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Nonwovens — Test methods —

Part 3:
Determination of tensile strength and elongation at break using the strip method

Nontissés — Méthodes d'essai —

Partie 3: Détermination de la résistance à la traction et de l'allongement à la rupture par la méthode sur bande

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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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.

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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.

This document was prepared by Technical Committee ISO/TC 38, *Textiles,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 248, *Textiles and textile products,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 9073-3:1989), which has been technically revised.

The main changes are as follows:

— the title has been changed from "Textiles — Test methods for nonwovens — Part 3: Determination of tensile strength and elongation" to "Nonwovens — Test methods — Part 3 Determination of tensile strength and elongation at break using the strip method";

— the mandatory Terms and definitions clause (Clause 3) has been added and subsequent clauses have been renumbered;

— 8.2 has been revised.

A list of all parts in the ISO 9073 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.

Nonwovens — Test methods —

Part 3: Determination of tensile strength and elongation at break using the strip method

SAFETY WARNING — This document does not claim to address all the safety concerns, if any, associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. It is expected that the person performing this test has been fully trained in all aspects of this procedure.

1 Scope

This document specifies a test method for the determination of the breaking force and elongation of nonwovens using a strip method in conditioned or wet state. This test method describes two procedures, Option A (width of test specimen: 25 mm) and Option B (width of test specimen: 50 mm).

This document specifies methods using constant rate of specimen extension (CRE) tensile testers. Constant rate of loading (CRL) instruments is covered, for information, in ISO 2062:2009, Annex A, in recognition of the fact that these instruments are still in use and can be used by agreement.

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 139, *Textiles — Standard atmospheres for conditioning and testing*

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

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

ISO 3951-1, *Sampling procedures for inspection by variables — Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL*

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

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*

ISO 10012, *Measurement management systems — Requirements for measurement processes and measuring equipment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological 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/

3.1
breaking force
maximum force (3.2) applied to a material carried to rupture

3.2
maximum force
maximum force appearing during a *test specimen* (3.11) carried to rupture in a tensile test under the specified conditions

3.3
force at rupture
force recorded at the point of rupture of a *test specimen* (3.11) during a tensile test

Note 1 to entry: See Figure 1.

3.4
constant-rate-of-extension tensile testing machine
CRE tensile testing machine
tensile-testing machine provided with one clamp which is stationary and another clamp which moves with constant speed throughout the test, the entire testing system being virtually free from deflection

3.5
constant-rate-of-load tensile testing machine
CRL tensile testing machine
testing machine in which the rate of increase of the load being applied to the specimen is uniform with time after the first 3 seconds

3.6
elongation
ratio of the *extension* (3.9) of a *test specimen* (3.11) to its *initial length* (3.15)

Note 1 to entry: Elongation is expressed as a percentage

3.7
elongation at maximum force
elongation (3.6) of a *test specimen* (3.11) produced by the *maximum force* (3.2)

Note 1 to entry: See Figure 1.

3.8
elongation at rupture
elongation (3.6) of a *test specimen* (3.11) corresponding to the *force at rupture* (3.3)

Note 1 to entry: See Figure 1.

3.9
extension
increase in length of a *test specimen* (3.11) produced by a force, in this context, stretching

3.10
sample
product or portion of a product taken from a production lot for testing purposes, identifiable and traceable back to the origin

3.11
test specimen
test specimen specific portion of the identified *sample* (3.10) upon which a test is performed, many specimens sometimes being tested from the same sample, using different locations

3.12
strip test
tensile test in which the full width of the *test specimen* (3.11) is gripped in the jaws of the testing machine

3.13
tensile strength
resistance of a material to breaking under tension

Note 1 to entry: See Figure 1.

