भारतीय मानक
Indian Standard

IS 16474 : 2015

भूकृत्रिम — एकल या बहू रिब विधि द्वारा ज्यौग्रिड की तन्यता गुणो के लिए परीक्षण की विधि

Geosynthetics — Method of Test for Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method

ICS 59.080.70

भारतीय मानक ब्यूरो
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Geosynthetics Sectional Committee, TXD 30

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Geosynthetics Sectional Committee had been approved by the Textile Division Council.

In the formulation of this standard assistance has been drawn from ASTM D6637 - 11 'Standard test method for determining tensile properties of geogrids by the single or multi-rib tensile method', issued by the American Society for Testing and Materials, USA.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GEOSYNTHETICS — METHOD OF TEST FOR TENSILE PROPERTIES OF GEOGRIDS BY THE SINGLE OR MULTI-RIB TENSILE METHOD

1 SCOPE

1.1 This test method covers the determination of the tensile strength properties of geo-grids by subjecting strips of varying width to tensile loading.

1.2 Three alternative procedures are provided to determine the tensile strength, as follows:

a) *Method A* — Testing a single geo-grid rib in tension (N).
b) *Method B* — Testing multiple geo-grid ribs in tension (kN/m).
c) *Method C* — Testing multiple layers of multiple geo-grid ribs in tension (kN/m).

1.3 This test method is intended for quality control and conformance testing of geo-grids.

2 REFERENCES

The following standards are necessary adjuncts to this standard:

IS No.	*Title*
13321 (Part 1) : 1992	Glossary of terms for geosynthetics: Part 1 Terms used in materials and properties
SP 45 : 1988	Handbook on glossary of textile terms

3 TERMINOLOGY

For the purpose of this standard the definitions given in SP45, IS13321 (Part 1) and the following shall apply.

3.1 Atmosphere for Testing Geo-Synthetics — Air maintained at a relative humidity 65 ± 2 percent and a temperature of 27 ± 2°C.

NOTE — Any other atmosphere for testing may be used as per the agreement between the concerned parties.

3.2 Breaking Force (F) — The force at failure.

3.3 Corresponding Force — The synonym for force at specified elongation.

3.4 Force at Specified Elongation (FASE) — A force associated with a specific elongation on the force-elongation curve (synonym for corresponding force).

3.5 Force-elongation curve — In a tensile test, a graphical representation of the relationship between the magnitude of an externally applied force and the change in length of the specimen in the direction of the applied force (synonym for stress-strain curve).

3.6 Geo-grid — A geo-synthetic formed by a regular network of integrally connected elements with apertures greater than 6.35 mm to allow interlocking with surrounding soil, rock, earth, and other surrounding materials to primarily function as reinforcement.

3.7 Geo-synthetic — A product manufactured from polymeric material used with soil, rock, earth, or other geotechnical engineering related material as an integral part of a man made project, structure, or system.

3.8 Index Test — A test procedure which may contain known bias, but which may be used to establish an order for a set of specimens with respect to the property of interest.

3.9 Integral — In geo-synthetics, forming a necessary part of the whole; a constituent.

3.10 Junction — The point where geo-grid ribs are interconnected to provide structure and dimensional stability.

3.11 Rib — For geo-grids, the continuous elements of a geo-grid which are either in the machine or cross-machine direction as manufactured.

3.12 Rupture — For geo-grids, the breaking or tearing apart of ribs.

3.13 Tensile — Capable of tensions, or relating to tension of a material.

3.14 Tensile Strength — For geo-grids the maximum resistance to deformation developed for a specific material when subjected to tension by an external force. Tensile strength of geo-grids is the characteristic of a sample as distinct from a specimen and is expressed in force per unit width.

3.15 Tensile Strength (α_f) — For geogrids the maximum resistance to deformation developed for a specific material when subjected to tension by an external force. Tensile strength of geo-grids is the characteristic of a sample as distinct from a specimen and is expressed in force per unit width.

