INTERNATIONAL STANDARD

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Third edition
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Corrugated fibreboard — Determination of edgewise crush resistance (Unwaxed edge method)

Carton ondulé — Détermination de la résistance à la compression sur chant (Méthode sans enduction de cire)

Reference number
ISO 3037:1994(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 3037 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 2, *Test methods and quality specifications for paper and board*.

This third edition cancels and replaces the second edition (ISO 3037:1982), of which it constitutes a technical revision.

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Introduction

A variety of methods for the determination of edgewise crush resistance are in use in different parts of the world. These can be classified into three groups as follows:

a) Those in which a carefully cut rectangular test piece is tested without any special treatment or modification.

b) Those in which the edges of the test piece to which the force is applied are waxed to prevent the test result being influenced by "edge effects".

c) Those in which the test piece edges are not waxed but the shape of the test piece is such that the length is substantially reduced at a point midway between the loaded edges in order to induce the failure to occur away from those edges.

The dimensions of the test piece vary from one group to the other and, in group c), the methods vary in the shape and method of reducing the length and in whether or not the test piece is held in a clamp during crushing.

The methods may not give the same numerical results, but it can be shown that most of them can be used to predict the top-to-bottom compression strength which will be achieved when the board is properly converted into a transport package.

This International Standard describes a method from group a). It is intended as a method for quality measurement and quality specification purposes and is selected because it correlates with the top-to-bottom compression strength of the final transport package and because it is the simplest and most operationally convenient method, an important factor when large numbers of tests need to be conducted. However, it does not measure the actual intrinsic compressive strength of the corrugated fibreboard, giving lower results than most of the methods of groups b) and c). This systematic difference is due to edge effects.

Other methods may be used for other purposes, particularly when the object of the test is to study fundamental structural characteristics of the package.

There are methods available for calculating the edgewise crush resistance from the compression strength of the component papers.

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Corrugated fibreboard — Determination of edgewise crush resistance (Unwaxed edge method)

1 Scope

This International Standard specifies a method for the determination of edgewise crush resistance of corrugated fibreboard. It is applicable to all corrugated fibreboard grades.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 186:1994, *Paper and board — Sampling to determine average quality.*

ISO 187:1990, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples.*

3 Principle

Subjection of a rectangular test piece of the corrugated fibreboard, placed between the platens of a crush tester with the flutes perpendicular to the surfaces of the platens, to a compressive force until failure occurs.

Measurement of the maximum force sustained by the test piece.

4 Apparatus

4.1 Motor-driven, platen-type, crush tester

The platens shall be large enough to take a test piece of the required size (see 7.2) and the guide blocks (4.3) without any part of the test piece projecting beyond the edges of the platens.

They shall be flat and also meet the following requirements:

— deviation from parallel shall not be greater than 1:1 000 of the dimensions;

— lateral play shall not exceed 0,05 mm.

NOTE 1 Because it is a requirement of other crush methods, the platens may be faced with very fine emery paper, but where this is done, due regard should be paid to maintaining the flatness and parallelism requirements prescribed for the faces. However, it is preferable to use clean unfaced platens when testing in accordance with this International Standard, and therefore it is advisable to provide two sets of platens, one unfaced and one faced with fine emery paper, and to use whichever set is appropriate to the test to be carried out.

4.1.1 If the tester operates with one fixed platen, the other having a direct positive drive, the rate at which platens approach each other shall be 12,5 mm/min ± 2,5 mm/min. The tester shall be provided with a means of measuring the true peak force to within 1 N.

4.1.2 If the tester operates on the principle of beam deflection, the force applied by the platens shall be developed at a rate of 110 N/s ± 10 N/s when the platens contact with one another. The tester shall be provided with a means of measuring the true peak force to within 5 N or 1 %, whichever is the greater.

NOTE 2 A rate of 67 N/s ± 23 N/s is used in some countries, but the results obtained with this loading rate will not be the same as those obtained with the standard rate. The rate used should be included in the test report.

4.2 Test piece cutter

Test piece cutter capable of cutting test pieces to the requirements prescribed in 7.2 to 7.4.

If a Billerud type cutter is used it shall be fitted with flat, straight, parallel and freshly sharpened blades which should be approximately 0,5 mm thick, sharpened on one or both sides to a bevel of about 3 mm. Single bevelled blades shall be mounted so that plane sides of the blades face each other, i.e. inwards. The blades of such a cutter shall be kept in good alignement.

NOTE 3 It is recommended that the blades of this type of cutter should not be used more than 50 times between sharpenings.

Other types of test piece cutter can be used provided it can be shown that they meet the requirement of this subclause.

A Billerud type cutter is usually unsuitable for cutting test pieces from triple-wall board and some heavy weight double-wall board. For products which cannot be satisfactorily cut by Billerud type cutters, a high-speed table saw equipped with a small-tooth, no-set, hollow ground blade and minimum clearance throatplate has been found to give the most satisfactory cut, but any cutting device may be used providing it produces the quality of cut described in 7.2, 7.3 and 7.4.

