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

*Géosynthétiques — Essai de traction des joints/coutures par la
méthode de la bande large*



Reference number
ISO 10321:2008(E)

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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.

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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 10321 was prepared by Technical Committee ISO/TC 221, *Geosynthetics*.

This second edition cancels and replaces the first edition (ISO 13021:1992), which has been technically revised.

Geosynthetics — Tensile test for joints/seams by wide-width strip method

1 Scope

This International Standard specifies an index test method for determination of the tensile properties of joints and seams in geosynthetics, using a wide-width strip. The method is applicable to most geosynthetics. It is also applicable to geogrids, but the specimen dimensions may need to be altered. This test is not applicable to polymeric or bituminous geosynthetic barriers.

This method quantifies the tensile strength of a joint or seam between geosynthetics. It can provide data to indicate the joint or seam tensile strength which can be achieved.

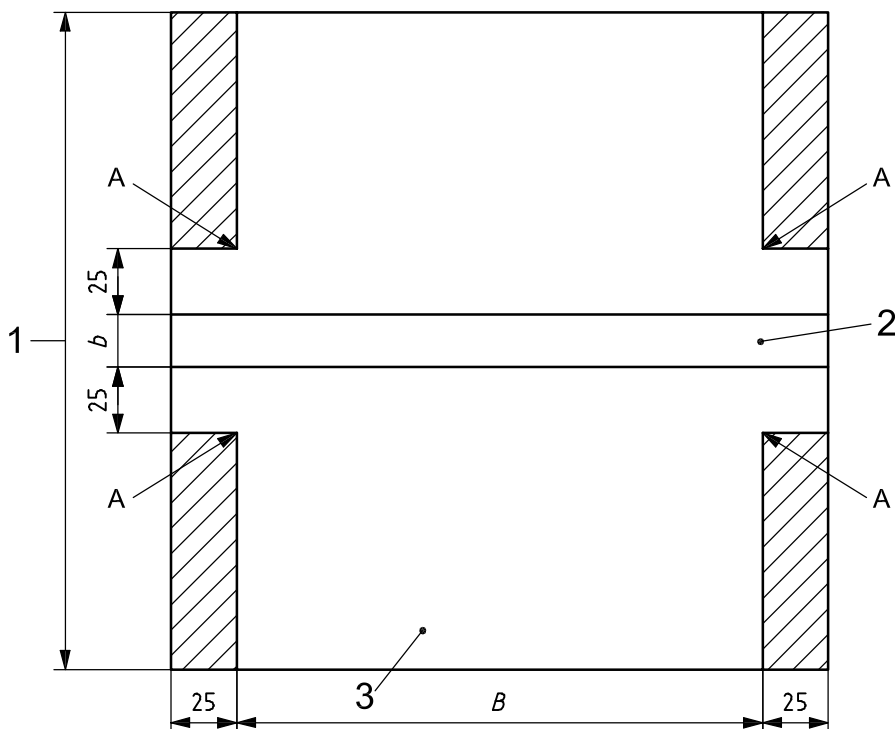
A joint or seam efficiency can be calculated by comparison of the joint/seam tensile strength with the tensile strength of the unjointed material, as determined by ISO 10319.

Procedures for measuring the tensile properties of both conditioned and wet specimens are included.

Some modification of techniques may be necessary for particular geosynthetics, e.g. strong geosynthetics, meshes or geosynthetics made from glass fibre, to prevent them from slipping in the jaws or being damaged as a result of being gripped in the jaws.

The basic test for joints or seams in all kinds of geosynthetics uses test specimens of 200 mm width, with the provision for the seam or joint to extend for 25 mm on each side, in order to provide joint or seam stability during the test (see Figure 1).

Dimensions in millimetres



Key

- 1 length, in millimetres
- 2 joint/seam
- 3 finished specimen
- A see 6.3.5 and 8.4 b)
- B specimen width, in millimetres
- b joint/seam width, in millimetres

Figure 1 — Preparation of test specimen

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 10319, *Geosynthetics — Wide-width tensile test*

3 Terms and definitions

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

3.1

seam

series of stitches joining two or more separate pieces of a material or materials of planar structure, e.g. geosynthetics or related products

3.2

joint

junction at which two or more separate pieces of a geosynthetic are joined by a method other than stitching

3.3

joint/seam strength

$T_{j/s \max}$

maximum tensile stress of the seam formed by joining two or more sheets

NOTE The joint or seam strength is expressed in kilonewtons per metre.