3.16 Tensile Test — A test in which a material is stretched uniaxially to determine the force elongation characteristics, the breaking force, or the breaking elongation.

3.17 Tension — The force that produces a specified elongation.

4 PRINCIPLE

4.1 Method A

In this method, a single, representative rib specimen of a geo-grid is clamped and placed under a tensile force using a constant rate of extension testing machine. The tensile force required to fail (rupture) the specimen is recorded. The ultimate single rib tensile strength (N) is then determined based on the average of six single rib tensile tests.

4.2 Method B

A relatively wide specimen is gripped across its entire width in the clamps of a constant rate of extension type tensile testing machine operated at a prescribed rate of extension, applying a uniaxial load to the specimen until the specimen ruptures. Tensile strength (kN/m), elongation, and secant modulus of the test specimen can be calculated from machine scales, dials, recording charts, or an interfaced computer.

4.3 Method C

A relatively wide, multiple layered specimen is gripped across its entire width in the clamps of a constant rate of extension type tensile testing machine operated at a prescribed rate of extension, applying a uniaxial load to the specimen until the specimen ruptures. Tensile strength (kN/m), elongation and secant modulus of the test specimen can be calculated from machine scales, dials recording charts, or an interfaced computer.

5 SIGNIFICANCE AND USE

5.1 The determination of the tensile force-elongation values of geo-grids provides index property values. This test method shall be used for quality control and acceptance testing of commercial shipments of geo-grids.

5.2 In cases of dispute arising from differences in reported test results when using this test method for acceptance testing of commercial shipments, the purchaser and the supplier shall conduct comparative tests to determine, if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum the two parties shall take a group of test specimens which are as homogeneous as possible and which are from a lot of material of the type in question. The test specimens shall then be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories shall be compared using Student's t-test for unpaired data and an acceptable probability level chosen by the two parties before the testing began. If a bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results in light of the known bias.

5.3 All geo-grids can be tested by any of these methods. Some modification of techniques may be necessary for a given geo-grid depending upon its physical make-up. Special adaptations may be necessary with strong geo-grids, multiple layered geo-grids, or geo-grids that tend to slip in the clamps or those which tend to be damaged by the clamps.

6 APPARATUS

6.1 Testing Clamps — The clamps shall be sufficiently wide to grip the entire width of the specimens (as determined by the test method) and with appropriate clamping power to prevent slipping or crushing (damage). For a given product the same clamps shall be used in testing methods A, B and C prior to making any comparison between results.

6.1.1 *Size of Jaw Faces* — Each clamp shall have jaw faces measuring wider than the width of the specimen.

6.2 Tensile Testing Machine — A testing machine of the constant rate of extension type shall be used. The machine shall be equipped with a device for recording the tensile force and the amount of separation of the grips. Both of these measuring systems shall be accurate to ± 1.0 percent and, preferably, shall be external to the testing machine. The rate of separation shall be uniform and capable of adjustment within the range of the test.

6.3 Distilled Water and Non-ionic Wetting Agent — It shall be used for wet specimens only.

6.4 Extensometer — When required by the method, a device 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.

Examples of extensometers include mechanical, optical, infrared or electrical devices.

7 SAMPLING

7.1 Laboratory Sample

For the laboratory sample, take a full roll width swatch long enough in the machine direction from each roll in the lot sample to ensure that the requirements in **8.1** can be met. The sample may be taken from the end portion of a roll provided there is no evidence it is distorted or different from other portions of the roll.

8 TEST SPECIMEN

8.1 The specimens shall consist of three (3) junctions or 300 mm in length, in order to establish a minimum specimen length in the direction of the test (either the machine or cross-machine direction). All specimens shall be free of surface defects, etc, not typical of the laboratory sample. Take no specimens nearer the selvage edge along the geogrid than 1/10 the width of the sample.

NOTE — If a comparison of one geo-grid to another is to be made the length of each specimen shall be the same (as similar as possible) and agreed upon by all the parties.

