		
Elongation (cm)	10				10		
Orig. Elongation (E)							
Elongation after (X)							
% Elastic Recovery							
Avg. % Elastic Recovery							

Additional Info.

Project:
Type Mat:

Handling Conditions
A.C. - Sieve Size:
Pour Temp:
? Reheat:

Emul. - Dist. Temp:
Sieve Size
? Reheat
Pour Temp.

FIG. 2 Sample Report Form