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Board — Determination of puncture resistance

Carton — Détermination de la résistance à la perforation

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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The committee responsible for this document is ISO/TC 6, *Paper, board and pulps* Subcommittee SC 2, *Test methods and quality specifications for paper and board*.

This second edition cancels and replaces the first edition (ISO 3036:1975), of which it constitutes a minor revision with the following changes:

— the normative references have been updated;

— Annex B with precision data has been added;

— a Bibliography has been added.

Introduction

Several makes of instrument, differing only in minor details, are used for the measurement of the puncture resistance of board. The results obtained with these different makes of instrument are similar but not necessarily identical. Therefore, for purposes of comparison, it is essential to ensure that the same make of instrument is used for all tests.

Board — Determination of puncture resistance

1 Scope

This document specifies a method for determining the puncture resistance of board.

This document is applicable to all types of heavy board, including corrugated fibreboard, especially those used in the manufacture of packing cases.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

3 Terms and definitions

There are no terms and definitions listed in this document.

4 Principle

Subjection of a test piece from a representative sample of board to puncture by a triangular pyramid puncture head attached to a pendulum.

Measurement of the energy required to force the puncture head completely through the test piece, i.e. to make the initial puncture and to tear and bend open the board.

5 Apparatus

5.1 Description of apparatus

5.1.1 General

The apparatus used is a puncture tester, which produces an impact by means of a pendulum.

The bed plate of the frame of the instrument shall be firmly attached to a strong base to prevent energy losses. The instrument shall be accurately levelled and shall not vibrate during the test.

The instrument shall be so designed that the energy contained in the pendulum in each of the measuring ranges corresponds to the respective scale (see Annex A).

The instrument consists of the elements described in 5.1.2 to 5.1.7.

5.1.2 Pendulum and puncture head

The pendulum is fitted with an arm, having the shape of a 90° circular arc, to which the puncture head is attached. Both pendulum and arm shall be strong enough to minimize deformation and vibration when the test is carried out.

The puncture head shall be a right-angled triangular pyramid, 25 mm ± 0,7 mm high, with edges between sides honed to a radius between 1,0 mm and 1,6 mm.

One of the edges of the base of the pyramid shall be parallel to the axis of rotation of the pendulum and the opposite corner of the base shall point towards the axis of rotation.

The axis of symmetry through the effective point of the puncture head shall be vertical when it is half-way through the horizontal plane through the axis of the pendulum.

NOTE To allow the use of existing instruments, a tolerance of ±12,5 mm is acceptable on the distance between the mid-point and the horizontal plane.

At the release point, the pendulum shall be in the horizontal position, which is determined by measuring through an angle of 90° from the pendulum with its centre of gravity at rest.

5.1.3 Interchangeable weights

By the use of interchangeable weights that can be attached to the pendulum, several ranges of energy are provided.

The range selected shall be such that the test result will be between 20 % and 80 % of the maximum value of the corresponding scale.

5.1.4 Release mechanism

A safety catch shall be provided to prevent accidental release of the pendulum. The release mechanism shall not impart any acceleration or deceleration to the pendulum.

5.1.5 Collar

The neck of the puncture head shall be fitted with a close-fitting collar designed so as to slip off its seating and to keep open the aperture in the test piece after the puncture head has passed through. This is to prevent the corrugated fibreboard from springing back on the arm and braking the pendulum, thus altering the test result.

The loss of energy due to friction when the collar is forced off its seating shall be measurable and shall not exceed 0,25 J. This loss of energy shall be compensated for in the reported test results.

5.1.6 Clamping device

To hold the test piece, two horizontal clamping plates are provided, the upper plate being fixed. The lower face of the upper clamping plate, which contacts the test piece, shall be on the horizontal plane through the axis of the pendulum, or up to 7 mm above it.

Both clamping plates shall be sufficiently rigid to withstand the clamping forces employed, without deformation.

The effective clamping dimensions of the clamping plates shall be not less than 175 mm × 175 mm.

The upper clamping plate shall have an opening in the centre in the form of an equilateral triangle with sides 100 mm ± 2 mm in length. The aperture in the lower plate should preferably be identical and coincident with that in the upper plate; however, a centrally positioned circular aperture, with a diameter 90 mm ± 2 mm may be used.

NOTE To allow the use of certain existing types of instrument, the lower plate may have a centrally positioned circular aperture with a diameter up to 100 mm.

The force holding the test piece between the clamping plates shall be at least 250 N and not more than 1 000 N. If the instrument has no device for measuring the clamping force, the force applied shall in any case be sufficient to ensure that the test piece does not slip when the test is carried out.

5.1.7 Measurement indicator

The test result shall be indicated by a friction-loaded pointer operating over a dial on which the several scales corresponding to the energy ranges are engraved.

The scale divisions shall be calibrated in joules.

NOTE Many existing instruments are calibrated in GE units and kgf.cm:

1 GE unit = 0,029 8 J

1 kgf.cm = 0,098 J

The friction mounting of the pointer shall be just sufficient to ensure smooth operation without over-run.

5.2 Adjustment of the instrument

For all measuring ranges, the effective point of the puncture head shall be within ±5 mm of the horizontal plane through the axis of rotation of the pendulum, when the centre of gravity of the pendulum is at its lowest point.

5.3 Instrument checks

No compensation for loss of energy due to friction shall be made in the calibration of the measuring scales.

Energy loss due to friction in the bearings of the pendulum and to air resistance shall not exceed 1 % of the measuring scale.

To measure energy loss due to collar friction, a slip-off device shall be provided which catches the collar when the pendulum is allowed to swing freely from the release point.

Energy losses due to pointer friction shall be determined by twice allowing the pendulum to make a free swing from the release position. The first swing shall carry the pointer close to the scale zero. The second free swing, made without resetting the pointer, shall carry the pointer nearer to the zero reading. The difference between the two readings represents the energy loss due to pointer friction.

When making re-adjustments to the settings of the measuring scales, the following checks shall be made.

— Allow the pendulum to come to rest, with its centre of gravity at the lowest point, and then move the pointer towards the maximum scale value.

— When the drive pin just touches the pointer, the latter shall indicate the maximum scale value.

— Carry out an analogous check with the pendulum in the horizontal position, 180° from the release point, when the pointer shall indicate zero.

5.4 Calibration

See Annex A.

6 Sampling

Sampling shall be carried out in accordance with ISO 186.

7 Preparation of test pieces

Prepare test pieces with minimum dimensions 175 mm × 175 mm from the sample selected in accordance with Clause 6. These test pieces shall be free from conversion machine marks, irregularities and damage. In no instance shall the puncture area be less than 60 mm from the edge of the test piece