Designation: D3768 – 22

# Standard Test Method for Microcellular Urethanes—Flexural Recovery[1]

This standard is issued under the fixed designation D3768; 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 procedure and apparatus for measuring the flexural recovery of microcellular urethanes.

1.2 The values stated in SI units are to be regarded as 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—There is no known ISO equivalent to this standard.

1.4 *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]

D883 Terminology Relating to Plastics

D3040 Practice for Preparing Precision Statements for Standards Related to Rubber and Rubber Testing (Withdrawn 1987)[3]

D3489 Test Methods for Microcellular Urethane Materials

E456 Terminology Relating to Quality and Statistics

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

E2935 Practice for Evaluating Equivalence of Two Testing Processes

## 3. Terminology

3.1 Terms used in this standard are defined in accordance with Terminology D883, unless otherwise specified. For terms relating to precision and bias and associated issues, the terms used in this standard are defined in accordance with Terminology E456.

3.2 The following definition is from Test Methods D3489:

3.2.1 *microcellular urethane, n*—an elastomeric material made by the interaction of a polyol and an organic isocyanate, having cell diameters in the range from 0.0001 to 0.001 mm, with a minimum density of 160 kg/m$^3$ (10 lb/ft$^3$).

## 4. Significance and Use

4.1 This test method is used to indicate the ability of a material to recover after a 180° bend around a 12.7-mm (0.5-in.) diameter mandrel at room temperature.

4.2 Before proceeding with this test method, reference shall be made to any specification for the material being tested. Any test specimen preparation, conditioning, or dimensions, or combination thereof, and testing parameters covered in the materials specification shall take precedence over those mentioned in these test methods. If there are no material specifications, then the default conditions apply.

NOTE 2—This test method is applicable to solid urethanes.

## 5. Apparatus

5.1 *Flexural Recovery Test Fixture*—The test fixture shall consist of a 12.7-mm diameter mandrel mounted to a base equipped with a protractor. A drawing of a typical test fixture is shown in Fig. 1.

5.2 *Timer,* capable of indicating seconds.

5.3 *Thickness Indicator,* accurate to 0.03 mm.

## 6. Test Specimens

6.1 The test specimens shall be cut from molded plaques or parts. The recommended standard test specimen is 4 mm in thickness, and the minimum specimen thickness shall not be less than 3 mm. The specimen shall be 25 mm in width by 150 mm in length (1 by 6 in.).

[1] This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.22 on Cellular Materials - Plastics and Elastomers.

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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.

***A Summary of Changes section appears at the end of this standard**

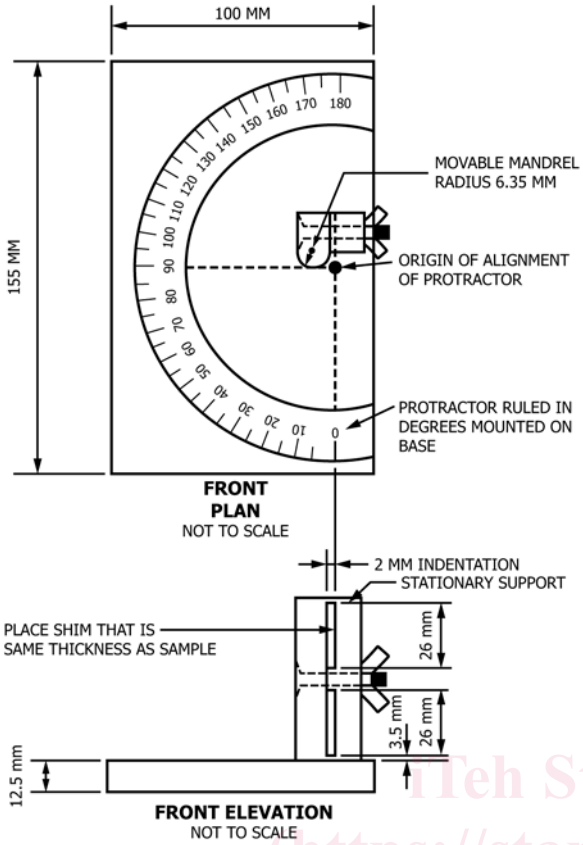


**FIG. 1 Example Fixture for Flexural Recovery Test**

## 7. Conditioning

7.1 *Conditioning*—Condition the test specimens and the test fixture at 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 10 % relative humidity for not less than 24 h prior to testing, unless otherwise specified.