[ISO 10318:2005]

3.4

joint/seam efficiency

$\xi_{j/s}$

ratio of the joint or seam strength to the tensile strength of the material measured in the same direction

NOTE The joint or seam efficiency is expressed in percent.

[ISO 10318:2005]

4 Principle

A geosynthetic specimen, 200 mm wide and containing a joint/seam, is gripped across its entire width in the clamps of a tensile testing machine, operated at a prescribed rate of extension, and subjected to a longitudinal force (perpendicular to the seam axis) until the joint/seam of the geosynthetic ruptures.

5 Apparatus and materials

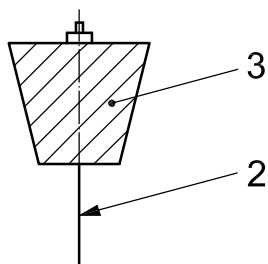
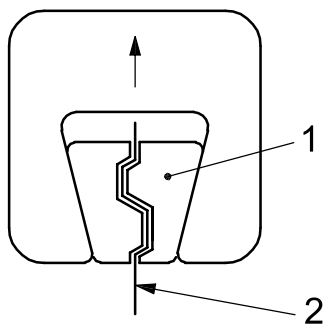
5.1 Tensile testing machine

Tensile testing machine, constant rate of extension type, complying with ISO 7500-1, Class 2 or higher, in which the rate of increase of the specimen length is uniform with time.

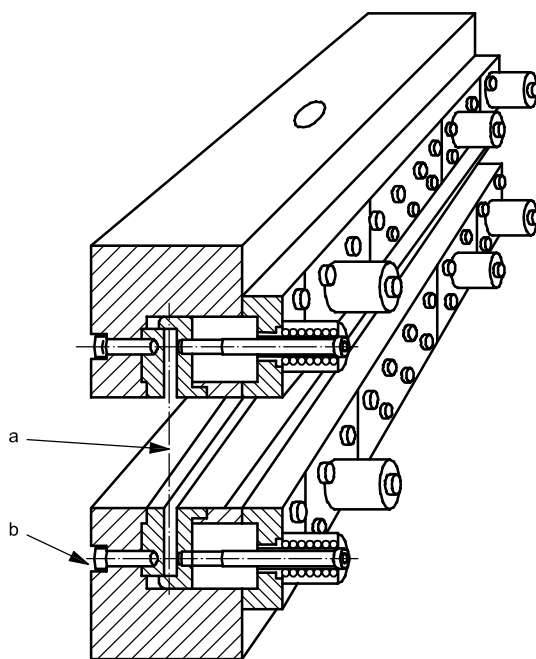
5.2 Jaws

Jaws which are sufficiently wide to hold the entire width of the specimen and with appropriate means to limit slippage or damage. Each jaw shall have faces measuring at least the width of the specimen, i.e. 200 mm.

NOTE It is stressed that it is essential to choose jaw faces that limit any slippage of the geosynthetic that may occur, especially for stronger geosynthetics. Examples of types of jaw face, which have been found satisfactory, are given in Figure 2.

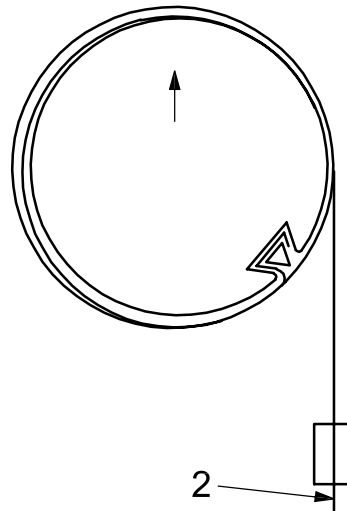


a) Wedge jaws



b) Compressive block jaws

Figure 2 — Examples of jaw faces for testing geosynthetics



c) Capstan

Key

- 1 serrated wedge
 - 2 geosynthetic
 - 3 epoxy or soft-metal wedge
- a Specimen maximum width: 0,5 m.
 b Compressive force adjustable up to 400 kN.

Figure 2 (continued)

5.3 Water

For wet specimens only, water complying with Grade 3 of ISO 3696.

5.4 Non-ionic wetting agent

For wet specimens only.

6 Test specimens**6.1 Number of test specimens**

Cut at least five test specimens, each of which includes the seam or joint.

6.2 Selection of test specimens

Select specimens in accordance with ISO 9862.

6.3 Dimensions of test specimens**6.3.1 General**

Prepare test specimens from the jointed or seamed specimen, each of sufficient length to ensure an initial jaw separation of 100 mm plus the joint or seam width, b (see Figure 1) and with the seam or joint located along the centre-line of the specimen, perpendicular to the direction of the applied load.