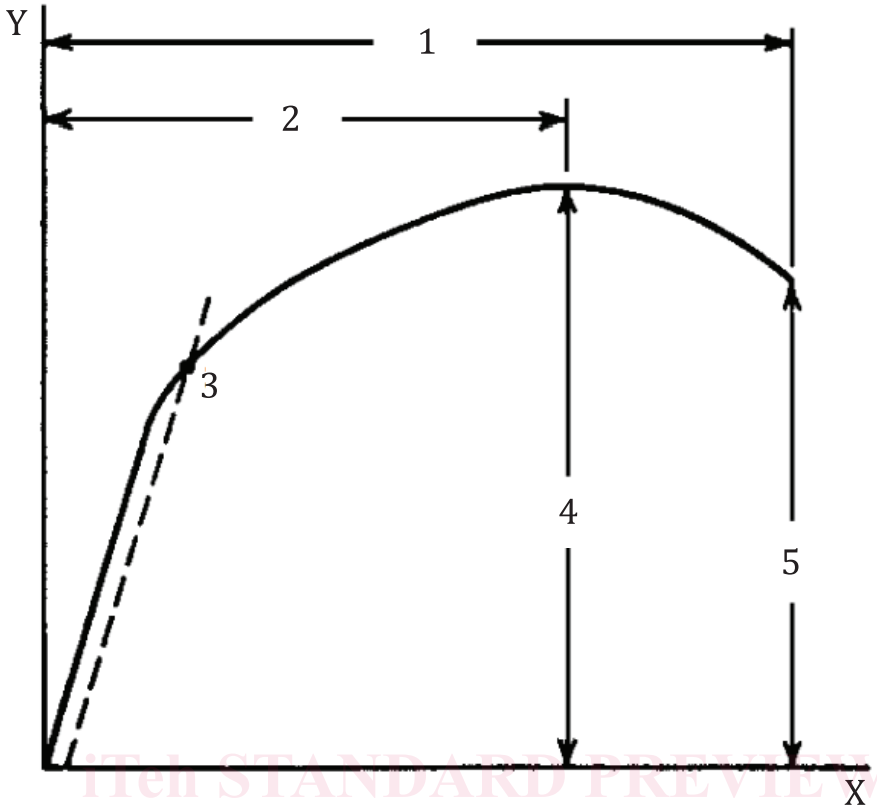
Note 2 to entry: Tensile strength is preferably expressed in Newton.

3.14
gauge length
distance between the two effective clamping points of a testing device

Note 1 to entry: The effective clamping points (or lines) of jaws can be checked by clamping a test specimen under defined pretension with carbon copy paper to produce a gripping pattern on the test specimen and/or the jaw faces.

3.15
initial length
length of a *test specimen* (3.11) under specified pretension between the two effective clamping points at the beginning of certain tests

Note 1 to entry: See also 3.15.



Key

X conventional strain
Y average stress
1 strain to fracture
2 uniform strain
3 offset yield strength
4 tensile strength
5 fracture stress

Figure 1 — Example of force-elongation curve

4 Principle

A test specimen of specified dimensions is extended at a constant rate until it ruptures. The maximum force and the elongation at maximum force and, if required, the force at rupture and the elongation at rupture are recorded. Values for the breaking force and elongation of the test specimen are obtained from machine scales, dials, autographic recording charts, or a computer interface.

Comparison of results from tensile testing machines operating on different principles is not recommended. When different types of machines are used for comparison testing, constant time-to-break at (20 ± 3) seconds is the established way of producing data. Even then the data can differ significantly. The constant-rate-of-extension tensile testing machine is preferred for this method.

5 Reagents and materials

5.1 Grade 3 water, in accordance with ISO 3696 for wetting test specimens.

5.2 Nonionic wetting agent.

5.3 Blotting paper, two sheets required for the test on wet test specimens.

6 Apparatus

6.1 Tensile testing machine (CRE or CRL)

The mechanism of the two types of tensile tester (CRE and CRL) is different (see ASTM D76) and their results are not comparable. In ISO 1421 and the ISO 13934 series, the CRE machine is the only one considered.

If it is necessary to describe CRE machines, these alternative methods shall be described for information in ISO 2062:2009, Annex A.

Metrological confirmation system of the tensile-testing machine shall be in accordance with ISO 10012.

The constant-rate-of-extension machine (CRE machine) shall have the general characteristics given in 6.1.1 to 6.1.6.

6.1.1 The tensile-testing machine shall be provided with means for indicating or recording both the force applied to the test specimen in stretching it to rupture and the corresponding extension of the test specimen. Under conditions of use, the accuracy of the apparatus shall be class 1 of ISO 7500-1. The error of the indicated or recorded maximum force at any point in the range in which the machine is used shall not exceed ±1 %, and the error of the indicated or recorded jaw separation shall not exceed ±1 mm.

6.1.2 If a class 2 tensile-testing machine according to ISO 7500-1 is to be used, this shall be stated in the test report.

6.1.3 If recording of force and elongation is obtained by means of data acquisition boards and software, the frequency of data collection shall be at least eight per second.

6.1.4 The machine shall be capable of constant rates of extension of 100 mm/min and 300 mm/min, with an accuracy of ±10 %.

6.1.5 The machine shall be capable of setting the gauge length to 75 mm and 200 mm, to within ±1 mm.

6.1.6 The clamping device of the machine shall be positioned with the centre of the two jaws in the line of applied force, the front edges shall be at right angles to the line of applied force, and their clamping faces shall be in the same plane.

The jaws shall be capable of holding the test specimen without allowing it to slip and designed so that they do not cut or otherwise weaken the test specimen.

