INTERNATIONAL STANDARD

ISO 13426-1

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Geotextiles and geotextile-related products — Strength of internal structural junctions —

Part 1:
Geocells

Géotextiles et produits apparentés — Résistance des liaisons de structures internes —

Partie 1: Géosynthétiques alvéolaires

Reference number
ISO 13426-1:2003(E)

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 part of ISO 13426 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13426-1 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 221, *Geosynthetics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

ISO 13426 consists of the following parts, under the general title *Geotextiles and geotextile-related products — Strength of internal structural junctions*:

— *Part 1: Geocells*

— *Part 2: Geocomposites*

Contents

Foreword

This document (EN ISO 13426-1:2003) has been prepared by Technical Committee CEN/TC 189 "Geosynthetics", the secretariat of which is held by IBN, in collaboration with Technical Committee ISO/TC 221 "Geosynthetics".

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2003, and conflicting national standards shall be withdrawn at the latest by July 2003.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

Geocells are geotextile-related products composed of single strips interconnected in several possible ways (extrusion, thermal bonding, gluing, hot melt, stitching, etc) to form a panel of adjacent cells, where generally the contact between two elements occurs along lines or in specific points, and not uniformly on the whole surface. These lines or points are referred to as "junctions".

A geocell junction may fail in four different ways:

1) by shear (see Figure 1): when failure is caused by a force parallel to the junction itself;

2) by peeling or delamination (see Figure 2): when failure is caused by a force, normal to the junction, which separates the cells from each other at one edge of the junction;

3) by tensile stress (see Figure 3): when a force, normal to the junction, pulls away the two cells adjacent to the junction;

4) by local overstressing (see e.g. Figure 4: geocells secured with pins) : when the fixation element locally overstresses the junction, leading to a compression, shear or peel failure.

NOTE This can be considered as a performance property, in the same way as a tensile test on seams/joints.

It is therefore impossible to define one single testing method for measuring the junction strength of geocells. Hence this standard includes the principles for testing the four failure mechanisms explained above. These principles should be adapted to each single product. In order to avoid confusion about the interpretation of figures, reference should be made to the exact test method in test reports and data sheets, e.g. EN ISO 13426-1, method A – shear strength of internal structural junctions.

1 Scope

This standard describes four index test methods for the determination of the strength of internal structural junctions of geocells under different loading conditions.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 963, *Geotextiles and geotextile-related products - Sampling and preparation of test specimens (ISO 9862:1990)*

EN ISO 7500-1, *Metallic materials - Verification of static uniaxial testing machines - Part 1: Tension/compression testing machines (ISO 7500-1:1999)*

ISO 554, *Standard atmospheres for conditioning and/or testing – Specifications*

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply:

3.1
geocell
three-dimensional, permeable, polymeric (synthetic or natural) honeycomb or web structure made of strips linked in a staggered pattern, used to hold soil particles, roots and small plants for erosion control and soil containment applications in civil engineering

3.2
junction
point, line or area where two strips are connected to form the unit cells of a geocell structure

3.3
fastening system
system (staples, pegs, U-shaped bars, etc.) used to fix the geocells to the ground at single points

3.4
nominal cell size
length L_c (in machine direction) and width W_c (in cross-machine direction) of the cell when opened according to the specification

4 Principle

Specimens of geocells are tested in accordance with one or more of the following four test methods representing different stress modes.

NOTE 1 It is possible that, for some products, not all four test methods can be applied.

NOTE 2 In order to perform the tests correctly, information about the nominal open cell sizes (L_c, W_c) and the direction of installation of the geocells panels, e.g. with the machine direction down the slope or parallel to the contour lines, should be provided.

4.1 Method A: Tensile shear test (Figure 1)

This test is performed on a X-shaped specimen cut from a geocell panel. The junction forms the centre of the ‘X’. The left upper leg and the right lower leg of the ‘X’ are trimmed close to the junction. The two remaining legs are mounted in the clamps of a tensile testing machine. The specimen is tested at constant rate of strain and the peak tensile shear resistance is measured and recorded.

4.2 Method B: Peeling test (Figure 2)

This test is performed on a X-shaped specimen cut from a geocell panel. Both upper legs of the ‘X’ are mounted in the clamps of a tensile testing machine and tested at constant rate of strain until peel failure of the junction occurs. The peak peel resistance is measured and recorded. For products having a non-symmetric junction, the peel test shall be performed on the upper legs and on the lower legs.

4.3 Method C: Splitting test (Figure 3)

This test is performed on a X-shaped specimen cut from a geocell panel. The left legs of the ‘X’ are mounted in a special clamp keeping the edges of the legs apart at a specified distance.

