



# Standard Test Method for Ductility of Bituminous Materials<sup>1</sup>

This standard is issued under the fixed designation D 113; 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 approval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

## 1. Scope

1.1 The ductility of a bituminous material is measured by the distance to which it will elongate before breaking when two ends of a briquet specimen of the material, of the form described in Section 4, are pulled apart at a specified speed and at a specified temperature. Unless otherwise specified, the test shall be made at a temperature of  $25 \pm 0.5^\circ\text{C}$  and with a speed of  $5 \text{ cm/min} \pm 5.0\%$ . At other temperatures the speed should be specified.

1.2 *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<sup>2</sup>

D 5 Test Method for Penetration of Bituminous Materials<sup>3</sup>

D 1754 Test Method for Effects of Heat and Air on Asphaltic Materials (Thin-Film Oven Test)<sup>3</sup>

D 2872 Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)<sup>3</sup>

E 1 Specification for ASTM Thermometers<sup>4</sup>

E 11 Specification for Wire-Cloth Sieves for Testing Purposes<sup>5</sup>

## 3. Significance and Use

3.1 This test method provides one measure of tensile properties of bituminous materials and may be used to measure ductility for specification requirements.

## 4. Apparatus

4.1 *Mold*—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.

4.2 *Water Bath*—The water bath shall be maintained at the specified test temperature, varying not more than  $0.18^\circ\text{F}$  ( $0.1^\circ\text{C}$ ) from this temperature. The volume of water shall be not less than 10 L, and the specimen shall be immersed to a depth of not less than 10 cm and shall be supported on a perforated shelf not less than 5 cm from the bottom of the bath.

4.3 *Testing Machine*—For pulling the briquet of bituminous material apart, any apparatus may be used which is so constructed that the specimen will be continuously immersed in water as specified in 5.3, while the two clips are pulled apart at a uniform speed, as specified, without undue vibration.

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

|                          |                      |
|--------------------------|----------------------|
| Temperature Range        | ASTM Thermometer No. |
| –8 to $32^\circ\text{C}$ | 63C                  |

NOTE 1—In those cases where the ductility specimens are aged in the standard penetration bath at  $25^\circ\text{C}$ , the thermometer as prescribed for Test Method D 5 may be substituted in place of the above.

## 5. Procedure

5.1 Assemble the mold on a brass plate. Thoroughly coat the surface of the plate and interior surfaces of the sides  $a$  and  $a'$ , Fig. 1, of the mold with a thin layer of a mixture of glycerin and dextrin, talc, or kaolin (china clay) to prevent the material under test from sticking. The plate upon which the mold is placed shall be perfectly flat and level so that the bottom surface of the mold will be in contact throughout. Carefully heat the sample to prevent local overheating until it has become sufficiently fluid to pour. Strain the melted sample through a  $300\text{-}\mu\text{m}$  sieve conforming to Specification E 11. After a thorough stirring, pour it into the mold. In filling the mold, take care not to disarrange the parts and thus distort the briquet. In filling, pour the material in a thin stream back and forth from end to end of the mold until the mold is more than level full. Let the mold containing the material cool to room temperature

<sup>1</sup> 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.

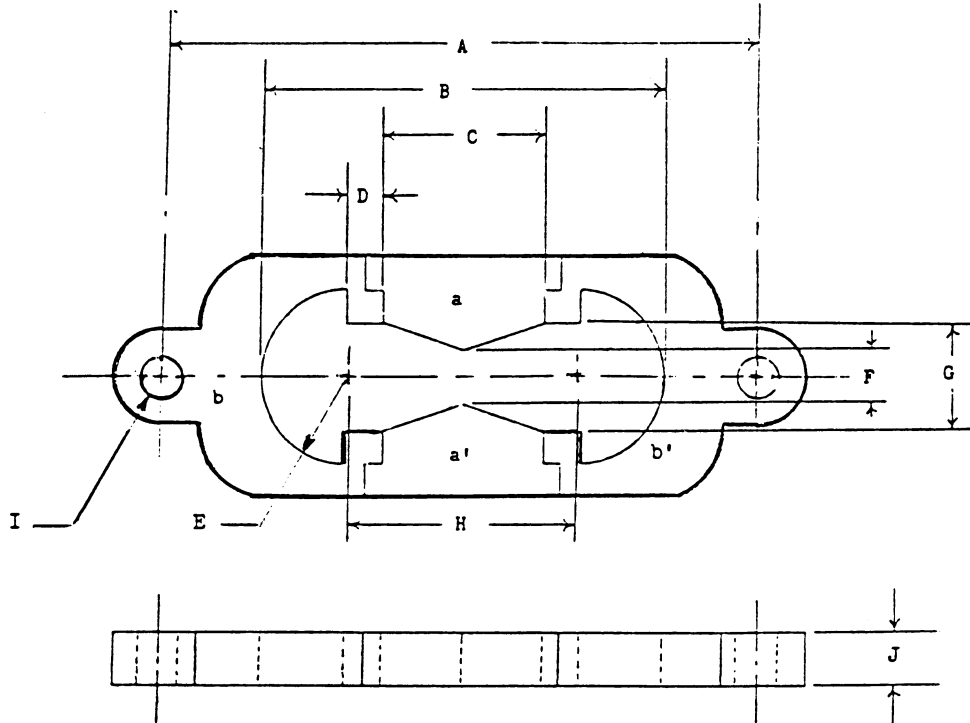
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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.02.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 04.03.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 14.03.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 14.02.