The faces of the jaws shall be smooth and flat, except that when, even with packing, the test specimen cannot be held satisfactorily with flat-faced jaws, engraved or corrugated jaws can be used to prevent slippage. Other auxiliary materials for use with either smooth or corrugated jaws to improve specimen gripping include paper, leather, plastics, or rubber.

For all strip tests, each jaw face shall measure at least 10 mm wider than the test specimen being tested and at least 25 mm in the direction of the applied force.

NOTE 1 Different jaw face surfaces can lead to different elongation results.

NOTE 2 If jaw breaks or slippage cannot be prevented with flat jaws, capstan jaws have often been found suitable. Extension measurement can be carried out by means of an extension meter which follows the movement of two reference points on the test specimen.

6.2 Clamps and jaw faces

Each jaw face shall be smooth, flat, and with a metallic, or other agreed upon, surface. The faces shall be parallel and have matching centres with respect to one another in the same clamp and to the corresponding jaw face of the other clamp.

For all strip tests, each jaw face shall measure at least 10 mm wider than the specimen being tested and at least 25 mm in the direction of the applied force.

6.3 Container

In which test specimens can be immersed in water preparatory to wet testing.

7 Conditioning

The atmospheres for preconditioning, conditioning and testing shall be as specified in ISO 139. Equilibrium is considered to have been reached when the increase in mass of the specimen in successive weighing made at intervals of not less than 2 hours does not exceed 0,25 % of the mass of the specimen.

It is recommended that samples be conditioned for at least 24 h in the relaxed state.

NOTE While conditioning for a fixed time cannot be accepted in cases of dispute, it can be sufficient in routine testing to expose the material to the standard atmosphere for testing textiles for a reasonable period of time before the specimens are tested.

8 Sampling

8.1 General

Carry out sampling in accordance with ISO 186. Ensuring that the areas from which samples are taken, have no visible flaws and are not creased.

If provided in the customer specification, take random sample as directed. If no requirements are provided, ISO 2859-1 or ISO 3951-1 shall be used. In and of themselves, these are not valid sampling plans by default. An agreement between the purchaser and supplier requires taking into account process stability, producer's risk, consumer's risk, acceptable quality level and the cost needs to be established.

In general, if the test characteristic can be considered normally distributed, the sampling procedures for inspection by variables will require fewer samples. However, small samples may not reflect that normal distribution and the estimated percent defective can therefore be over or underestimated. In this case, as well as for attribute data, the sampling procedures for inspection by attributes should be used.

In the absence of any sampling size requirement, Table 1 and Table 2 below can be used. Switching rules are required to maintain the AQL protection.

Table 1 — Attributes (1.0 AQL, General Inspection Level II)

Number of units in the lot inclusive	Number of units that comprise the lot sample
1 to 150	13
151 to 280	32
281 to 500	50
501 to 1 200	80

Table 2 — Variables ("s" method, General Inspection Level II)

Number of units in the lot inclusive	Number of units that comprise the lot sample
1 to 15	3
16 to 25	4
26 to 50	6
51 to 90	9
91 to 150	13
151 to 280	18
281 to 500	25
501 to 1 200	35

An adequate specification or other agreement between the purchaser and the supplier requires taking into account the variability between rolls of material and between specimens. A sampling plan with a meaningful producer's risk and consumer's risk shall be provided. The plan shall justify the intended quality level.

8.2 Laboratory sample

From each roll or portion of material taken from the lot sample, cut at least one laboratory sample of the full width of the fabric and 1 m in the machine direction.

NOTE Results obtained on small hand samples can only be considered as representative of that sample and cannot be assumed to be representative of the material portion from which the hand sample or swatch was taken.

8.3 Test specimens

From each laboratory sample, test five specimens from the machine direction and five specimens from the cross direction.

9 Preparation of specimens

9.1 General

From each laboratory sample, two sets of test specimens shall be cut, one set in the machine direction and the other in the cross-machine direction.

Each set shall consist of at least five test specimens, except that if a higher degree of precision is required, more test specimens shall be tested. No test specimens shall be cut from within 150 mm of either edge of the laboratory sample. Test specimens shall be provided as diagonally.

Narrow test specimens of material which are 50 mm or less wide are tested full width and the dimension noted on the test report.

NOTE The length of the test specimen depends on the type of clamps being used. The test specimen should be long enough to extend through the clamps and projected at least 10 mm at each end.

9.2 Dimension

9.2.1 Option A, the width of test specimen shall be (25 ± 1) mm and its length shall be long enough to allow a gauge length of 75 mm long and the long dimension shall be parallel to the direction of testing and force application (see NOTE under 9.1).