NOTE The right legs are mounted in a similar way. This simulates the aperture of the cells when installed with the machine direction parallel to the contour lines of the slope.

The specimen shall be placed in the clamps at the same cell aperture as indicated by the nominal cell size (L_c, W_c). The specimen shall be mounted slightly in tension, i.e. without any slack. The two clamps are inserted in a tensile testing machine and tested at constant rate of strain until a tensile split failure of the junction occurs. The peak split resistance is measured and recorded.

4.4 Method D: Local overstressing test (Figure 4)

This test is performed on a X-shaped specimen cut from the geocell panel, the upper and lower legs being oriented in the production direction. The upper legs of the ‘X’ are mounted in a special clamp keeping the edges of the two legs apart at a specified distance. The lower legs are mounted in a similar way.

NOTE This simulates the aperture of the cells when installed.

The two clamps are mounted in a tensile testing machine. A steel rod or wooden peg, or any other means simulating a real fastening system, is placed across and over the junction, and fixed to the base of the testing machine. The specimen is tested at a constant rate of strain until failure occurs due to plasticization of the junction by the fastening system. The maximum tensile strength is measured and recorded. When geocells are installed with the machine direction along the contour lines, the specimen shall be mounted in the clamps as shown in Figure 3. For products having a non-symmetric junction, this test shall be performed twice, i.e. by mounting the upper legs as well as the lower legs in the moving clamp.

5 Conditioning of specimens

Test specimens shall be conditioned and the tests conducted in the standard atmosphere for testing, defined in ISO 554, i.e. at a temperature of (20 ± 2) °C and a relative humidity of (65 ± 2) %

NOTE Conditioning and/or testing at a specified relative humidity may be omitted if it can be shown that results are not affected.

6 Test specimens

Take specimens in accordance with EN 963.

At least five specimens shall be tested for each of the relevant directions of the product. If junctions are not symmetrical, five specimens for each side of the junction shall be tested.

Cut specimens according to the shapes and dimensions shown in Figures 5, 6, 7, and 8, respectively for the test methods A, B, C, D, described in 4.1 to 4.4.

Cut specimens always such that clamping occurs at equal distance between junctions.

7 Apparatus

7.1 Tensile testing machine

A constant rate of extension tensile testing machine, in accordance with EN ISO 7500-1, shall be used.

7.2 Clamps

The clamps shall be sufficiently wide to hold the entire width of the specimen. They shall be equipped with appropriate means to prevent specimen slippage or damage.

NOTE Compressive jaws should be used for most products.

8 Test procedure

All test methods are carried out at a constant rate of strain of 20 % per minute.

Adjust the distance between the jaws at the start of the test to the required test specimen length ± 3 mm.

Set the machine so as to induce the required strain rate of 20% per minute.

Mount the test specimen centrally in the jaws. Take care that the specimen length is parallel to the application direction of the force.

Start the tensile machine and continue until specimen rupture occurs. Stop the machine, record and report the maximum load to an accuracy of 2 % of the full-scale reading. Report the related strain to the first decimal.

Reset to the initial gauge position.

The decision to discard a test result shall be based on observation of the specimen and on the inherent variability of the product. In the absence of other criteria for rejecting a jaw break, any failure occurring within 5 mm of the jaws, which results in a value below 50 % of the average value of all other tests, shall be discarded. No other break results shall be discarded, unless the test is known to be invalid.

NOTE 1 The precise reason of the specimen's rupture in or near the jaws is not easy to determine. If a specimen is damaged by the jaws the test result should be discarded. If, however, it is merely due to randomly distributed weaknesses in the test specimen, the test result should be accepted. In some cases, it may also be caused by a concentration of stress in the area adjacent to the jaws because they prevent the test specimen from contracting laterally when the load is applied. In these cases, a rupture near the edge of the jaws is inevitable and should be accepted as characteristic for that particular method of test.

NOTE 2 Special precautions should be taken for the testing of specimens made of specific materials (e.g. glass fiber, carbon fiber) to minimize damage by the jaws. If slippage occurs or if more than 25 % of the specimens break in the jaws or less than 5 mm from the edge of the jaws, then one or more of the following actions should be taken:

- padding of the jaws;
- applying a coating to the test specimen under the jaw face area;
- modification of the jaw surface.

These modifications should be stated in the test report.

9 Calculations

9.1 General

In case of non-symmetric junctions, tests A, B, C, D shall be performed on both sides of the junctions and the minimum values shall be recorded.

