INTERNATIONAL STANDARD

ISO 10319

Second edition
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Geosynthetics — Wide-width tensile test

Géosynthétiques — Essai de traction des bandes larges

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Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 10319 was prepared by Technical Committee ISO/TC 221, *Geosynthetics*.

This second edition cancels and replaces the first edition (ISO 10319:1993), which has been technically revised.

Geosynthetics — Wide-width tensile test

1 Scope

This International Standard describes an index test method for the determination of the tensile properties of geosynthetics, using a wide-width strip. The method is applicable to most geosynthetics, including woven geotextiles, nonwoven geotextiles, geocomposites, knitted geotextiles and felts. The method is also applicable to geogrids and similar open-structure geotextiles, but specimen dimensions might need to be altered. This test is not applicable to polymeric or bituminous geosynthetic barriers, while it is applicable to clay geosynthetic barriers.

The tensile test method covers the measurement of load elongation characteristics and includes procedures for the calculation of secant stiffness, maximum load per unit width and strain at maximum load. Singular points on the load-extension curve are also indicated.

Procedures for measuring the tensile properties of both conditioned and wet specimens are included in this International Standard.

2 Normative references

The following referenced documents are indispensable for the application 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 554, *Standard atmospheres for conditioning and/or testing — Specifications*

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

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

ISO 9862, *Geosynthetics — Sampling and preparation of test specimens*

ISO 10318:2005, *Geosynthetics — Terms and definitions*

ISO 10321, *Geosynthetics — Tensile test for joints/seams by wide-width strip method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10318 and the following apply.

3.1
nominal gauge length
initial distance, normally 60 mm (30 mm on either side of the specimen symmetrical centre), between two reference points located on the specimen parallel to the applied load

3.2
extension at preload
measured increase in gauge length corresponding to an applied load of 1 % of the maximum load

NOTE 1 The extension at preload is indicated as SA in Figure 1.

NOTE 2 The extension at preload is expressed in millimetres.

3.3
true gauge length
nominal gauge length plus the extension at preload

3.4
maximum load
F_{max}
maximum tensile force obtained during a test

NOTE The maximum load is expressed in kilonewtons (kN).

3.5
strain
ε
increase in true gauge length of a specimen during a test

NOTE Strain is expressed as a percentage of the true gauge length.

3.6
strain at maximum load
ε_{max}
strain exhibited by the specimen under maximum load

NOTE Strain at maximum load is expressed in percent.

3.7
secant stiffness
j
ratio of load per unit width to an associated value of strain

NOTE Secant stiffness is expressed in kilonewtons per metre (kN/m).

3.8
tensile strength
T_{max}
maximum strength per unit width observed during a test in which the specimen is stretched until it breaks

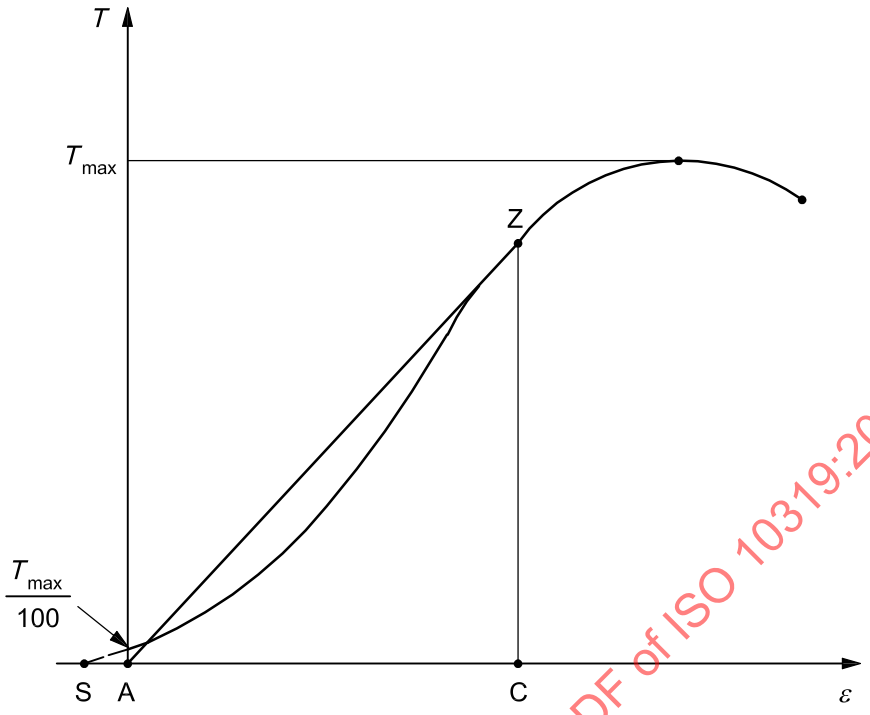
NOTE 1 Tensile strength is expressed in kilonewtons per metre (kN/m).