6.3.2 Nonwoven geotextiles

Cut each specimen, as shown in Figure 1, to achieve a final specimen width of 200 mm. When removing the shaded area from a specimen, as shown in Figure 1, the angles between the 25 mm extensions, which are parallel to the seam or joint, and that section of the specimen having a finished width of 200 mm shall be 90°.

6.3.3 Woven geotextiles

For woven geotextiles (see ISO 10319), make 25 mm long cuts at a distance of (25 mm plus $b/2$) from the vertical centre-line of the specimen, to facilitate the removal of the edge yarns in attaining the nominal width of 200 mm.

6.3.4 Geogrids

For geogrids, prepare jointed specimens at least 200 mm wide and sufficiently long to ensure a clamp separation of at least 100 mm plus the seam/joint width, measured to ± 3 mm. The jointed test specimen shall contain the same number of tensile elements as the wide-width tensile test specimens and at least one row of nodes or cross-members on either side of the joint, excluding those by which the test specimen is held in the jaws or from which the joint is to be made. Cut all ribs or cross-members at least 10 mm from any node (see Figure 3).

The cross-members, from which the joint is to be made, shall be extended by at least one pitch beyond the tensile elements to be tested, on both sides of the specimen, in order to facilitate the formation of the joint.

6.3.5 Knitted geotextiles

For knitted geotextiles, geocomposites or others, in which preparing the specimen by cutting with a knife or scissors may affect the geotextile structure, thermal cutting can be used, taking care to avoid damaging the specimen during the cutting operation, particularly at the points labelled "A" in Figure 1.

6.3.6 Wet testing

If wet testing is also required, cut five additional specimens.

6.4 Index characterization

For index characterization of the seam/joint, the two elements seamed/jointed together shall be oriented in the same direction (warp or weft, machine or cross-machine direction) and aligned perpendicular to the seam/joint and parallel to the applied load axis.