In case one or more of the tests yields a saw-tooth load-deformation plot, the peak of the peaks shall be recorded as test result.

9.2 Method A: Tensile shear

The tensile shear strength α_{ts}, expressed in kN/m, is calculated directly from the test results, using equation (1).

$$\alpha_{ts} = F_{ts} \times n_j \qquad (1)$$

where

F_{ts} is the recorded maximum load, in kN (recorded to three significant digits);

n_j is the minimum number of junctions within a 1 m width of the product when opened to the nominal cell size (L_c, W_c) according to the recommendations of the manufacturer.

9.3 Method B: Peeling

The peel strength α_p, expressed in kN/m, is calculated directly from the test results, using equation (2).

$$\alpha_p = F_p \times n_j \qquad (2)$$

where

F_p is the recorded maximum load, in kN (recorded to three significant digits);

n_j is the minimum number of junctions within a 1 m width of the product when opened to the nominal cell size (L_c, W_c) according to the recommendations of the manufacturer.

9.4 Method C: Splitting

The tensile split strength $\alpha_{split,}$ expressed in kN/m, is calculated directly from the test results, using equation (3).

$$\alpha_{split} = F_{split} \times n_j \qquad (3)$$

where

F_{split} is the recorded maximum load, in kN (recorded to three significant digits);

n_j is the minimum number of junctions within a 1 m width of the product when opened to nominal cell size (L_c, W_c) according to the recommendations of the manufacturer.

9.5 Method D: Local overstressing

The maximum resistance to local overstressing α_{lo}, expressed in kN, are calculated directly from the test results, using equation (4).

$$\alpha_{lo} = F_{lo} \times n_j \qquad (4)$$

where

F_{lo} is the recorded maximum load, in kN (recorded to three significant digits);

n_j is the minimum number of junctions within a 1 m width of the product when opened to nominal cell size (L_c, W_c) according to the recommendations of the manufacturer.

10 Test report

The test report shall include the following information (for each method A, B, C, D):

a) reference to this European Standard and to the specific test method used (e.g. EN ISO 13426-1, Method A: tensile shear);

b) all relevant data for complete identification of the specimen tested;

c) the mean tensile strength, recorded to three significant digits;
if required, in both specimen positions for methods B and D and, if required, the individual values, expressed as in clause 9;

d) if applicable, the mean strain at the maximum load in both machine direction and cross direction and, if required, the individual values, expressed as in clause 9;

e) the standard deviation or coefficient of variation of any of the properties determined;

f) the number of specimens tested in each direction;

g) the manufacturer and model of the tensile testing machine;

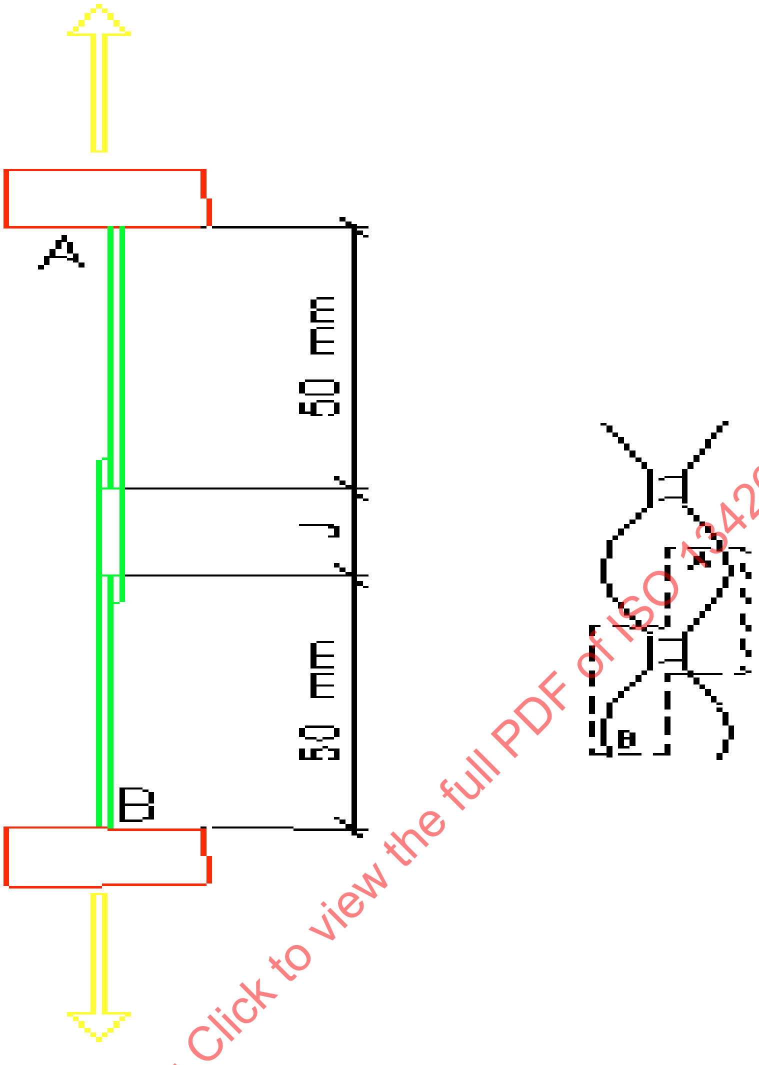
h) the type of jaw, including the dimensions of the jaws and the type of jaw faces used, type of deformation measuring system and initial jaw separation; for method D), details of the fastening system used;