NOTE 2 See also 1.3.4.1.4 in ISO 10318:2005.

3.9
strain rate
percentage increase in true gauge length at maximum load, divided by the duration of the test, i.e. the time to attainment of maximum load from preload

NOTE 1 Strain rate is expressed in percentage per minute.

NOTE 2 See also 1.3.4.6.3 in ISO 10318:2005.



Key

T load/unit width, in kN/m

ε strain, in %

AZ secant

SA extension at preload

Figure 1 — Typical load per unit width/strain curve

4 Principle

A test specimen is held across its entire width in a set of clamps or jaws (see Figure 2) of a tensile testing machine operated at a constant speed, and a longitudinal force is applied to the test specimen until the specimen ruptures. The tensile properties of the test specimen are calculated from machine scales, dials, autographic recording charts, or an interfaced computer. A constant test speed is selected so as to give a strain rate of (20 ± 5) % per minute in the gauge length of the specimen.

The basic distinction between the current method and other methods for measuring tensile properties of fabrics is the width of the specimen. In the current method, the width is greater than the length of the specimen, as some geosynthetics have a tendency to contract (neck down) under load in the gauge length area. The greater width reduces the contraction effect of such fabrics and provides a relationship closer to the expected fabric behaviour in the field, as well as a standard for comparison of geosynthetics.

The test uses test specimens 200 mm wide and 100 mm long (see 6.3.3 for details on the preparation of geogrid specimens). When information on strain is required, extension measurements are made by means of an extensometer which follows the movement of two reference points on the specimen. These reference points are situated on the specimen symmetry axis, which is parallel to the applied load, and are separated by a distance of 60 mm (30 mm on each side of the specimen symmetry centre). This distance can be adapted for geogrids in order to include at least one row of nodes (see 6.3.3).

5 Apparatus and reagents

5.1 Tensile testing machine (constant rate of extension), complying with ISO 7500-1, Class 2 or higher, in which the rate of increase of specimen length is uniform with time, fitted with a set of clamps or jaws which are sufficiently wide to hold the entire width of the specimen and equipped with appropriate means to limit slippage or damage.

Compressive jaws should be used for most materials, but for materials where the use of these grips gives rise to excessive jaw breaks or slippage, capstan grips may be used.

It is essential to choose jaw faces that limit slippage of the specimen, especially in stronger geosynthetics. Examples of jaw faces that have been found satisfactory are shown in Figure 2.

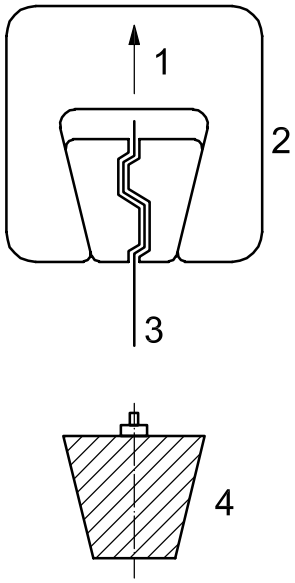
5.2 Extensometer, capable of measuring the distance between two reference points on the specimen without any damage to the specimen or slippage, care being taken to ensure that the measurement represents the true movement of the reference points.

EXAMPLE Mechanical, optical, infrared or other types, all with an electrical output.