7.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 10 % relative humidity, unless otherwise specified.

## 8. Procedure

8.1 There shall be at least three recovery measurements.

8.2 Measure the thickness of specimen to the nearest 0.03 mm.

8.3 Insert the test specimen in the lower slot of the specimen clamp and position the end of the specimen flush with the rear face of the bend mandrel. Tighten the clamp while holding the specimen in a horizontal position. (Do not allow the outer end of the specimen to be in contact with the base of the test fixture.) A spacer of approximately the same thickness as the test specimen must be used in the upper slot to ensure proper clamping in the lower slot. A specimen mounted in a test fixture at the start of a test is shown in Fig. 2.

8.4 Make an initial reading where the mandrel edge of the specimen (the surface of the test specimen that is in contact with the bend mandrel) intercepts the protractor scale. Make a reading to the nearest 1° and record the value.

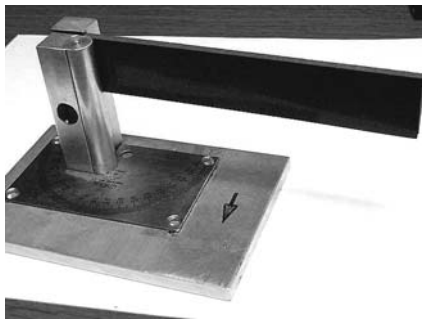

**FIG. 2 Specimen Mounted in Fixture**

8.5 Apply force approximately 30 mm (1.25 in.) from the clamp and bend the specimen 180° around the mandrel. Hold the specimen for 5 ± 1 s in the bent position, then release slowly and allow to recover. Start the timer immediately upon release. Do not allow the specimen to drag on the fixture base during recovery. A specimen that is being bent 180° around the mandrel is shown in Fig. 3.

8.6 Read the intercept of the mandrel edge of the specimen on the protractor scale after 30-s and 300-s recovery. The difference between these readings and the initial reading is the appropriate flexural recovery value in degrees.

## 9. Calculation

9.1 The intercept of the mandrel edge of the specimen on the protractor scale in degrees = φ.

9.2 The flexural set after 30 s is given by:
Flexural Set (30 s) = φ30 s − φ0 (see Note 3).

9.3 The flexural set after 300 s is given by:
Flexural Set (300 s) = φ300 s − φ0 (see Note 3).

NOTE 3—This measurement in the automotive industry is customarily referred to as recovery.

## 10. Report

10.1 The report shall include the following:
10.1.1 Direction of cutting,
10.1.2 Conditioning procedures before testing,
10.1.3 Flexural set (30 s), average of three,
10.1.4 Flexural set (300 s), average of three, and
10.1.5 Sample thickness.

## 11. Precision and Bias

11.1 The precision of this test method is based on an interlaboratory study of flexural recovery conducted in 1980.[4] Four laboratories tested three different materials. Every flexural recovery represents an individual determination. Each laboratory was asked to submit three replicate test results, from a single operator, for each material. Practice E691 was followed for the design and analysis of the data; the details are given in ASTM Research Report No. RR:D20-1191. (**Warning—**The data in Table 1 shall not be rigorously applied to acceptance or rejection of material, as those data are specific

[4] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D20-1191.

FIG. 3 Specimen Being Bent Around Mandrel

to the interlaboratory study and are not necessarily representative of other lots, conditions, materials, or laboratories. Users of this test method shall apply the principles outlined in Practice E691 to generate data specific to their laboratory and materials, or between specific laboratories.)

## 12. Keywords

12.1 flexural; microcellular; recovery; urethane