

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 1974

PAPER

DETERMINATION OF TEARING RESISTANCE

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BRIEF HISTORY

The ISO Recommendation R 1974, *Paper – Determination of tearing resistance*, was drawn up by Technical Committee ISO/TC 6, *Paper, board and pulps*, the Secretariat of which is held by the Association Française de Normalisation (AFNOR).

Work on this question led to the adoption of Draft ISO Recommendation No. 1974, which was circulated to all the ISO Member Bodies for enquiry in May 1970. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

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

No Member Body opposed the approval of the Draft.

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

PAPER

DETERMINATION OF TEARING RESISTANCE

1. SCOPE

This ISO Recommendation describes a method for determining the internal tearing resistance of paper. It may also be used for light boards if the tearing resistance is within the range of the instrument used. It does not apply to combined corrugated boards.

2. DEFINITIONS

For the purposes of this ISO Recommendation, *internal tearing resistance* is defined as the mean force required to continue the tearing of an initial cut in a single sheet of paper. If the initial slit is in the machine direction, the result is given as machine direction tearing resistance; similarly for the cross direction.

The *tear factor* is 100 times the tearing resistance divided by the grammage (basis weight) of the paper.

3. PRINCIPLE OF THE METHOD

An initial cut or cuts is/are made

- (a) in several sheets simultaneously, or
- (b) in a single sheet of paper.

Several (normally four) sheets together, or the single sheet, are/is torn through a fixed distance using a pendulum to apply the tearing force. The work done in tearing the test piece is measured by the loss in potential energy of the pendulum. The scale is calibrated to indicate the average tearing force (work done divided by the total distance torn). The internal tearing resistance of the paper is determined from the average tearing force and the number of sheets in the test piece.

4. APPARATUS

There are two basic designs of testing apparatus in common use :

- *single tear testers**, in which the test pieces are cut to shape, usually on a guillotine, and a single initial cut is made in the test pieces after clamping on the instrument using a pre-set pivoted knife mounted on the instrument;
- *double tear testers***, in which the test pieces are cut and two initial cuts made, usually on a guillotine, before the test pieces are clamped in the instrument.

In this ISO Recommendation the use of both types of instrument is described.

Under the conditions of this test, the total work done by the pendulum includes the work done in tearing the paper and also the work done in lifting and bending the test piece, overcoming frictional losses between the torn edges of the test piece. With some instruments, the total work done also includes overcoming frictional forces due to the test piece rubbing on the pendulum during the test, but this is a major source of error with some papers and such instruments, and instruments on which this occurs are not to be considered suitable for testing in accordance with the method.

4.1 Single tear testers

The apparatus consists of a suitably mounted pendulum which is free to swing about a horizontal axis from bearings of very low frictional resistance. The paper is held by two clamps, one of which is attached to the frame and the other to the pendulum. The clamping surfaces are at least 25 mm wide and 15 mm deep.

In the initial position, before the paper is torn, the pendulum is displaced from its equilibrium position and held by a hand operated catch. The distance between the clamps is then 2.8 ± 0.3 mm and the clamping surfaces lie in a vertical plane which is perpendicular to the plane of oscillation of the pendulum. The upper edges of the clamping surfaces are in a horizontal line lying at a distance of 104 ± 1 mm from the axis of the pendulum and the plane containing this line and the pendulum axis makes an angle of $27.5^\circ \pm 30'$ with the vertical.

The method depends on measuring the energy given up by the pendulum in tearing the test piece. A common method of measurement is, for example, by means of a sleeve to which a pointer is attached, mounted on the pendulum coaxially; the position of the pointer relative to the pendulum can be read from a circumferential scale carried on the pendulum. The frictional resistance of this sleeve should be kept within certain specified limits. (For adjustment of this resistance, see Annex A.)

The pointer engages an adjustable stop on the base plate, and the scale pointer and stop are so arranged that the scale reading is a measure of the work done in tearing the paper test piece. The adjustable pointer stop provides a means for setting the scale reading at zero when no work is done in tearing. This adjustment provides an approximate compensation for pendulum and pointer friction at other positions.

The pivoted knife used to produce the initial tear should be so mounted that the distance to be torn after cutting will be 43.0 ± 0.5 mm, and the distance above the clamp of the end of the tear should be 4.0 ± 0.5 mm.

The instrument should be adjusted and checked as described in Annex A, and calibrated as described in Annex B.

In order to provide for the measurement of a wide range of tearing resistance, interchangeable pendulums or additional weights may be used. Each pendulum or pendulum/weight combination will have a different scale factor or different scale and may have different base zero marks.

Most instruments have graduated scales, the scale reading then being the appropriate tearing resistance for a given number of sheets, most frequently 8, 16 or 32. When testing four sheets simultaneously as specified in this method, the scale reading should then be multiplied by 2, 4 or 8 respectively to give the tearing resistance in millinewtons as indicated in section 7.

In some instruments of this type, it is possible for a test piece of the dimensions specified in this method to foul the pendulum during the test. Such instruments, without modification, are not to be considered suitable for testing in accordance with this ISO Recommendation.

* Examples are the APITTA-Elmendorf, Lhomargy and Thwing-Elmendorf tear testers.

** An example is the Marx-Elmendorf tear tester.