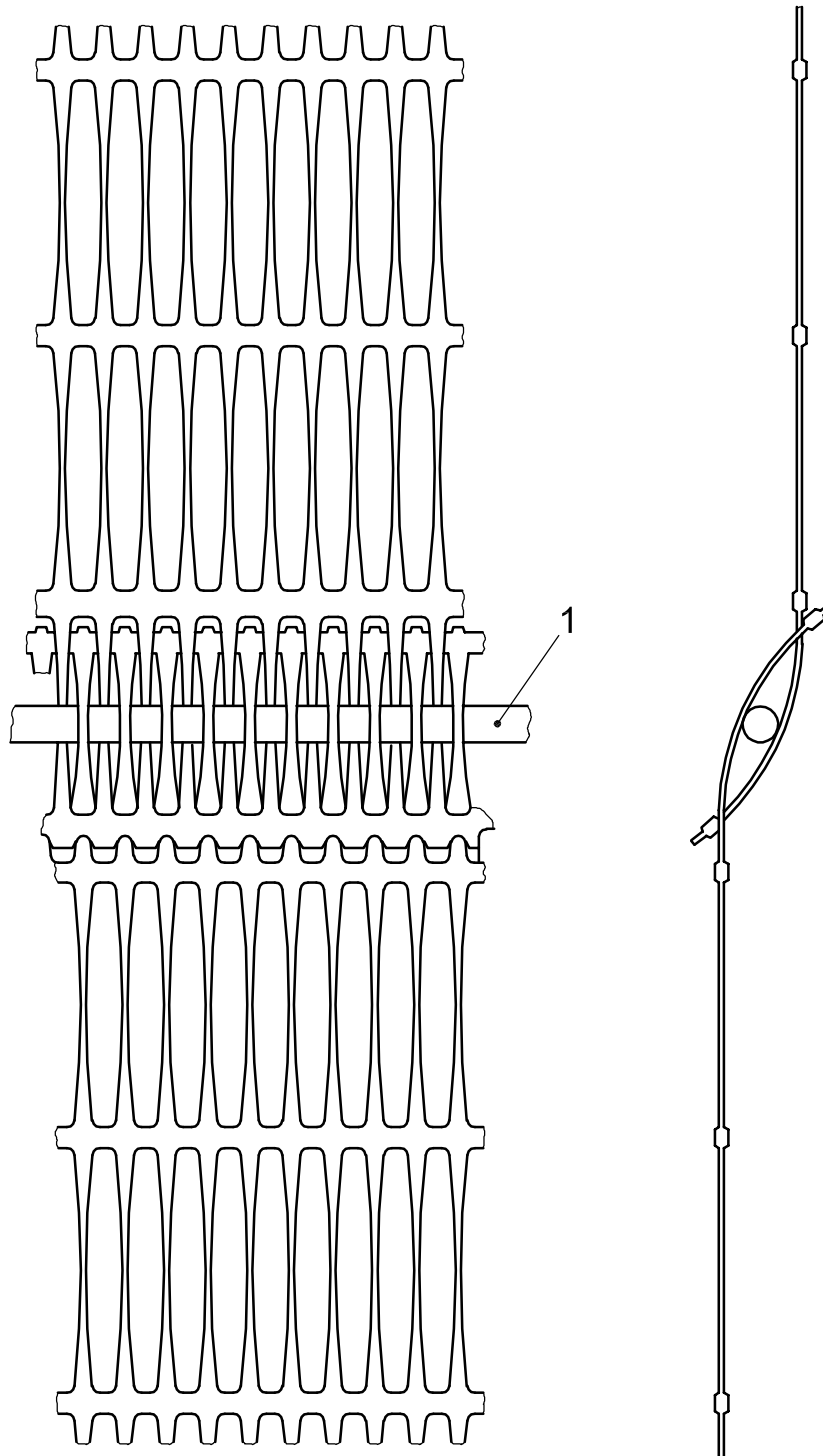
7 Conditioning

7.1 Conditioning and test atmosphere

The test specimens shall be conditioned and tested in the standard atmosphere for testing as defined in ISO 554 ($20\text{ °C} \pm 2\text{ °C}$ at $65\% \text{ RH} \pm 5\% \text{ RH}$) (RH is the relative humidity).

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 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.



Key

- 1 bodkin

Figure 3 — Example of geogrid seam/joint specimen

7.2 Conditioning for testing in the wet condition

Specimens to be tested in the wet condition shall be immersed in water (5.3) maintained at a temperature of $(20 \pm 2) ^\circ\text{C}$. The time of immersion 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, and at least 24 h. To obtain thorough wetting, it may be necessary to add no more than 0,05 % of a non-ionic neutral wetting agent (5.4) to the water.

8 Procedure

8.1 Setting up of machine

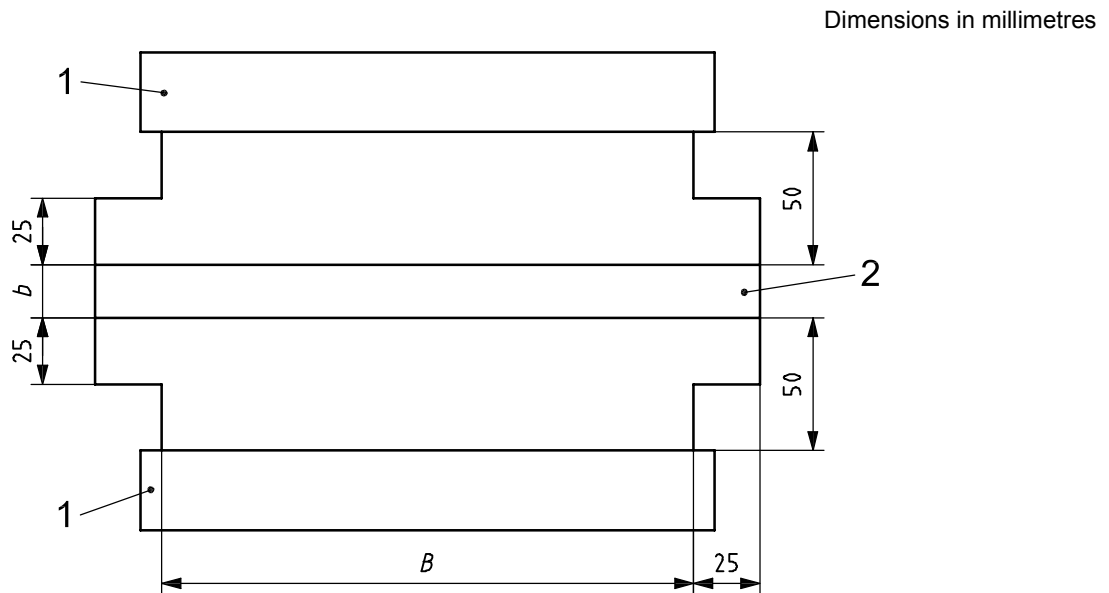
Adjust the distance between the jaws at the start of the test, to give a length of 100 mm plus the seam or joint width, measured to ± 3 mm, except for geogrids and geosynthetics when using capstan grips.