- A—Distance between centers, 111.5 to 113.5 mm.
- B—Total length of briquet, 74.5 to 75.5 mm.
- C—Distance between clips, 29.7 to 30.3 mm.
- D—Shoulder, 6.8 to 7.2 mm.
- E—Radius, 15.75 to 16.25 mm.
- F—Width at minimum cross section, 9.9 to 10.1 mm.
- G—Width at mouth of clip, 19.8 to 20.2 mm.
- H—Distance between centers of radii, 42.9 to 43.1 mm.
- I—Hole diameter, 6.5 to 6.7 mm.
- J—Thickness, 9.9 to 10.1 mm.

FIG. 1 Mold for Ductility Test Specimen

for a period of from 30 to 40 min and then place it in the water bath maintained at the specified temperature of test for 30 min; then cut off the excess bitumen with a hot straightedged putty knife or spatula to make the mold just level full.

5.2 *Keeping Specimen at Standard Temperature*—Place the brass plate and mold, with briquet specimen, in the water bath and keep at the specified temperature for a period of from 85 to 95 min. Then remove the briquet from the plate, detach the side pieces, and immediately test the briquet.

5.3 *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 as specified until the briquet ruptures. A variation of  $\pm 5\%$  from the speed specified will be permissible. Measure the distance in centimetres through which the clips have been pulled to produce rupture. 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.

## 6. Report

6.1 A normal test is one in which the material between the two clips pulls out to a point or thread until rupture occurs at

the point where the thread has practically no cross-sectional area. Report the average of three normal tests as the ductility of the sample.

6.2 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.

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

## 7. Precision

7.1 Criteria for judging the acceptability of ductility test results at 25°C obtained by this test method are shown in Fig. 2.

NOTE 2—The precision statement for ductility, as presented in Fig. 2, is based on tests performed on asphalt cements. The precision of tests on residues, such as those obtained by Test Methods D 1754 and D 2872, have not been established.

NOTE 3—The numbers plotted in Fig. 2 represent the (1S) and (D2S) limits for single operator precision and multilaboratory precision as

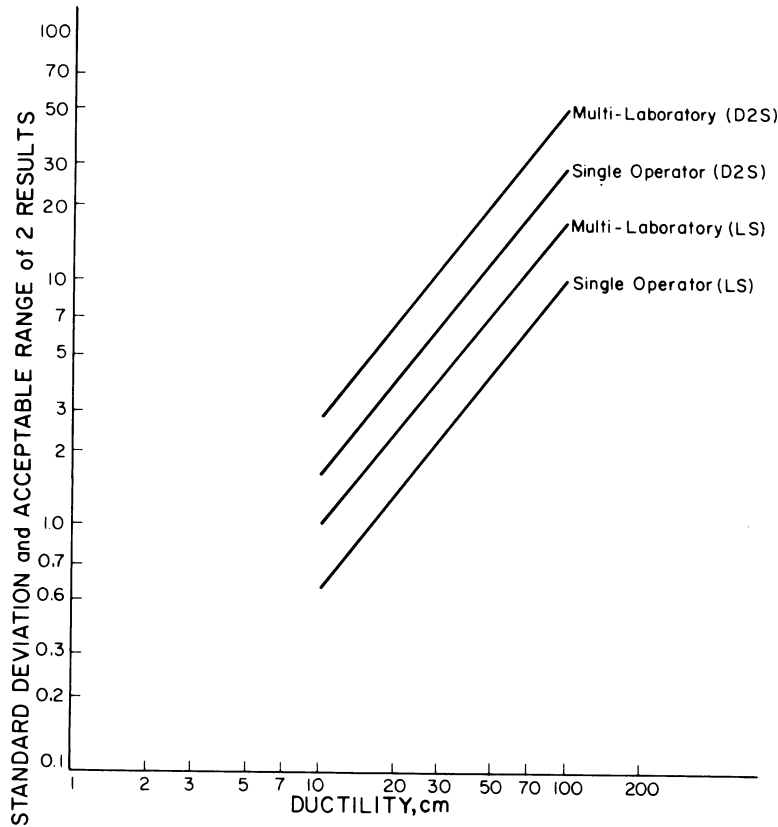


FIG. 2 Precision Data

described in Practice C 670.

NOTE 4—Insufficient data are available to properly define precision at 15.6°C. However, analysis of data resulting from tests by 13 laboratories on one asphalt for which the average ductility test result was 45 cm shows a multi-laboratory precision (D2S) of 23 cm.

## 8. Keywords

8.1 ductility; ductility mold; ductilometer

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