8.2 Preparation

8.2.1 *Method A*

Prepare each finished specimen, as shown in Fig. 1, to contain one rib in the cross-test wide by at least three junctions (two apertures) long in the direction of the testing, with the length dimension being designated and accurately cut parallel to the direction for which the tensile strength is being measured.

8.2.2 *Method B*

Prepare each finished specimen, as shown in Fig. 2, to be a minimum of 200 mm wide and contain five ribs in the cross-test direction wide by at least three junctions (two apertures) or 300 mm long in the direction of the testing, with the length dimension being designated and accurately cut parallel to the direction for which the tensile strength is being measured.

8.2.3 *Method C*

Prepare each finished specimen as shown in Fig. 2, to be a minimum of 200 mm wide and contain five ribs in the cross-test direction wide by at least three junctions (two apertures) or 300 mm long in the direction of the testing, with the length dimension being

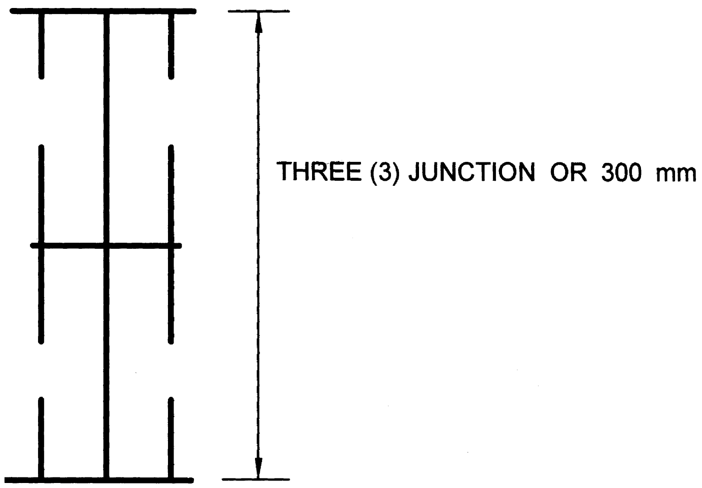

FIG. 1 SPECIMEN DIMENSIONS FOR METHOD A

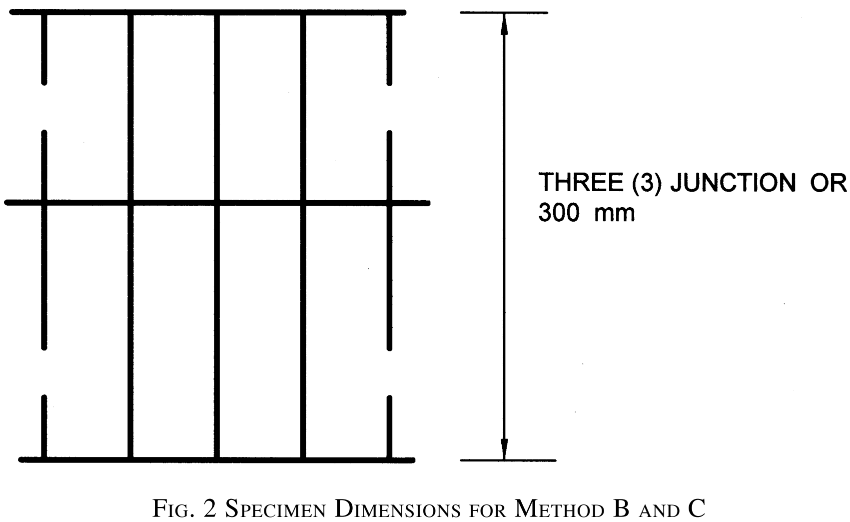

FIG. 2 SPECIMEN DIMENSIONS FOR METHOD B AND C

designated and accurately cut parallel to the direction for which the tensile strength is being measured. This must be repeated for each layer of geo-grid included in the test.

