



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

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1. Scope

1.1 This test method describes the use of the M.I.T.-type folding apparatus for determining folding endurance of paper. The M.I.T. tester can be adjusted for papers of any thickness; however, if the outer fibrous layers of paper 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 D 643. This test method is the technical equivalent of TAPPI T 511.

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:

- D 585 Practice for Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, and Related Products²
- D 643 Test Method for Folding Endurance of Paper by the Schopper Tester²
- D 685 Practice for Conditioning Paper and Paper Products for Testing²
- D 1968 Terminology Relating to Paper and Paper Products²
- E 122 Practice for Calculating Sample Size to Estimate, with a Specified Tolerable Error, the Average for a Characteristic of a Lot or Process³

3. Terminology

3.1 Definitions shall be in accordance with Terminology D 1968 and the *Dictionary of Paper*.⁴

4. Significance and Use

4.1 The folding endurance of a paper is frequently used to estimate the ability of the paper to withstand repeated bending,

folding, and creasing, and may be encountered as a measure of the quality of bank note paper, or document paper.

4.2 Folding endurance has also been found useful in measuring the deterioration of paper 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 ± 0.001 in.) and a width of 19 mm (0.75 in. ± 0.04 in.). The distance separating the folding surfaces is greater than the uncompressed thickness of the paper 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 in.) beyond the axis of rotation. The rotary oscillating movement of the head is such as to fold the paper through an angle of $135^\circ \pm 2^\circ$, both to the right and to the left of the position of the unfolded specimen.

5.1.3 Various size folding heads are required for testing different thicknesses of paper. Heads available will accommodate thicknesses from 0 to 0.25 mm (0 to 0.01 in.), 0.25 to 0.50 mm (0.01 to 0.02 in.), 0.50 to 0.75 mm (0.02 to 0.03 in.), 0.75 to 1.02 mm (0.03 to 0.04 in.), and 1.02 to 1.25 mm (0.04 to 0.05 in.).

5.2 *Power Driven Device*, for imparting a rotary oscillating motion of 175 ± 25 cycles/min to the folding clamp.

5.3 *Counter*, for registering the number of double folds required to break the specimen and a device to stop the instrument when the specimen breaks.

5.4 *Strip Cutter*, to cut 15-mm wide parallel strips within ± 0.02 mm with clean edges.

¹ This test method is under the jurisdiction of ASTM Committee D06 on Paper and Paper Products and is the direct responsibility of Subcommittee D06.92 on Test Methods.

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² *Annual Book of ASTM Standards*, Vol 15.09.

³ *Annual Book of ASTM Standards*, Vol 14.02.

⁴ Available from the Technical Association of the Pulp and Paper Industry, P.O. Box 105113, Atlanta, GA 30348.