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Tissue paper and tissue products — Part 12: Determination of tensile strength of perforated lines ~~— Calculation~~and calculation of perforation efficiency

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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This document was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 2, *Test methods and quality specifications for paper and board,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 172, *Pulp, paper and board,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 12625-12:2010), which has been technically revised.

The main changes are as follows:

— the expression of the rate of elongation has been changed from a value expressed in mm/min into a value expressed in the rate of elongation of the initial test span length in %/min, independently from the test piece length (see 5.1)~~:~~.

~~— a rate of elongation of the initial test span length per minute (%/min)".~~

— precisions ~~were~~have been added in case of decrease of the distance between the clamping lines (see 5.2).

A list of all parts in the ISO 12625 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Tissue papers such as toilet paper and kitchen towel are often pre-cut. They are used after separation of two consecutive sheets.

It is important to know the efficiency of the pre-cut perforations.

The perforation strength should be enough to ensure the product cohesion, but not too high, so that sheets can be easily separated.

The method described in this document uses forces applied perpendicular to the perforation lines.

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Tissue paper and tissue products — Part 12: Determination of tensile strength of perforated lines ~~— Calculation~~and calculation of perforation efficiency

1 Scope

This document specifies a test method for the determination of the tensile strength of perforated lines of tissue paper. It uses a tensile-testing apparatus operating with a constant rate of elongation.

This method is only used for measuring machine-direction tensile strength, that is for cross-direction perforations on tissue paper.

The calculation of perforation efficiency is also specified in this document.

2 Normative references ~~- rearrange~~

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*

ISO 1924-2, *Paper and board — Determination of tensile properties — Part 2: Constant rate of elongation method (20 mm/min)*

ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

ISO12625-1, *Tissue paper and tissue products — Part 1: Vocabulary*

ISO 12625-4, *Tissue paper and tissue products — Part 4: Determination of tensile strength, stretch at maximum force and tensile energy absorption*

~~ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*~~

43 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12625-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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3.1
tensile strength
S
maximum tensile force per unit width that a test piece will withstand before breaking

3.2
perforation efficiency
E_p
difference between the *tensile strengths* (3.1) of non-perforated and perforated material from the same sample divided by the tensile strength of non-perforated material

Note 1 to entry: The perforation efficiency is expressed as a percentage.

Note 2 to entry: The higher the perforation efficiency, the easier the sheet separation.

~~5~~4 Principle

A perforated test piece of tissue paper or tissue product, of given dimensions, is stretched to break in the machine direction at a constant rate of elongation using a tensile-testing apparatus that measures and records the tensile force as a function of the elongation of the test piece.

From the recorded data, the tensile strength is calculated.

In order to determine the perforation efficiency, measurements are performed both on perforated and non-perforated sections of the tissue product.

Precision data are available in Annex C. Information on the influence of a pre-cut and ageing is available in Annexes A and B.

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~~6~~5 Apparatus

5.1 Tensile-testing apparatus.

The tensile-testing apparatus shall be in accordance with ISO 1924-2. It shall be capable of stretching a test piece of tissue paper or tissue product of given dimensions, at a rate of elongation of (50 ± 2) % of the initial test span length per minute, i.e. (50 ± 2) mm/min for a 100 mm test span length and (25 ± 1) mm/min for a 50 mm test span length, and of recording the tensile force as a function of elongation on a strip chart recorder or any equivalent device. The force-measuring system (normally a load cell) shall measure loads with an accuracy of ~~±~~ ±1 % of the reading or ~~±~~ ±0,025 N, whichever is greater, and shall conform with ISO 7500-1.

5.2 Tensile-tester clamps.

The tensile-testing apparatus shall have two clamps of at least 50 mm in width. Each clamp shall be designed to grip the test piece firmly along a straight line across the full width of the test piece, without causing any damage, and shall have means for adjusting the clamping force.

The clamps should preferably grip the test piece between a cylindrical and a flat surface, with the plane of the test piece tangential to the cylindrical surface. Other types of clamps may be used if it can be ensured that the test piece does not slip or suffer any damage during the test.

During the test, the clamping lines shall be parallel to each other within an angle of 1°. The clamping lines shall be perpendicular to the direction of the applied tensile force and to the longest dimension of the test piece to the same level of accuracy.

The distance between the clamping lines (i.e. the test span length) shall be adjusted to (100 ± 1) mm. In cases where the distance between perforations on the finished products is less than 150 mm is not

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possible (as required in 8.1.2), a test span length of (50 ± 1) mm shall be used. If distance between perforation is less than 75 mm~~.~~, then each perforated test piece shall be (50 ± 0,5) mm in width and the maximum available length in the machine direction may be used.

This and other deviations from the specified procedure shall be recorded in the test report.

5.3 Cutting device.

The cutting device shall meet the requirements of ISO 12625-4 and shall produce test pieces (50,0 ± 0,5) mm wide, with undamaged, straight, smooth and parallel edges.

~~7~~6 Sampling

If the tests are being made to evaluate a lot, the sample shall be selected in accordance with ISO 186. If the tests are being made on another type of sample, make sure the specimens taken are representative of the sample received.

~~8~~7 Conditioning

Condition the samples in accordance with ISO 187, unless otherwise agreed between the parties concerned, and keep them in the standard atmosphere throughout the test.

~~9~~8 Preparation of test pieces

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~~9.1~~8.1 Dimensions

~~9.1.1~~8.1.1 Non-perforated test pieces

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If the distance between perforations is 150 mm or longer, then non-perforated test pieces shall be (50 ± 0,5) mm in width and at least 150 mm in length in the machine direction, excluding perforations and defects.

