
Nonwovens — Test methods —

Part 4:

**Determination of tear resistance by
the trapezoid procedure**

Nontissés — Méthodes d'essai —

*Partie 4: Détermination de la résistance à la déchirure par la méthode
du trapèze*

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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).

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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.

This document was prepared by Technical Committee ISO/TC38, *Textiles*.

This third edition cancels and replaces the second edition (ISO 9073-4:1997), which has been technically revised.

The main changes compared to the previous edition are as follows:

- the title has been changed to "Nonwovens — Test methods — Part 4: Determination of tear resistance by the trapezoid procedure";
- the value method of single specimen, changed from average value of the series of significant load peaks to maximum force as the test result of a single specimen has been modified.

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 4: Determination of tear resistance by the trapezoid procedure

1 Scope

This document specifies a method for the determination of tear resistance of nonwovens by the trapezoid method.

This document applies to nonwovens.

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

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

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 <http://www.electropedia.org/>

3.1

constant rate of extension testing machine

CRE testing machine

tensile-testing machine where one clamp is stationary whilst the other is moving with a constant speed throughout the test and where the entire testing system is virtually free from deflection

3.2

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 jaw faces.

3.3

tear force

force required to propagate a tear initiated under the specified conditions

4 Principle

Marking of a trapezoid on a test specimen. Clamping of the non-parallel sides of the trapezoid in the jaws of a tensile testing machine. Application of a continuously increasing extension to the test specimen in such a way that a tear propagates across its width. The force to continue the tear over a specified distance is recorded. The arithmetic mean of the maximum force of specimens is taken as the result of testing.

5 Apparatus

5.1 Tensile testing machine, metrological confirmation system of which shall be in accordance with ISO 10012. The constant rate of extension testing machine (CRE testing machine) having the following characteristics:

- a) capable of operating at a constant rate of extension of (100 ± 10) mm/min;
- b) capable of gauge length to be set to (25 ± 1) mm;
- c) provided with means for recording the force applied to the test specimen during the tear test;
- d) under conditions of use, 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;
- e) if recording of force and extension is obtained by means of data acquisition boards and software, the frequency of data collection shall be at least 8 per second.

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

NOTE Constant rate of traverse type (CRT) tester can also be used when agreed upon between interested parties. There can be no overall correlation between the test results obtained with the CRT-type machine and CRE-type machine.

5.2 Clamping device, comprising the two jaws of the machine, the central points of which are in the line of applied force, the front edges at right angles to the line of applied force and the clamping faces 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 width of the jaws should preferably be 100 mm, but shall not be less than the width of the test specimen.

5.3 Isosceles trapezoid template, having dimensions with a tolerance of $\pm 0,5$ % as shown in [Figure 1](#).

5.4 Equipment, in which test specimens can be immersed in water preparatory to wet testing.

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

5.6 Nonionic wetting agent.

Dimensions in millimetres

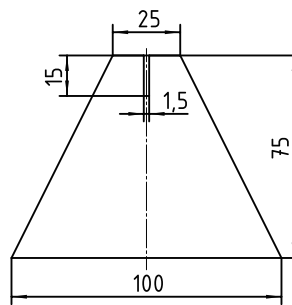


Figure 1 — Isosceles trapezoid template

6 Sampling

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

7 Preparation and conditioning of test specimens

7.1 Unless otherwise specified, cut five test specimens in the machine direction and five in the cross-machine direction.

NOTE The edge of the sample cannot normally form part of the test specimen

7.2 Cut test specimens $(75 \pm 1) \text{ mm} \times (150 \pm 2) \text{ mm}$. Mark each test specimen with an isosceles trapezoid using the template (5.3). Make a preliminary cut of 15 mm in the centre of the trapezoid short side as shown in Figure 2.

NOTE Other dimensions, respecting the general proportions of the original test specimen, can be agreed between interested parties, especially in order to reproduce some in-use conditions of nonwovens, and can be noted in the test report. The values measured with different test specimen dimensions cannot be compared.

Dimensions in millimetres

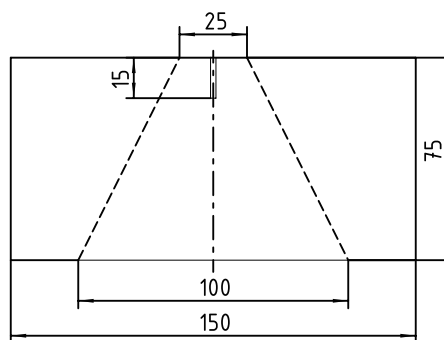


Figure 2 — Marked isosceles trapezoid test specimen

7.3 Condition the test specimens in the standard atmosphere as specified in ISO 139.

The test specimens do not need to be conditioned when the tear force is measured in wet state.

It is recommended that test specimens be conditioned for at least 24 h in relaxed state.

