

# ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

## ISO RECOMMENDATION R 438

METHOD FOR THE DETERMINATION  
OF THE BULKING THICKNESS AND BULK OF PAPER

1st EDITION

June 1965

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AMENDMENT 1 - JANUARY 1967  
TO ISO RECOMMENDATION R 438-1965

**Amendment 1**  
**to ISO Recommendation R 438-1965**

**METHOD FOR THE DETERMINATION**  
**OF THE BULKING THICKNESS AND BULK OF PAPER**

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*Amend the second line of the table to read as follows:*

|                       |  |   |
|-----------------------|--|---|
| Area of pressure foot | 200 mm <sup>2</sup><br>(nominal value) | 0.31 in <sup>2</sup><br>(nominal value) |
|-----------------------|--|---|

This Amendment is the logical result of the acceptance of ISO Recommendation R 534-1966,  
*Determination of the Thickness of Single Sheets of Paper.*

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## BRIEF HISTORY

The ISO Recommendation R 438, *Method for the Determination of the Bulking Thickness and Bulk of Paper*, was drawn up by Technical Committee ISO/TC 6, *Paper*, the Secretariat of which is held by the Association Française de Normalisation (AFNOR).

Work on this question by the Technical Committee began in 1958 and led, in 1961, to the adoption of a Draft ISO Recommendation.

In October 1961, this Draft ISO Recommendation (No. 475) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

|                |             |                |
|----------------|-------------|----------------|
| Belgium        | Greece      | Romania        |
| Brazil         | Israel      | Sweden         |
| Bulgaria       | Italy       | Turkey         |
| Czechoslovakia | Japan       | U.A.R.         |
| Denmark        | Netherlands | United Kingdom |
| Finland        | Norway      | U.S.S.R.       |
| France         | Poland      | Yugoslavia     |
| Germany        | Portugal    |                |

Four Member Bodies opposed the approval of the Draft:

Australia      Canada      India      U.S.A.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in June 1965, to accept it as an ISO RECOMMENDATION.

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## METHOD FOR THE DETERMINATION OF THE BULKING THICKNESS AND BULK OF PAPER

### 1. OBJECT AND SCOPE

This ISO Recommendation describes a method of measuring the bulking thickness of papers up to a substance of 250 g per square metre.

Knowledge of the bulking thickness and of the mass of the paper permits the calculation of the bulk.

### 2. DEFINITIONS

**2.1** *Bulking thickness.* Thickness of a single sheet calculated from the measurement of the thickness of several superposed sheets (called a pack), when a static load is applied.

**2.2** *Bulk.* Volume in cubic centimetres occupied by one gramme of paper in the form of a pack of superposed sheets.

### 3. PRINCIPLE

The method is based on the use of a precision dial micrometer to measure the thickness of a pack of sheets when a static load is applied.

Results for thickness are given in terms of the bulking thickness per sheet.

### 4. EQUIPMENT

#### 4.1 Precision dial micrometer

This instrument is provided with two parallel plane faces between which the paper is placed for measurement. One of the faces should be capable of movement in a direction perpendicular to the other, which is fixed. The movable face (or pressure foot) should be circular. The fixed face (or anvil) should also be circular and of such size that the whole area of the pressure foot is in contact with the anvil in the zero position.

To ensure that the pressure between the faces is uniform within the limits given, the use of a dead weight rather than a spring is preferred.

The instrument should be checked in accordance with the procedure detailed in the Appendix and should conform to the following:

|  | Metric system                   | Inch system                    |
|--|---------------------------------|--------------------------------|
| Diameter of pressure foot                            | 16 ± 0.5 mm                     | 0.65 ± 0.02 in                 |
| Area of pressure foot                                | 200 ± 10 mm <sup>2</sup>        | 0.31 ± 0.015 in <sup>2</sup>   |
| Pressure exerted by the foot                         | 1.00 ± 0.10 kgf/cm <sup>2</sup> | 14.2 ± 1.5 lbf/in <sup>2</sup> |
| Repeatability of measurement<br>(standard deviation) | ≤ 0.0025 mm or 0.5 per cent*    | ≤ 0.0001 in or 0.5 per cent*   |
| Indication error                                     | ± 0.0025 mm or ± 0.5 per cent*  | ± 0.0001 in or 0.5 per cent *  |
| Error of parallelism of foot and anvil               | ≤ 0.0050 mm or 1 per cent*      | ≤ 0.0002 in or 1 per cent *    |

#### 4.2 Auxiliary apparatus

A set of feeler gauges of thickness known to within 0.001 mm or 0.000 04 in.

#### 4.3 Calibration of the instrument

The instrument should be calibrated at reasonable intervals. The Appendix gives details as to the procedure to be followed. For instruments in frequent use, it is suggested that the calibration be checked daily for repeatability and accuracy, and monthly for parallelism and foot pressure.

### 5. PREPARATION OF TEST PIECES

The test pieces (a minimum of four) are composed of the same number of sheets (a minimum of five). Each sheet is cut to a size of 20 cm × 25 cm\*\* from a specimen taken at random from those that had been selected according to ISO Recommendation R 186, *Method of sampling paper for testing*, and then conditioned according to ISO Recommendation R 187, *Method for the conditioning of paper and board test samples*.

The sheets forming the test piece are superposed as a pack. The sheets should all face the same way, i.e. the wire side of one sheet should be against the top side of the other. Each sheet should be independent of the remainder; one sheet folded and inserted into the test piece to form two or more sheets is not satisfactory.

### 6. TEST PROCEDURE

The tests are made in the ISO standard reference atmosphere (see ISO Recommendation R 187, section 4).

Make five measurements on each test piece defined above. These measurements are made between 4 and 8 cm from the sides of the test piece and distributed along the two sides parallel to the cross direction of the paper, three on one side and two on the other, as indicated in the figure below.

\* Whichever is the greater.

\*\* The length of 25 cm being, where practicable, in the cross direction.