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This Test Method may include safety precautions which are believed to be appropriate at the time of publication of the method. The intent of these is to alert the user of the method to safety issues related to such use. The user is responsible for determining that the safety precautions are complete and are appropriate to their use of the method, and for ensuring that suitable safety practices have not changed since publication of the method. This method may require the use, disposal, or both, of chemicals which may present serious health hazards to humans. Procedures for the handling of such substances are set forth on Material Safety Data Sheets which must be developed by all manufacturers and importers of potentially hazardous chemicals and maintained by all distributors of potentially hazardous chemicals. Prior to the use of this method, the user must determine whether any of the chemicals to be used or disposed of are potentially hazardous and, if so, must follow strictly the procedures specified by both the manufacturer, as well as local, state, and federal authorities for safe use and disposal of these chemicals.

Bending resistance (stiffness) of paper (Taber-type tester in 0 to 10 Taber stiffness unit configuration)

1. Scope

1.1 This test method covers a procedure used to measure the resistance to bending of papers which are of low grammage, or high flexibility, or both, and which exhibit bending stiffness in the range of 0 to 10 Taber stiffness units.

1.2 This test is used to determine the bending moment required to deflect the free end of a 38 mm (1.5 in.) wide vertically clamped specimen 15° from its center line when the load is applied 10 mm (0.39 in.) away from the clamp. The resistance to bending is calculated from the bending moment.

1.3 The instrument used in this test method is identical to that described in TAPPI T 489 “Bending Resistance (stiffness) of Paper and Paperboard,” used in the modified configuration described in section 6.2.4. Preparation of Apparatus.

1.4 Test results obtained using the Taber-Type Tester as described in this test method have been reported to be as much as 40% different from those obtained using TAPPI T 489, and this test method must not be used where TAPPI T 489 is specified.

2. Summary of test method

2.1 A test specimen of defined dimensions is bent through a specified angle using a specific testing instrument. The resulting bending moment is read from the instrument scale.

2.2 The resistance to bending can be calculated from the bending moment.

3. Significance and use

3.1 Bending resistance of paper having low grammage, high flexibility, or both relates to a number of end use applications including wrapping, printing, copy machine performance, high speed mechanical handling of documents and other applications.

4. Applicable documents

TAPPI T 400 "Sampling and Accepting A Single lot of Paper, Paperboard, Containerboard, or Related Product;" TAPPI T 402 "Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp Handsheets, and Related Products;" TAPPI T 489 "Bending Resistance (Stiffness) of Paper and Paperboard (Taber-Type Tester in Basic Configuration)."

5. Definitions

5.1 *Bending moment*, the torque in millinewton meters (force multiplied by the length of the level arm used to apply it) required to deflect the test piece under the specified conditions of the test.

5.2 *Resistance to bending*, the force, in Newtons, required to deflect a rectangular test piece, clamped at one end, through a specified angle when the force is applied near the free end of the test piece, normal to the plane which includes the near edge of the test piece, the clamp, and the point or line of application of the force. Resistance to bending will vary if the angle, the width of the rectangular test piece, or the distance between the edge of the clamp and the application of the force are changed from those specified. This is commonly referred to as stiffness.

5.3 *Stiffness (or bending stiffness)*, the degree to which paper or board resists bending when subjected to a bending force in its intended use, or when using a defined testing procedure such as the one described in this test method.

5.4 *Stiffness unit (or Taber stiffness unit)*, the common unit of stiffness measure used with instruments of the type described in this test method. Most Taber stiffness testers are calibrated in multiples of this unit. One Taber stiffness unit (gram-force centimeter) is equal to 0.098066 millinewton meters.

6. Apparatus¹

6.1 Description:

6.1.1 The basic instrument that has been used for the test described in this test method for nearly fifty years is a manually operated (crank-driven) instrument. Over the years, various improvements in the basic instrument have been made for improved ease of use or greater reproducibility of data, or both. These improvements include replacement of the manual (crank) drive system with a constant speed motor, addition of automatic data determination, and automated instrument (motor sequencing) operation. Fig. 1 shows the motor-driven version of the instrument (see 6.1.2). It is the motor-driven model of the basic instrument that is the basis for this test method. However, any of the instrument variations described in this section, when properly calibrated and operated, should yield the same result. The components of the basic instrument can be seen in Fig. 1 as follows:

6.1.1.1 A pendulum (A) supported by anti-friction bearings, carrying a vise (C) that has two clamping screws for holding and centering the test specimen, the lower edge of the vise coinciding with the center of the pendulum bearing. The pendulum is balanced, and at its lower end is a stud (D) to which weights may be attached and that loads the pendulum at a distance of 100 ± 0.025 mm (3.94 in.) from its center; without added weights the loading is 10 ± 0.001 g. A line (E) coinciding with the center line of the vise jaws and the weight stud (D), is engraved at the upper end of the pendulum.

6.1.1.2 A vertical disk (F), driven on the same axis as the pendulum by a driving mechanism, carries two driving arm attachments (G) so located as to provide the specimen with a cantilevered loading length of 50 ± 0.025 mm (1.97 in.) when it is deflected 15° . Fig. 1 does not show the crank driving mechanism. The driving arms have rollers (H) that are adjustable to accommodate specimens of different thicknesses. On the periphery of the upper part of the disk is a marked line (J) coinciding with the center line between the driving rollers (H) and the axis, and two reference lines (K and L) are engraved on the periphery of the disk at angular distances of 7.5° and 15° on both sides of the center mark (J).

6.1.1.3 Located around the periphery of the disk (F) is a fixed annular disk (M) with a load scale from 0 to 100 on both sides of a zero point that is adjusted to coincide with the center line mark (J), the scale indicating the bending moment required to flex the specimen to the right or to the left, the divisions being in accordance with the sine of the angle through which the pendulum and weight are turned.

6.1.1.4 A 10-unit compensating weight (X) to be mounted on the stud (Y) near the top of the pendulum when the instrument is used as described in this test method.

¹ Names of suppliers of testing equipment and materials for this method may be found on the Test Equipment Suppliers list, available as part of the CD or printed set of Standards, or on the TAPPI website general Standards page..