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Bending resistance of paper and paperboard by single-point bending method

1. Scope

This procedure is used to measure the bending resistance of paper and paperboard in the machine and cross machine directions, by determining the bending resistance in mN of a 38 mm (1.5 in.) wide vertically clamped sample, at 15° or 7.5° deflection. For this method the standard bending angle is $15 \pm 0.1^\circ$. For specimens that break or are otherwise unsuitable at 15° a bending angle of $7.5 \pm 0.1^\circ$ shall be used.

2. Significance

2.1 Bending resistance affects the product performance in many converting operations and end use applications including printing, packaging, etc.

3. Definitions

3.1 *Bending resistance*, the resistance offered to a bending force by a rectangular specimen, which is clamped along one side, measured under specified conditions. The bending resistance is considered to be measured towards the side (felt or wire) that is concave during bending. Bending resistance is commonly referred to as “stiffness”; however, this is incorrect for the engineering meaning of the wording.

3.2 *Machine direction bending resistance*, the bending resistance of a specimen, clamped with its machine direction perpendicular to the line of clamping.

3.3 *Cross direction bending resistance*, the bending resistance of a specimen, clamped with its cross direction perpendicular to the line of clamping.

4. Apparatus

4.1 A bending resistance tester (in Fig. 1, an enlarged diagram of the external bending assembly is shown in alternate positions) consisting of a clamp (B) 38.0 ± 0.1 mm (1.5 in.) wide with clamping surfaces mounted at $90 \pm 1.0^\circ$.

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It can be pivoted about a vertical axis (A) through the front edge of the clamping nip, and turned at a constant speed of $5^\circ \pm 0.5^\circ$ per second through bending angles of $7.5 \pm 0.1^\circ$ or $15.0 \pm 0.1^\circ$.

NOTE 1: Commercially available apparatus may have other fixed or variable bending angles available up to 30° ; however, they are not included in the scope of this method. Results obtained using these alternate angles must be reported accordingly, as indicated in section 9.1.

4.1.2 A knife (C) mounted vertically at $90 \pm 1.0^\circ$ and attached to a transducer (D). The length of knife-edge is 16 ± 2 mm (0.6 ± 0.08 in.) and the edge is centrally placed relative to the width of the test piece. The distance from its edge to the pivot axis of the clamp (A) is normally adjusted to 50.0 ± 0.1 mm (2.0 in.) or 10.0 ± 0.1 mm (0.4 in.). The knife is also mounted at $90 \pm 0.1^\circ$ in the direction perpendicular to the specimen.

NOTE 2: Commercially available apparatus may have other available bending lengths from 1.0 mm to 25.0 mm; however, they are not included in the scope of this method. Results obtained using these alternate bending lengths must be reported accordingly, as indicated in section 9.1.

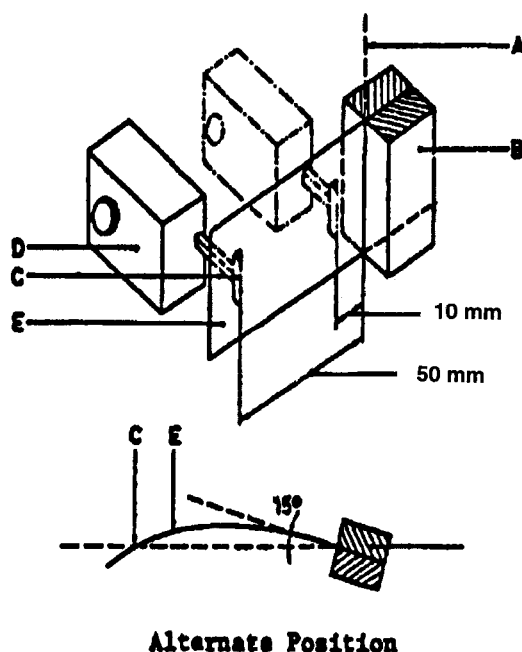


Fig. 1. Principle of the bending resistance tester: A. pivoting axis; B. clamping device; C. blunt knife-edge; D. force transducer with adjustable knife; E. test piece. The alternate position of the measurement head is indicated by the dashed lines.

4.1.3 The clamp must be at least 38 mm (1.5 in.) wide and at least 20 mm (0.8 in.) long with two flat and parallel jaws clamping the test piece uniformly. Normally, a clamping pressure of 200 ± 50 kPa (30 ± 7 psi) is suitable.

NOTE 3: Too low clamping pressure will give too low a bending resistance due to slippage between the surfaces of the jaws and the test piece. Too high a clamping pressure may, if thickness reduction occurs in the testing of low-density papers, also give too low a bending resistance. In case of uncertainty, make tests with varying clamping pressures. In general, the correct clamping pressures may be considered to be that which gives the highest bending value.

4.1.4 The force transducer (D) shall have a range between 0–1000 mN (0–2.25 lbf), or an optional 0–10,000 mN range, with an accuracy of $\pm 1.0\%$ of the nominal range. The transducer should have minimum sensitivity to lateral forces, and its movement in its response direction should be less than 0.05 mm (0.002 in.) when covering the full range of measurement.