i) a typical load-strain curve with the yield points, if required;

j) details of any deviations from the specified procedure;

k) strain rate, in percent per minute, reported to the nearest percent;

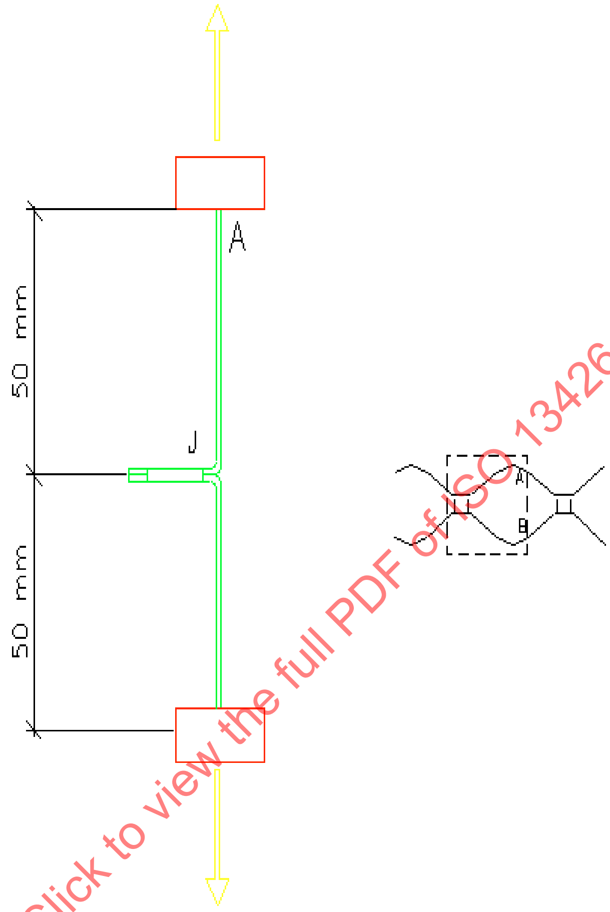
l) the standard atmosphere used.



Key

J Junction

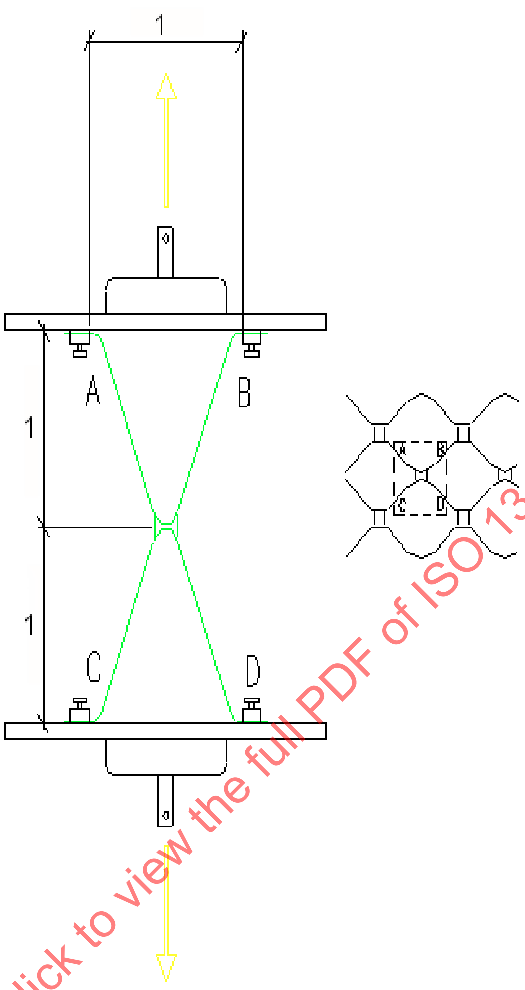
Figure 1– Schematic representation of the tensile shear test for geocells (Method A)



