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# Standard Test Method for Flexibility of Resilient Flooring Materials with Cylindrical Mandrel Apparatus<sup>1</sup>

This standard is issued under the fixed designation F 137; 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.

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

## 1. Scope

1.1 This test method covers the determination of the flexibility of resilient flooring materials by means of cylindrical mandrel apparatus. It is especially applicable to sheet goods and some tiles.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are for information only.

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 to determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

E 691 [Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method](#) Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

F 141 [Terminology Relating to Resilient Floor Coverings](#)

## 3. Significance and Use

~~3.1 Flexibility is that property of a material which allows it to be deformed by bending or rolling without cracking, breaking, or other permanent defects, using whatever force is necessary to bend or roll it. Flexibility is an important characteristic of flooring in that it provides for ease of handling in rolling, cutting, and fitting. Terminology~~

~~3.1 For definitions, refer to Terminology F 141.~~

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## 5. Apparatus

~~4.1~~

5.1 Flexibility Test Equipment, consisting of mandrels, that is, cylindrical rods with circular cross sections having outside diameters of 0.25 in. (6.4 mm) and 0.50 to 5 in. (12.7 to 127 mm) increasing in increments of 0.5 in. (12.7 mm). The contacting faces of the rods shall be a minimum of 2.5 in. (63.5 mm) in length.

~~4.2~~

5.2 Stand or Other Device, to firmly support the mandrel in a horizontal position during the test.

~~4.3~~

5.3 Conditioning Area, capable of maintaining  $73.4 \pm 1.8^\circ\text{F}$  ( $23 \pm 1^\circ\text{C}$ ) and  $50 \pm 5\%$  relative humidity.

~~4.4~~

5.4 Die, Knife, or Similar Instrument to prepare test specimens with uniform smooth edges.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee F06 on Resilient Floor Coverings and is the direct responsibility of Subcommittee F06.20 on Test Methods - Products Construction/Materials.

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<sup>2</sup> 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.

## 5. Test Specimen

5.1 The test specimens shall consist of a portion of the material  $2 \pm 0.05$  in. ( $50 \pm 1.27$  mm) wide and at least 9 in. (225 mm) long.

5.2 Use a die, knife, or other similar instrument to prepare the specimen and to produce uniform smooth edges. Do not test specimens with nicked or fractured edges.

## 6. Conditioning

6.1 Condition the test specimens for at least 24 h at  $73.4 \pm 1.8^\circ\text{F}$  ( $23 \pm 1^\circ\text{C}$ ) and  $50 \pm 5\%$  relative humidity, and test in the same environment. Alternatively, testing may be performed at room temperature in an uncontrolled environment if carried out within 5 min.

6.2 Specimens shall be conditioned on a flat surface. If necessary, they can be weighted to remove all curvature.

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## 7. Conditioning

7.1 Condition the test specimens for at least 24 h at  $73.4 \pm 1.8^\circ\text{F}$  ( $23 \pm 1^\circ\text{C}$ ) and  $50 \pm 5\%$  relative humidity, and test in the same environment. Alternatively, testing may be performed at room temperature in an uncontrolled environment if carried out within 5 min.

7.2 Specimens shall be conditioned on a flat surface. If necessary, they can be weighted to remove all curvature.

## 8. Procedure

7.1

8.1 In the actual flexing of the specimen, place the specimen over a mandrel with the wearing surface face out and the major axis of the specimen perpendicular to the major axis of the mandrel.

7.2 Bend 8.2 Bend the material around the mandrel at a uniform rate through a  $180^\circ$  angle while holding the specimen at each end. Take 3 to 5 s to complete the bend. Maintain a good contact between specimen and mandrel.

7.3 Examine the specimen face visually in the bent position for breaks, cracks, or other damage at the completion of the bending operation. When required by the detailed specification, straighten the specimen at the same rate at which it was bent and examine the back for the same faults.

7.4 8.4 When a mandrel of particular diameter has been specified, as for a purchase specification, use that mandrel.

7.5

8.5 Determine the smallest mandrel around which the material may be bent without showing breaks, cracks, or other damage. To do this, estimate the size of the mandrel over which the specimen will not break. Then use a series of mandrels, each one consecutively smaller than the first, until breaks or cracks are exhibited. Start with a fresh specimen for each separate flex.

7.6

8.6 The exact number of test on a specified mandrel (7.4 8.4) or of the smallest mandrel around which the material will not break (7.5 8.5) shall be as specified in the given purchaser specification. In any case, make at least two separate determinations with the long dimension of the specimen parallel to the machine direction or grain of the material and two separate determinations with the long dimension perpendicular to the machine direction (MD) of the material.

NOTE 1—When the MD cannot be determined by the appearance of the material, two specimens shall be cut parallel to one edge of the material and two perpendicular to that set. Report that a MD could not be determined.

7.7 Repeat 7.1

8.7 Repeat 8.1, 7.4 8.4, and 7.6 8.6 or 7.1, 7.5 8.1, 8.5, and 7.6 8.6 with the specimen face inside against the mandrel. Examine the back, while the specimen is still in the bent position, for cracks, breaks, or other damage. Then straighten the specimens and examine the wearing surface. Use untested specimens for the face inward part of the test.

## 8. Precautions

8.1 When comparing materials the thicknesses should be approximately the same.

8.2 Avoid warming the specimens by hand.

8.3 Be careful in handling the specimens so that they are not flexed before testing.

## 9. Report

9.1 When the material is required to pass a specified mandrel, report the passing or failing of each specimen relative to this mandrel. The passing criteria is that neither the face nor the back may exhibit breaks, cracks, or other permanent damage (a different size mandrel may be specified for machine and cross-machine direction).

9.2 If no mandrel diameter is specified, report the smallest mandrel around which the material may be bent without showing breaks, cracks, or other permanent damage. Average the determinations in each direction (machine and cross-machine) and report separately. Precautions