



Designation: D2176 – 16

Standard Test Method for Folding Endurance of Paper and Plastics Film by the M.I.T. Tester¹

This standard is issued under the fixed designation D2176; 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.

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

1. Scope*

1.1 This test method describes the use of the M.I.T.-type folding apparatus for determining folding endurance of paper and plastics film. The M.I.T. tester can be adjusted for samples of any thickness; however, if the outer layers thicker than about 0.25 mm (0.01 in.) rupture during the first few folds, the test loses its significance. The procedure for the Schopper-type apparatus is given in Test Method [D643](#).

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not considered 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:*²

[D585 Practice for Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, and Related Product \(Withdrawn 2010\)](#)³

[D643 Test Method for Folding Endurance of Paper by the Schopper Tester \(Withdrawn 2010\)](#)³

[D685 Practice for Conditioning Paper and Paper Products for Testing](#)

[D1968 Terminology Relating to Paper and Paper Products](#)

¹ This classification system is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials.

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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.

[E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process](#)

3. Terminology

3.1 Definitions shall be in accordance with Terminology [D1968](#) and the *Dictionary of Paper*.⁴

4. Significance and Use

4.1 The folding endurance is frequently used to estimate the ability of the paper and plastics film to withstand repeated bending, folding, and creasing.

4.2 Folding endurance has also been found useful in measuring the deterioration of paper and plastics film upon aging.

5. Apparatus

5.1 *Folding Tester*, consisting of:

5.1.1 A spring-loaded clamping jaw constrained to move without rotation in a direction perpendicular to the axis of rotation of the folding head specified below and having its clamping surfaces in the plane of this axis. The load is applied by a spring attached to the jaw assembly which is easily adjustable to provide any desired tension on the specimen within range of 4.9 to 14.72 N (500 to 1500 gf). The deflection of the spring when loaded shall be at least 17 mm (0.67 in.)/9.81 N, which is achieved by using a weight of 1 kg mass.

5.1.2 An oscillating folding head supporting two smooth, cylindrical folding surfaces parallel to, and symmetrically placed with respect to, the axis of rotation. Each of the two folding surfaces shall have a radius of curvature of 0.38 mm (0.015 \pm 0.001 in.) and a width of 19 mm (0.75 \pm 0.04 in.). The distance separating the folding surfaces is greater than the uncompressed thickness of the specimen being tested by no more than 0.25 mm (0.010 in.). The position of the axis of rotation is midway between the common tangent planes of the two folding surfaces. The folding head is provided with a clamping jaw with its nearest edge not less than 9.5 mm (0.375

⁴ Available from Technological Association of the Pulp and Paper Industry (TAPPI), 15 Technology Parkway South, Suite 115, Peachtree Corners, GA 30092, http://www.tappi.org.

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