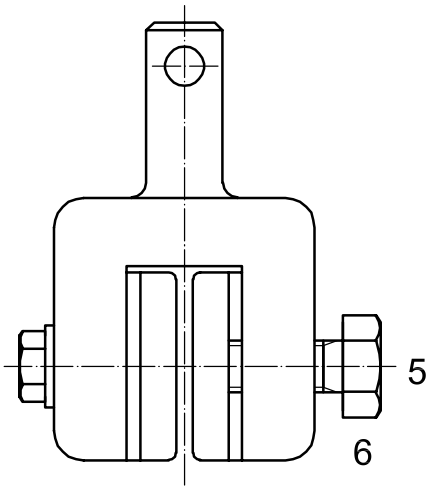
The extensometer shall be capable of measuring to an accuracy of ± 2 % of the indicated reading. If any irregularity of the stress-strain curve due to the extensometer is observed, this result shall be discarded and another specimen shall be tested.

5.3 Distilled water, for wet specimens only, complying with Grade 3 of ISO 3696.

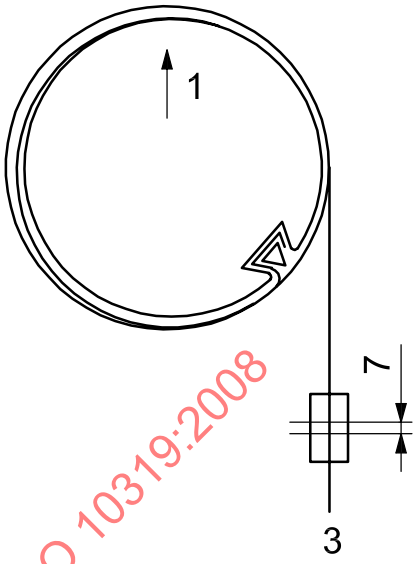
5.4 Non-ionic wetting agent, for wet specimens only.



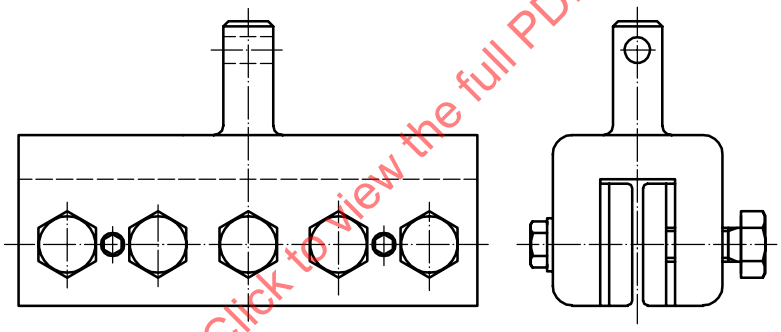
a) Wedge jaws



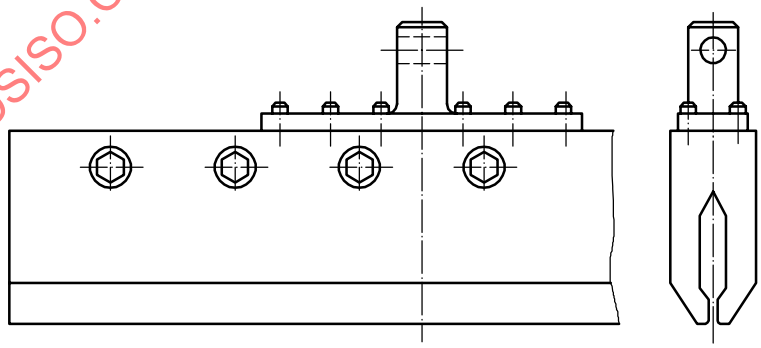
b) Compressive block jaws



c) Capstan



d) Jaw design suitable for testing geogrids



e) Alternative jaw design suitable for testing geogrids

Key

1 direction of applied force
2 serrated wedge
3 geosynthetic
4 epoxy or soft metal wedge
5 compressive force adjustable up to 400 kN
6 maximum width of sample: 0,5 m
7 strain measurement point

Figure 2 — Examples of jaw faces for tensile testing of geosynthetics

6 Test specimens

6.1 Number of test specimens

Cut a minimum of five test specimens in both the machine direction and the cross direction.

6.2 Preparation of test specimens

Prepare the test specimens in accordance with ISO 9862.

6.3 Dimensions

6.3.1 Prepare each finished test specimen to a nominal 200 mm ± 1 mm width (excluding fringes when applicable, see 6.3.2), and of sufficient length to ensure 100 mm between the jaws, with the length dimension being designated and parallel to the direction in which the tensile force is applied. Where appropriate and for monitoring any slippage, draw two lines running the full width of the test specimen jaw faces, perpendicular to the length dimension and separated by 100 mm [except for capstan grips – see Figure 2 c)].