Key

J Junction

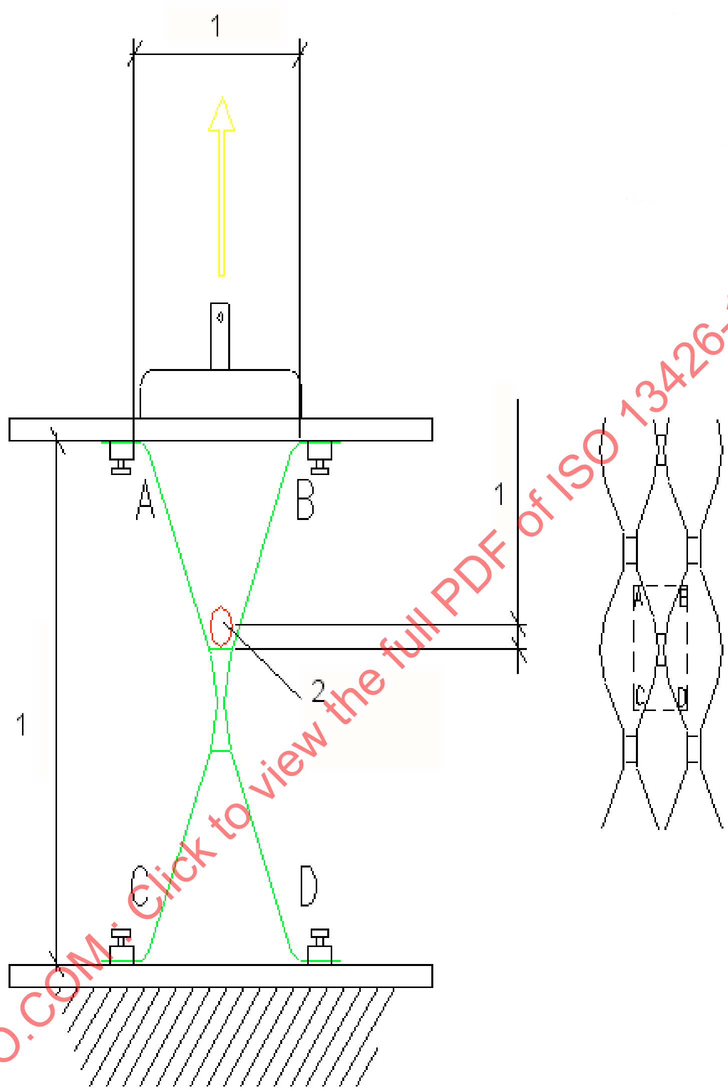
Figure 2 – Schematic representation of the peel test for geocells (Method B)



Key

1 Variable

Figure 3 – Schematic representation of the split test for geocells (Method C)

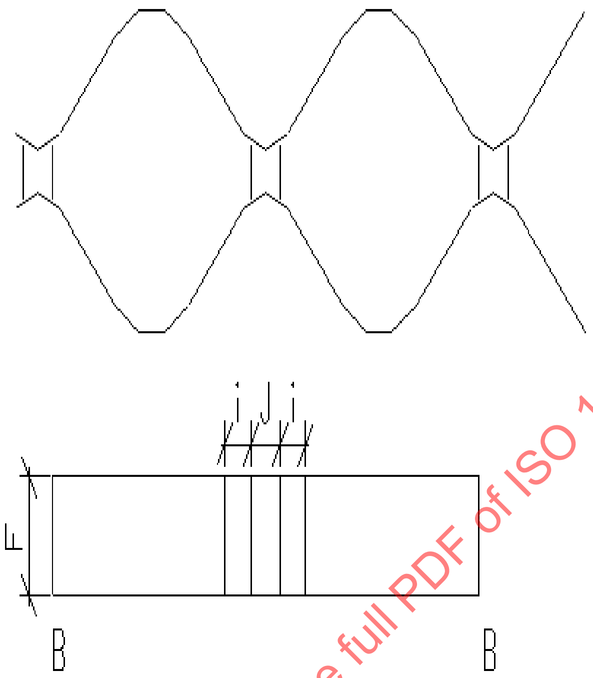


Key

1 Variable

2 Fixed steel rod

Figure 4 – Schematic representation of the local overstressing test for geocells (Method D)



Key

F Full height of the strip

J Junction

B Beginning of next junction

I 30mm

Figure 5 – Specimen for the tensile shear test for geocells (Method A)