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Paper and board — Determination of tensile strength

Papiers et cartons — Détermination de la résistance à la traction

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

Prior to 1972, the results of the work of the Technical Committees were published as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, Technical Committee ISO/TC 6 has reviewed ISO Recommendation R 1924 and found it suitable for transformation. International Standard ISO 1924 therefore replaces ISO Recommendation R 1924-1971.

ISO Recommendation R 1924 was approved by the Member Bodies of the following countries :

Australia	Greece	Sweden
Belgium	India	Switzerland
Canada	Israel	Thailand
Czechoslovakia	Netherlands	Turkey
Egypt, Arab Rep. of	Norway	United Kingdom
Finland	Portugal	U.S.S.R.
France	Romania	
Germany	South Africa, Rep. of	

The Member Body of the following country expressed disapproval of the Recommendation on technical grounds :

U.S.A.

The Member Body of the following country disapproved the transformation of ISO/R 1924 into an International Standard :

Sweden

Paper and board — Determination of tensile strength

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method for measuring the tensile strength of paper and board.

The procedure described in this International Standard is applicable, within the limitation of the instruments used, to all types of paper and board generally up to a basis weight (substance) of 400 g/m².

It does not apply to combined corrugated board.

This International Standard has been prepared in a form which has a general application and is not limited to any particular type of tensile testing apparatus.

2 REFERENCES

ISO/R 186, *Method of sampling paper and board for testing*.

ISO/R 187, *Method for the conditioning of paper and board test samples*.

ISO/R 536, *Determination of paper substance*.

3 DEFINITIONS

For the purposes of this International Standard, the following definitions apply :

3.1 tensile strength : The limiting resistance of a test piece of paper or board submitted to a breaking force applied to each of its ends under the conditions defined in this International Standard.

3.2 breaking length : The calculated limiting length of a strip of paper or board of any uniform width, beyond which, if such a strip were suspended by one end, it would break by its own weight.

4 PRINCIPLE

Measurement of the tensile force required to cause failure of a test piece of given dimensions when applied under standardized test conditions.

5 APPARATUS

Any system may be used which is capable of acting on the test piece at the defined rate and of permitting the tensile force at the moment of failure to be read to an accuracy of 1 %.

The rate of loading should be so adjustable that failure of the test piece can be obtained in a mean time of 20 ± 5 s¹⁾. When a substantially inextensible material is gripped between the clamps and a full scale reading is obtained in 20 s, the rate of loading at any time shall not differ by more than 5 % from the rate of loading 1 s later.

1) This rate is not always possible without modification using existing commercial testing apparatus, on all types of paper (for rapidity in routine testing, 10 ± 5 s is often used but this will give results about 2 % higher than the specified method).

The centre line of the clamps and of the test piece shall lie along the same axis, which shall also be parallel to the direction of the applied force. The clamping surfaces of the two clamps (flat clamps) or lines of contact (line contact clamps) shall be in the same plane and so aligned that they hold the test piece in that plane throughout the test.

The clamps shall grip the test piece firmly along its full width, without slipping, throughout the test.

At the start of the test the lines of contact (if line contact clamps are used) or the inner edges of the contact areas shall be 180 ± 2 mm apart and shall be perpendicular to the direction of application of the force throughout the test.

6 PREPARATION OF THE TEST PIECE

6.1 Sampling

Sampling shall be carried out in accordance with ISO/R 186. The samples shall be conditioned in accordance with ISO/R 187, and an equal number of test pieces for machine direction and cross direction tests shall then be cut. No creases, obvious flaws or watermarks shall be included in the test area and test pieces shall not include any part of the sample within 15 mm of the edge of any sheet or roll. If it is necessary to include watermarks, this fact shall be reported.

The width of the test pieces required is $15,0 \pm 0,1$ mm. The minimum length of test piece shall in general be 250 mm but instrument jaw design may require the preparation of longer or shorter test pieces.

NOTE — For certain materials, such as coarse building papers or boards over 3 mm thick, tissues or filter papers, a test piece of greater width, such as $25,0 \pm 0,1$ mm, may be used if the apparatus can accommodate such a width. If this is done, the width of the test piece shall be stated in the test report.

The central 180 mm of the test piece shall be handled as little as possible before testing.

6.2 Conditioning

Test pieces shall be conditioned and tested in an atmosphere in accordance with ISO/R 187. The duration of the conditioning process will be determined by the type of material being tested.

6.3 Cutting of test pieces

Sufficient test pieces shall be cut from each specimen to enable at least ten tests to be made in both the machine direction and cross direction.

7 PROCEDURE

7.1 Calibration of apparatus

Set up the apparatus as recommended by the manufacturer. A suitable method of calibration is to apply weights to the clamp actuating the load-indicating mechanism with the

instrument otherwise in its normal working condition. Note the scale reading when the system comes into equilibrium in the same time as that used in actual testing. Check the correct operation of the indicating mechanism, which should be free from excessive backlash, lag, or friction. If errors of more than 1 % are found, use a correction curve.

7.2 Test method

Unless otherwise stipulated in this method, carry out the operation involved in the measurement of the tensile strength of each test piece in the manner recommended by the manufacturer of the apparatus in use.

The test length (the distance between the closest points at which the test piece is firmly gripped) shall initially be 180 ± 2 mm (see note 1).

By an initial trial experiment, select a rate of application of tensile force which causes failure in a mean time of 20 ± 5 s.

Clamp the test piece within the jaws of the apparatus so that no slipping occurs during the test; (it is essential that the test piece be clamped in such a manner that its edges are parallel to the direction of application of the tensile force, and the test length at the start of the test is within the tolerance of ± 2 mm given above). Ignore tests which result in failure within 10 mm of the line of contact, or the inner edge of the contact area of the clamps (see note 2).

Read the breaking force to a consistent number of decimal places and record to two or three significant figures, as the graduations allow, and note the "time to break" to the nearest second.

If breaking length is required, determine the grammage (basis weight or substance) of the material according to ISO/R 536.

NOTES

1 In some instances, the dimensions of the specimens are not such as to permit test pieces to be cut as specified in this procedure. This is frequently true, for instance, in the case of laboratory handsheets. In such cases the test length shall preferably be 100 ± 2 mm and the length used shall be clearly stated in the report. With test lengths shorter than 180 mm, higher results will normally be obtained.

2 If test pieces regularly break at or near a clamp, find the reason and rectify it.

8 EXPRESSION OF RESULTS

Calculate the tensile strength as follows :

$$S = \frac{\text{scale reading in newtons} \times 15,0}{w}$$

or

$$S = \frac{9,8 \times \text{scale reading in kilogrammes-force} \times 15,0}{w}$$