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 $(20 \pm 5) \%/min$ in the distance between the jaws. For wet test specimens, perform the test within 3 min of removal from the water.

If joint/seam efficiency is to be measured, the cross-head speed used shall be the same as that used for the tensile tests (specified in ISO 10319).

8.2 Insertion of test specimen in jaws

Mount the test specimen centrally in the jaws, taking care that the specimen length is parallel to the direction of application of the force. Where appropriate, after mounting, draw a line on the specimen parallel and adjacent to each jaw face, in order to observe any jaw slippage during testing (see Figure 4).



Key

- 1 clamp
- 2 joint/seam
- B* specimen width = 200 mm
- b* joint/seam width

Figure 4 — Example of seam/joint specimen placed in compressive clamps

8.3 Measurement of tensile seam/joint strength

Start the tensile testing machine and continue the procedure until the joint, the seam or the material itself ruptures. Stop the machine and reset to the initial gauge position. Record and report the maximum force, as read directly from the testing machine, to an accuracy of 0,01 kN. Observe and record whether the rupture is caused by:

- a) material rupture;
- b) sewing thread rupture;
- c) material slippage relative to the joint/seam;
- d) tear-type geosynthetic yarn rupture;
- e) joint failure;
- f) a combination of two or more of the foregoing.

Also note any other comment on the failure mode.

8.4 Discard criteria

Discard any individual test result and test a further specimen where one or more of the following occurs:

- a) a single determination is more than 3 standard deviations below the mean of the five results, and the reason for the premature failure is clearly due to faulty specimen preparation;
- b) the specimen failure is initiated from any of the points labelled "A" in Figure 1;
- c) jaw slippage is observed, and this clearly initiates a premature failure of the seam/joint.

9 Expression of results

9.1 Seam/joint strength

Using Equation (1), calculate the mean maximum joint or seam strength of individual specimens having a similar seam assembly, i.e. the force, in kilonewtons per metre, at which the specimen ruptures, as read directly from the testing machine.

$$T_{j/s \max} = F_{\max} \times c \quad (1)$$

where

$T_{j/s \max}$ is the joint or seam strength, expressed in kilonewtons per metre;

F_{\max} is the recorded maximum force, expressed in kilonewtons;

c is obtained from Equation (2) or (3), as appropriate.

For nonwoven geotextiles, closely woven geotextiles or similar materials:

$$c = \frac{1}{B} \quad (2)$$

where B is the specimen width, in metres (usually 0,2 m, see Figure 1).

Or, for coarse woven geotextiles, meshes, geogrids or similar materials:

$$c = \frac{N_m}{n_s} \quad (3)$$

where

N_m is the average number of tensile elements within 1 m width of the product being tested;

n_s is the number of tensile elements within the test specimen.

9.2 Seam/joint efficiency

If requested, determine the seam/joint efficiency ($\xi_{j/s}$) using Equation (4) when the strength of the unjointed/unseamed material (T_{\max}) has been determined by the wide-strip tensile test method (specified in ISO 10319), in the same direction as it was for the joint/seam strength test.

$$\xi_{j/s} = 100 \times (T_{j/s}/T_{\max}) \quad (4)$$

where

$\xi_{j/s}$ is the seam/joint efficiency, expressed in percent;

$T_{j/s\max}$ is the mean seam/joint strength, expressed in kilonewtons per metre;

T_{\max} is the mean tensile strength of the unseamed/unjointed material, expressed in kilonewtons per metre.

10 Test report

The test report shall include the following information:

- a) the number and year of publication of this International Standard;
- b) identification and description of the material, the product seam or joint method used, the width of the seam, the method of sampling used, where relevant, the direction of the joined parts of the specimen and whether the specimens were prepared using thermal cutting techniques;
- c) the condition of the test specimens, i.e. wet or dry;
- d) the number of test specimens tested;
- e) the type of jaw, including the jaw dimensions, and the type of jaw face;
- f) the standard atmosphere used; if tests are done outside conditioning limits, data on the effect of temperature and humidity on test results shall be shown;
- g) the mean joint or seam strength, in kilonewtons per metre, and, if required, the individual results, the standard deviation or coefficient of variation, or both, of the seam/joint strength;
- h) the type of failure for each test specimen (the material itself, joint/seam or other failure for each specimen);
- i) if requested, the seam efficiency, in percent.

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