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WI \_\_\_\_\_ 180808.02 \_\_\_\_\_

T \_\_\_\_\_ 500 \_\_\_\_\_

DRAFT NO. \_\_\_\_\_ 3 SARG \_\_\_\_\_

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WORKING GROUP  
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SUBJECT  
CATEGORY \_\_\_\_\_ Physical Properties \_\_\_\_\_

RELATED  
METHODS \_\_\_\_\_ See "Additional Information" \_\_\_\_\_

**CAUTION:**

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 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.

**Book bulk and bulking number of paper  
(Proposed Reaffirmation of T 500 cm-07 as a Classical  
Method)  
(No changes from previous drafts. Standard Reaffirmed)**

**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 TAPPI T 411 "Thickness (caliper) of paper and paperboard."

**2. Summary**

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 the indicator.

### 3. Significance

The measurement of book bulk by this 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.

### 4. Definitions

4.1 *Book bulk*, the overall thickness in mm of a given number of sheets.

4.2 *Bulking number*, the number of sheets required to bulk 25 mm (about 1 in.).

### 5. Apparatus

5.1 *Thickness instrument*, consisting of:

5.1.1 *Two metal plane parallel circular concentric faces*, one movable, one fixed, and parallel to within  $\pm 0.1$  mm (0.004 in.). The movable face, or platen, is 20 cm<sup>2</sup> (about 3 in.<sup>2</sup>) in area. The fixed platen has a diameter equal to or larger than that of the movable platen.

5.1.2 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  $250 \pm 10$  kPa ( $36.3 \pm 1.4$  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 of 0–350 kPa (0 to about 50 psi).

5.1.3 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  $\pm 0.25$  mm ( $\pm 0.01$  in.).

### 6. Calibration

6.1 *Parallelism of the platens*

6.1.1 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 20–50 mm long radially on the block at right angles with their

inner ends 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.

6.1.2 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.

6.2 Accuracy of thickness reading.

6.2.1 Set the instrument to zero, place standard steel gauges or measured plates between the platens, apply the pressure, and check the corresponding reading over the range to be used.

6.3 Pressure between the faces.

6.3.1 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.

6.4 Alternately, calibrate by instrument manufacturer's procedures.

## 7. Sampling and test specimens

7.1 Obtain a sample of the paper in accordance with TAPPI T 400 "Sampling and accepting a single lot of paper, paperboard, Containerboard, or related product," 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 either: for procedure 9.1, the number of which the total bulk is desired to be known; or for procedure 9.2, 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. Conditioning

Condition and test the packs in an atmosphere in accordance with TAPPI T 402 "Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp Handsheets, and Related Products."

## 9. Procedure

9.1 *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.

9.2 *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 procedure 9.1.

9.2.1 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.

9.2.2 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 procedure 9.1 with the test pack containing the calculated number of sheets.

## 10. Report

10.1 For book bulk (Procedure 9.1), report the number of sheets in the test pack and their book bulk in mm.

10.2 For bulking number (Procedure 9.2), report the number of sheets required to bulk 25 mm (about 1 in.). For such cases where specifications call for “pages per inch,” the conversion number for bulking number for pages per 1.0 inch to pages per 25 mm would be 1.016.

## 11. Precision

11.1 Repeatability (within a laboratory) = 0.8 mm (0.03 in.) or 3% of the number of sheets required to bulk 25 mm (about 1 in.);

11.2 Comparability (between materials) = not known;

11.3 Reproducibility (between laboratories) = 1.3 mm (0.05 in.) or 5% of the number of sheets required to bulk 25.4 mm (1.00 in.); in accordance with the definition of these terms in T 1206 “Precision statement for test methods.”

## 12. Keywords

Paper, Bulk, Bulk number, Books, Thickness

**13. Additional information**

13.1 Effective date of issue: to be assigned.

13.2 Related methods: ASTM D 2175; AS/NZS P-426, and PAPTAC D.5H.

13.3 Reclassified as a Classical Method by vote of the Physical Properties Committee, 1998. The method, while valid, is seldom used. More often, the thickness of single sheets, or of small stack of sheets, measured in accordance with TAPPI T 411 “Thickness (Caliper) of Paper, Paperboard, and Combined Board,” is used for this purpose. The method was reissued in 2007 with only minor editorial changes.

*Your comments and suggestions on this procedure are earnestly requested and should be sent to the TAPPI Standards Department.* ■