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An American National Standard

Standard Test Method for Book Bulk and Book Bulking Number of Paper[1]

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1. Scope

1.1 This test method provides a means of determining the book bulk and bulking number of printing paper under a specified pressure.

1.2 For thickness of single sheets or small packs of sheets, see Test Method D 645.

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:*

D 585 Practice for Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, and Related Product[2]

D 645 Test Method for Thickness of Paper and Paperboard[2]

D 685 Practice for Conditioning Paper and Paper Products for Testing[2]

D 1968 Terminology Relating to Paper and Paper Products[2]

3. Terminology

3.1 *Definitions*—Definitions shall be in accordance with Terminology D 1968 and the *Dictionary of Paper.*[3]

4. Summary of Test Method

4.1 A stack of sheets of a specified height or a specified number of sheets is placed between parallel platens, the specified pressure is applied, and the distance between the platen faces is read from an indicator.

5. Significance and Use

5.1 The measurement of book bulk by this test method is particularly useful to book manufacturers and printers for determining the probable thickness of a book consisting of a particular paper in a specified number of sheets or pages.

6. Apparatus

6.1 *Testing Instrument*, conforming to the following requirements:

6.1.1 *Two Metal Plane Parallel Circular Concentric Faces*, one movable, one fixed, and parallel to within ±0.1 mm (0.004 in.). The movable face, or platen, is 20 cm^2(about 3 $in.^2$) in area. The fixed platen has a diameter equal to or larger than that of the movable platen.

6.1.2 Means by which the movable platen may be raised to separate the platen faces by a distance of over 25 mm (about 1 in.) and be lowered with a pressure of 250 ± 10 kPa (36.3 ± 1.4 psi).

NOTE 1—It is convenient to be able to measure directly the bulk of books up to 51 mm (2 in.) in thickness. Hence, a platen separation of this amount is desirable. For some purposes, other pressures have been found useful; it should therefore be possible to apply, maintain, and indicate the pressure to the nearest 10 kPa (about 1.5 psi) throughout the range from 0 to 350 kPa (0 to about 50 psi).

6.1.3 Means by which the distance between the platen faces may be read, while under pressure, to the nearest 0.5 mm (0.02 in.), with an accuracy of ±0.25 mm (±0.01 in.).

7. Sampling and Test Specimens

7.1 Obtain a sample of the paper in accordance with Practice D 585, except use separate sheets for a test pack (test specimen) when the test unit is in the form of cut sheets or cut them from locations at least 300 mm (about 12 in.) apart when the test unit is in the form of a roll.

7.2 The specimens may consist of sheets of any size convenient for handling, but not less than 64 mm (about 2.5 in.) square. The number of sheets required for each test pack is as follows:

7.2.1 For procedure 10.1, the number of which the total bulk is desired to be known.

7.2.2 For procedure 10.2, the approximate number that will bulk 25 mm (about 1 in.) under the specified pressure.

7.3 From each test unit of the sample, prepare one test pack.

8. Calibration

8.1 *Parallelism of the Platens*:

8.1.1 Place a metal block with parallel faces, 25.4 mm (1 in.) thick, centrally between the platens. Place four narrow metal strips each of the same thickness and 20 to 50 mm long radially on the block at right angles with their inner ends

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

equidistant (10 mm) from the periphery of the platen. Apply the standard pressure and, by moving the outer ends of each strip angularly, check that the inner ends of the strips are gripped with the same force.

8.1.2 Alternatively, cover both faces of a metal block with parallel faces about 25 mm thick and over 50 mm in diameter with a sheet of filter paper and soft carbon paper. Apply standard pressure and rotate the block slightly. Disassemble and check that the carbon impression made by the pressure of the platens on the soft paper is uniform.

8.2 *Accuracy of Thickness Reading*—Set the instrument to zero, place standard steel gages or measured plates between the platens, apply the pressure, and check the corresponding reading over the range to be used.

8.3 *Pressure Between the Faces*:

8.3.1 Use a spring balance or system of weights and pulleys to determine the force required to just prevent the movable platen from moving downward when raised 25 mm (about 1 in.) above the fixed platen.

8.4 Alternately, calibrate by instrument manufacturer's procedures.

9. Conditioning

9.1 Condition the test specimens in accordance with Practice D 685, and make the tests in an atmosphere conforming to this test method.

10. Procedure

10.1 *Book Bulk*—Count and stack the number of sheets specified. (Orders for book paper generally specify the number of pages per inch of book thickness.) The wire sides of all sheets are to face the same way in the stack, unless another arrangement has been specified. Raise the upper platen and place the test pack on the lower platen with the edges uniformly aligned and projecting from the circular edge of the upper platen by at least 6 mm. Lower the upper plate to engage the top sheet of the test pack, then quickly apply and maintain a pressure of 250 kPa (about 36 psi) on the pack for 30 s. Determine the distance between the platens to the nearest 0.5 mm (0.02 in.) or less.

10.2 *Bulking Number*—Stack a sufficient number of sheets to bulk slightly more than 25 mm (about 1 in.) under moderate pressure applied by hand. Measure the thickness of the test pack in accordance with 10.1.

10.2.1 If the thickness of the test pack is between 24.4 and 26.4 mm (0.96 and 1.04 in.), calculate the number of sheets to bulk 25 mm (about 1 in.) by direct proportion.

10.2.2 If the thickness is less than 24.4 mm (0.96 in.) or more than 26.4 mm (1.04 in.), calculate the number of sheets required to bulk 25 mm (about 1 in.) and repeat 10.1 with the test pack containing the calculated number of sheets.

11. Report

11.1 Report the following information:

11.1.1 For book bulk (10.1), report the number of sheets in the test pack and their book bulk in millimetres.

11.1.2 For bulking number (10.2), report the number of sheets required to bulk 25 mm (about 1 in.).

11.1.3 Where a specification requires bulking number in inches, multiply the bulking number (sheets per 25 mm) by 1.016 to convert to sheets per 1.0 in.

12. Precision and Bias

12.1 *Precision*:

12.1.1 *Repeatability (Within a Laboratory)*:

12.1.1.1 *Book Bulk*—0.8 mm (0.03 in.).

12.1.1.2 *Bulking Number*—3 % of the number of sheets required to bulk 25 mm (about 1 in.).

12.1.2 *Reproducibility (Between Laboratories)*:

12.1.2.1 *Book Bulk*—1.5 mm (0.05 in.).

12.1.2.2 *Bulking Number*—5 % of the number of sheets required to bulk 25 mm (about 1 in.).

12.2 *Bias*—The procedure in this test method has no bias because the value of book bulk or bulking number is defined only in terms of this test method.

13. Keywords

13.1 book bulk; bulking number; paper; printing paper