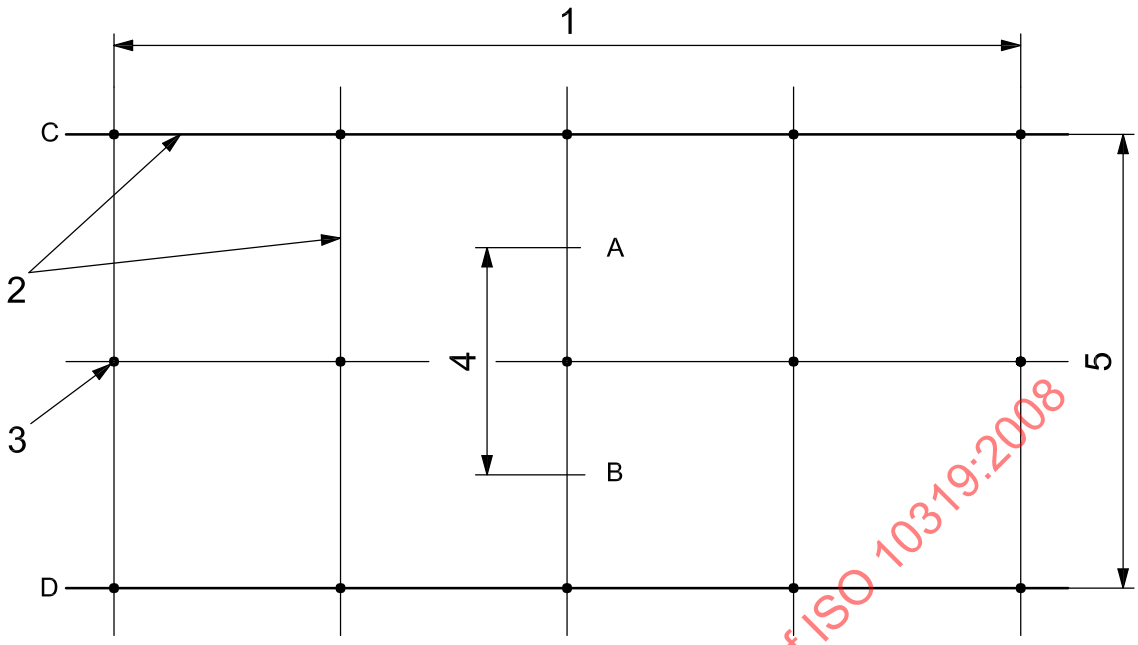
6.3.2 For woven geosynthetics, cut each specimen approximately 220 mm wide and then make fringes by removing an equal number of threads from each side to obtain the 200 mm ± 1 mm nominal specimen width.

NOTE This helps to maintain the specimen integrity during the test. When the specimen integrity is not affected, the specimens can be initially cut to the finished width.

6.3.3 For geogrids, prepare each specimen at least 200 mm wide and sufficiently long to ensure a length of at least 100 mm. Cut all ribs at least 10 mm from any node. Where the nodes are not separated by at least 10 mm, the specimens should be prepared two ribs wider than required for the test and, after clamping in the jaws, the outer rib on each side of the specimen should be severed. The test result (strength) shall be based on the unit of width associated with the number of intact ribs. The test specimen shall contain at least one row of nodes or cross-members, excluding the nodes of cross-members held in the jaws (see Figure 3), and, for products of pitch less than 75 mm, at least four complete tensile elements (ribs) in the width direction. Products of pitch greater than 75 mm and less than 120 mm shall contain at least two complete tensile elements in the width direction. For products of pitch greater than 120 mm, single ribs may be tested.

If the test is to be used as a reference test for the seam/joint strength test (see ISO 10321), the specimen width shall be the same for both sets of tests.

The reference points for the extensometer shall be marked on a central row of tensile elements that will be subjected to testing and shall be at least 60 mm apart. The reference points shall be marked at the centre-point of a rib and shall be separated by at least one node or cross-member. Where necessary, the two reference points may be separated by more than one row of nodes or cross-members, in order to achieve the minimum separation of 60 mm apart. In this case, the requirement to mark the reference points at mid-rib shall be maintained and the gauge length shall then be an integral number of pitches of the grid. Measure the nominal gauge length to an accuracy of ± 3 mm.