4.3 Guide blocks

Two rectangular, smooth-finished, blocks of dimensions approximately 20 mm × 20 mm × 100 mm, to support the test piece and keep it perpendicular to the platen surfaces. It is advisable to fit each guide block with a probe to enable them to be moved with safety during the test.

5 Sampling

Sampling shall be carried out in accordance with ISO 186.

6 Conditioning

The sample shall be conditioned in accordance with ISO 187.

7 Preparation of test pieces

7.1 Using a sharp blade (see 4.2) and a guide (4.3) to ensure the cuts are parallel, cut from the sample, strips with the following dimensions: 100 mm ± 0,5 mm in the direction perpendicular to the flutes and 70 mm to 300 mm in the direction parallel to the flutes.

7.2 Using an appropriate cutter as described in 4.2, cut at least 10 test pieces 25 mm ± 0,5 mm in the direction parallel to the flutes from the strips prepared in 7.1. Each test piece will then measure 25 mm ± 0,5 mm in the direction of the flutes and 100 mm ± 0,5 mm in the direction perpendicular to the flutes.

The width across the test piece shall not vary by more than 0,1 mm along its length.

NOTE 4 The quality of test piece cutting can have a significant effect on the test results and it is therefore essential that this be maintained to the highest possible standard.

When operating a Billerud type cutter for single-wall samples and those double-wall samples which can be cut satisfactorily by this device, insert the uncut strip until it almost contacts the end stop, ensure that a sufficient length of strip extends on the other side of the blades and that the edge is in contact with the squareness guide. A Billerud cutter is unsuitable for cutting triple-wall board and some high strength double-wall board and therefore a cutter of different design must be used.

Irrespective of the method of cutting, the edges subjected to load shall be cleanly cut, straight, parallel and perpendicular to the board surfaces. Do not include in the test pieces any creases, score lines or manufacturing defects not typical of the sample.

7.3 Cleanness of cut is judged by inspection of the test pieces. Flutes shall show no discernible distortion, and the cut edges shall not be furry or have loose fibres visible when inspected under normal laboratory conditions, i.e. under room lighting with no magnification. The cleanness of cut shall be at least as good as that achieved by a properly adjusted Billerud type test piece cutter.

7.4 Straightness, parallelism and perpendicularity may be judged by the following procedure:

Stand two test pieces on their cut edges on a plane surface with two of their faces almost touching. With perfectly flat board the two adjacent faces should ap-

pear flat and parallel to each other over their whole surfaces.

If the board is warped, this may not be so, but the test pieces are acceptable if they stand vertically on their bottom edges, if the top cut surfaces appear flat and parallel to each other and at right angles to the liner surfaces close to the cut, and if the cut ends of the test pieces appear to be in the same plane. It should not be possible to see light under the cut edge of either test piece when a load of about 1 N (equivalent to light finger pressure) is applied to the top edge.

End-for-end (rotate 180° on its vertical axis) one test piece, then invert (rotate 180° on its horizontal axis) it, then invert the other test piece. In each configuration, the criteria of the proceding paragraph shall apply.

Test other pairs of test pieces in the same way.

With a cutter of the Billerud type, these checks should be done when the cutter is first used to establish that it is operating correctly. Thereafter the checks need only be done periodically to ensure that the cutter remains in good condition.

8 Procedure

Conduct the tests in the standard atmosphere specified in clause 6.

With the platens of the crush tester (4.1) conveniently separated, place the test piece on one of its 100 mm cut edges on the lower platen. Support it by placing a guide block (4.3) on each side. Ensure that the reading is zero with the guide blocks in position.

Operate the tester until the test piece fails. When the load reaches about 50 N relocate the guide blocks away from the test piece but do not remove them from the platen.

Alternatively, the zero may be set before the guide blocks are placed in position on the lower platen. In this case they should be removed from the platen as soon as the test piece becomes securely held.

NOTE 5 On a number of instruments, the weight of the guide blocks, while resting on the lower platen, contributes to the force reading.

Record to the nearest 1 N the force developed at the instant failure occurs. If the force is calculated from a measured deflection, read the deflection to the nearest 0,01 mm.

Repeat the test on the remaining test pieces and calculate the mean maximum force and standard deviation.

9 Calculation

Calculate the edgewise crush resistance R, expressed in kilonewtons per metre, using the equation

$$R = 0{,}01\bar{F}_{max}$$

where $\bar{F}_{max}$ is the mean maximum force, in newtons.

10 Precision

At present, it is not possible to provide details of the repeatability and reproducibility which may be expected with this method.

11 Test report

The test report shall include the following particulars:

a) a reference to this International Standard;

b) the date and place of testing;

c) the type of tester used;

d) identification of the sample and description of the product tested;

e) the conditioning atmosphere used;

f) the arithmetic mean and standard deviation of the replicate test results;

g) the number of replicate tests;

h) any other information which may assist in the interpretation of results.

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