7.4 If the tear force of test specimens in wet state is required, immerse the test specimens for a period of one hour in grade 3 water (5.5) at a temperature of $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. For specimens not readily wet out with water, such as those treated with water-repellent or water-resistant materials, an aqueous solution containing not more than 1 g of a nonionic wetting agent per litre may be used instead of water.

NOTE For tropical regions, temperature according to ISO 139 can be applied.

8 Procedure

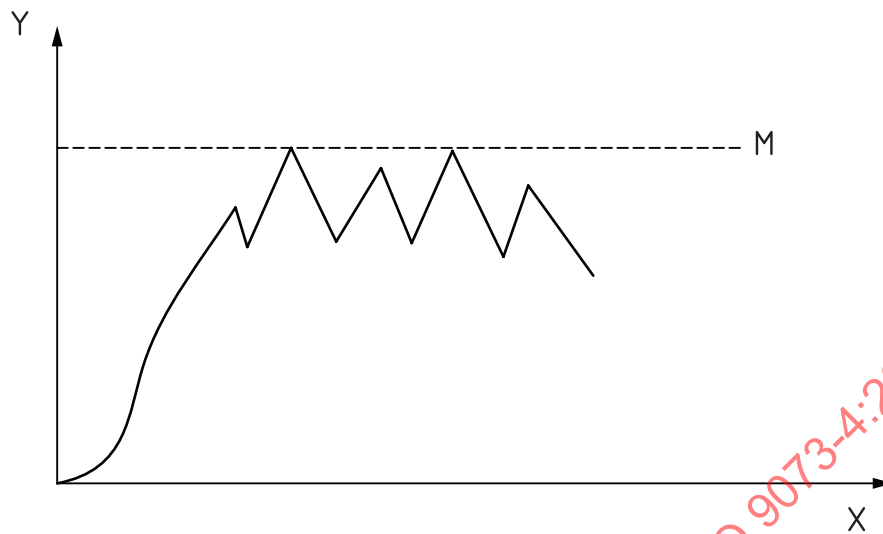
8.1 Carry out the test in the standard atmosphere for testing (see ISO 139).

8.2 At the start of the test, set the gauge length of tensile-testing machine to (25 ± 1) mm and set the rate of extension to 100 mm/min. Select the force range of the testing machine so that the break occurs between 15 % and 85 % of full scale.

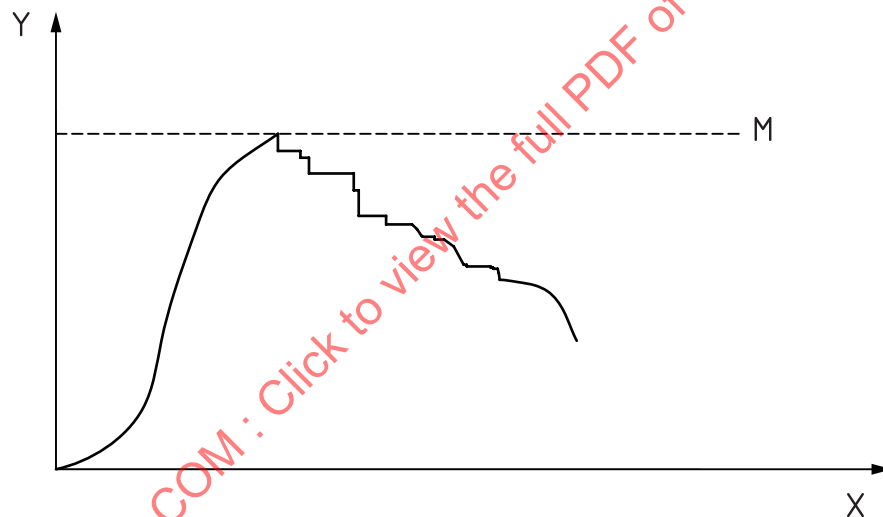
8.3 Secure the test specimen in the machine, clamping along the non-parallel sides of the trapezoid with the cut halfway between the clamps. Hold the short edge taut and let the long edge lie in folds.

8.4 Start the machine and record the tearing force on the recording device.

8.5 The tearing force will be a single value or appear as a series of maxima and minima. Two typical tearing curves are as shown in [Figure 3](#).



a) Typical tearing curve



b) Another typical tearing curve

Keys

- Y force
X extension
M maximum force

Figure 3 — Two typical tearing curves

8.6 If the test specimen does not tear at the cut or the specimen slides out from the clip, no result shall be registered. The specimen should be cut again on the original sample to obtain five normal results for each direction.

NOTE For specimens with strong tear force or easy to slip, special pincers can be replaced or pincers holding surface can be added with liner material, which can be explained in the test report.

8.7 For wet specimens, perform the test according [8.1](#) to [8.6](#) immediately after removal of a test specimen from liquid (see [7.4](#)) and briefly placing it on blotting paper to remove excess water.