Key

1 width, w
2 rib
3 node
4 gauge length
5 length, L

NOTE 1 A and B are reference points marked for use with an extensometer.

NOTE 2 The nodes and ribs on lines C and D are those by which the specimen is to be held in the jaws of the clamps.

NOTE 3 Width w is $\geqslant$ 200 mm.

NOTE 4 The gauge length is $\geqslant$ 60 mm and includes at least one row of cross-members. If necessary, more rows or cross-members can be included in the gauge length until it exceeds 60 mm. The gauge length is always measured from mid-rib to mid-rib.

Cut all ribs at least 10 mm from any node. Where the nodes are not separated by at least 10 mm, the specimens should be prepared two ribs wider than required for the test and, after clamping in the jaws, the outer rib on each side of the specimen should be severed. The test result shall then be based on the unit of width associated with the number of intact ribs.

Figure 3 — Typical geogrid

6.3.4 For knitted fabrics, geocomposites or others, preparation of the specimen by cutting with a knife or scissors can affect the fabric structure. In such cases, thermal cutting can be used, and this shall be reported in the test report (see Clause 10).

6.3.5 When the values of both the wet maximum load and the dry maximum load are required, cut each test specimen at least twice as long as is usually required. Number each test specimen and then cut each specimen crosswise into two halves, one for determining the dry maximum load, and the other for determining the wet maximum load. Each portion shall be marked with the specimen number. Thus, each paired break is performed on a test specimen containing the same threads.

For geosynthetics which shrink excessively when wet, the tensile strength shall be determined from the maximum load, in wet conditions, and the initial width shall be measured to an accuracy of $\pm$ 1 mm, after conditioning but before wetting (see Clause 7).

7 Conditioning atmosphere

7.1 General

The test specimens shall be conditioned and tested in the standard atmosphere for testing (20 ± 2 °C at 65 ± 5 % RH) as defined in ISO 554.

The specimens can be considered to have been conditioned when the change in mass in successive weightings made at intervals of not less than 2 h does not exceed 0,25 % of the mass of the test specimen.

Conditioning and/or testing in a standard atmosphere may only be omitted when it can be shown that results obtained for the same specific type of product (both structure and polymer type) are not affected by changes in temperature and humidity exceeding the limits. This information shall be included in the test report.

7.2 Conditioning for testing in the wet condition

Specimens to be tested in the wet condition shall be immersed in water maintained at a temperature of (20 ± 2) °C. The time of immersion shall be at least 24 h and shall be sufficient to wet the test specimens thoroughly, as indicated by no significant change in maximum load or strain following a longer period of immersion. To obtain thorough wetting, it may be necessary to add up to a maximum of 0,05 % of a non-ionic neutral wetting agent (5.4) to the water.

8 Test procedure

8.1 Setting up the machine

Adjust the distance between the jaws at the start of the test to 100 mm ± 3 mm, except for geosynthetics mounted on capstan grips and for geogrids. Select the force range of the testing machine such that the break can be measured to an accuracy of 0,01 kN.

Set the machine at a constant cross-head speed so as to induce a strain rate of 20 ± 5 % per minute in the gauge length.

For wet specimens, carry out the test within 3 min of removal from the water.

If capstan grips are used, the separation between the centres of the capstans at the beginning of each test shall be kept to a minimum, or for geogrids to a representative length. The use of capstan grips and the distance between the centres of the capstans shall be recorded in the test report.

8.2 Insertion of the test specimen in the jaws

Mount the test specimen centrally in the jaws. Take care that, in both the machine direction and cross direction tests, the specimen length is parallel to the direction of application of force. Where appropriate, do this by having the two lines, which were previously drawn 100 mm apart across the width of the test specimen (see 6.3.1), positioned as closely as possible adjacent to the inside edges of the jaws.

8.3 Installation of the extensometer

Fix the reference points on the specimen 60 mm apart (30 mm on each side of the symmetry centre of the specimen), and set the extensometer. If a contacting extensometer is used, ensure that no damage is caused to the specimen. Also ensure that there is no slippage of the reference points during the test.