If the distance between perforations is less than 150 mm, then non-perforated test pieces shall be (50 ± 0,5) mm in width and at least 75 mm in length in the machine direction, excluding perforations and defects.

~~9.1.2~~8.1.2 Perforated test pieces

Perforated test pieces shall be cut from different sheets than those used for tests outside the perforated lines (non-perforated test pieces). If the distance between perforations is 150 mm or longer, then each perforated test piece shall be (50 ± 0,5) mm in width and at least 150 mm in length in the machine direction, excluding defects, with its perforation located approximately equal distance from each end.

If the distance between perforations is less than 150 mm, then each perforated test piece shall be (50 ± 0,5) mm in width and at least 75 mm in length in the machine direction, excluding defects, with its perforation located approximately equal distance from each end.

If the distance between ~~perforation~~perforations is less than 75 mm~~.~~, then each perforated test piece shall be (50 ± 0,5) mm in width and the maximum available length in the machine direction may be used.

Perforated test pieces (cut in the machine direction) shall be cut from different sheets than those used for tests outside the perforated lines (non-perforated test pieces).~~"~~

Each of the ~~ten~~10 perforated test pieces shall be cut from different sheets (in the machine direction).

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~~9.2~~8.2 Number of test pieces

Cut sufficient test pieces to ensure ~~ten~~ 10 valid results on non-perforated papers and ~~ten~~ 10 valid results on perforated papers for each sample of tissue product.

Care should be taken not to handle the test pieces in any way that ~~might~~can decrease the perforation tensile strength (by stretching or breaking any of the perforations).

~~10~~9 Procedure

~~10.1~~9.1 General

Ensure that the tensile-testing apparatus is calibrated. Check that the force reading is zero when there is no load on the sample.

For test pieces that are 150 mm or longer, set the distance between the clamping lines to (100 ± 1) mm. For test pieces that are less than 150 mm in length, set the distance between the clamping lines to (50 ± 1) mm.

The elongation rate between the clamps shall be kept constant at 50 % of the initial test span length per minute, i.e. 50 mm/min for a 100 mm test span length and 25 mm/min for a 50 mm test span length.

Use the same distance between clamping lines and elongation speed for both perforated and non-perforated test pieces for a given sample.

Carry out all testing in the same standard atmosphere as used for conditioning.

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~~10.2~~9.2 Non-perforated test pieces

Place the non-perforated test piece in the clamps so that any observable slack is eliminated but the test piece is not placed under any significant strain (see Figure 1). The test piece shall not be clamped with a tension greater than 5 N/m.

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Minimize touching the test area of the test piece between the clamps with the fingers. Align and tightly clamp the test piece and carry out the test.

NOTE Any deviation from the vertical line would induce a decrease in the measured tensile strength of the non-perforated test pieces, and thus result in a lower calculated perforation efficiency than the true one.

Continue the test until the test piece ruptures and record the maximum tensile force.

Repeat the described procedure until ~~ten~~10 valid results are obtained.

Record all the readings, except those for test pieces that break within 5 mm of the clamping line.

~~10.3~~9.3 Perforated test pieces

Place the perforated test piece in the clamps so that any observable slack is eliminated but the test piece is not placed under any significant strain. The test piece shall not be clamped with a tension greater than 5 N/m. The perforation line shall be approximately equal distance between the lower and upper clamps (see Figure 2).

Minimize touching the test area of the test piece between the clamps with the fingers. Align and tightly clamp the test piece and carry out the test.

NOTE Any deviation from the vertical line would induce a decrease in the measured tensile strength of the perforated test pieces, and thus result in a greater calculated perforation efficiency than the true one.

Continue the test until the test piece ruptures. A valid test occurs when the test piece breaks at the perforation line. Record the maximum tensile force in ~~Newtons~~newtons (N) for each valid test.

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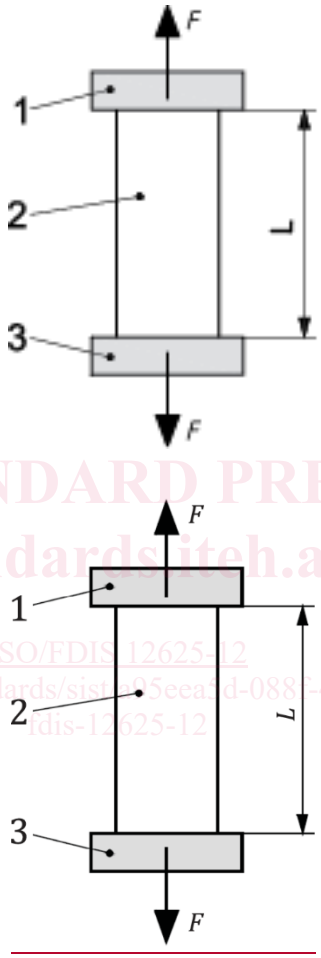
Repeat the described procedure until 10 valid results are obtained.

Record all the valid test readings, except those for test pieces that did not break at the perforation line. If more than ~~1~~one test piece breaks outside the perforation line, record the total number of tests that did not break at the perforation line and divide by the total number of perforation tests to yield a calculated result of "% of test pieces that broke outside of the perforation line" for that sample, and include in the test report, see Clause 11 list item e).

Dimensions in millimetres



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Key

1	upper clamp	*F*	maximum tensile force
2	test piece	*L*	(100 ± 1) mm
3	lower clamp		
~~*F*~~	~~maximum tensile force~~		
~~*L*~~	~~100 ± 1 mm~~		

Figure 1 — Non-perforated test piece

Dimensions in millimetres

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