8.2.4 Within test methods A, B and C, the outermost ribs are commonly cut prior to testing to permit extra width of material in the clamps to minimize slippage within the clamps. If this procedure causes non-uniform distribution of load to the gauge length area of the specimen, the same width of material shall be included in the clamps as will be tested in the gauge length area. In either case, the test results shall be based on the unit of width associated with the number of intact ribs.

8.3 Number of Test Specimens

8.3.1 Unless otherwise agreed upon as when provided in an applicable material specification, take a number of test specimens per swatch in the laboratory sample such that the user may expect at the 95 percent probability level that the test result is no more than 5 percent above the true average for each swatch in the laboratory sample for each required direction.

NOTE — In some applications, it may be necessary to perform tensile tests in both the machine and the cross-machine directions. In all cases, the direction of the tensile test specimen(s) shall be clearly noted.

8.3.2 *Reliable Estimate of v*

When there is a reliable estimate of v based upon extensive past records for similar materials tested in the user's laboratory as directed in the method, calculate the required number of specimens using equation as follows:

$$n = (tv/A)^2 \qquad \text{... (1)}$$

where

- n = number of test specimens (rounded upward to a whole number);
- v = reliable estimate, of the coefficient of variation of individual observations of similar materials;
- t = value of Student's t for one-sided limits, a 95 percent probability level, and the degrees of freedom associated with the estimate of v; and
- A = 50 percent of the average, the value of allowable variation.

8.3.3 *No Reliable Estimate of v*

When there is no reliable estimate of v for the user's laboratory, equation given in **8.3.2** shall not be used directly. Instead, specify the fixed number of 5 specimens for the required direction. The number of specimens is calculated using v = 9.5 percent of the average for the required direction. This value for v is somewhat larger than usually found in practice. When a reliable estimate of v for the user's laboratory becomes available, equation given in **8.3.2** will usually require fewer than the fixed number of specimens.

9 CONDITIONING

9.1 Expose the specimens to the atmosphere for testing geo-synthetics for a period long enough to allow the geo-grid to reach equilibrium within this standard atmosphere. Consider the specimen to be at moisture equilibrium when the change in mass of the specimen in successive weighing made at intervals of not less than 2 h does not exceed 0.1 percent of the mass of the specimen. Consider the specimen to be at temperature equilibrium after 1 h of exposure to the atmosphere for testing geo-synthetics.

9.2 Specimen to be tested in the wet condition shall be immersed in water for a minimum of 1 h maintained at a temperature of 21 ± 2°C. The time of immersion must be sufficient to wet out the specimens thoroughly, as indicated by no significant change in strength or elongation following a longer period of immersion, and at least 2 min. To obtain thorough wetting it may be necessary or advisable to use distilled water.

9.3 Geo-grids may be received in the laboratory rolled, thus it is important to flatten the specimens to avoid misleading elongation measurements. Geo-grids which exhibit curl memory shall be laid flat and weighted, until the geo-grid remains flat without weight.

10 PROCEDURE

10.1 Zero the testing system.

10.2 Machine Set up Condition

At the start of the test adjust the distance between the clamps or the distance from centreline to centreline of rollers to the greater distance of three junctions or 200 ± 3 mm such that at least one traverse rib is contained centrally within the gauge length. At least one clamp shall be supported by a free swivel or universal joint which will allow the clamp to rotate in the plane of the geo-grid. Select the force range of the testing machine so the break occurs between 10 and 90 percent of full scale force. The test shall be conducted at a strain rate of 10 ± 3 percent per minute of the gauge length based on the gauge length as depicted in Fig. 3.

10.3 Mount the specimen centrally in the clamps and tighten sufficiently to prevent damage to the specimen (*see* Notes). Measure the distance between clamp faces or centreline to centreline of the roller grips to determine test specimen gauge length. External extensometers or other external means of measurement (for example, photo methods) are encouraged for all tests where modulus is to be measured and must be

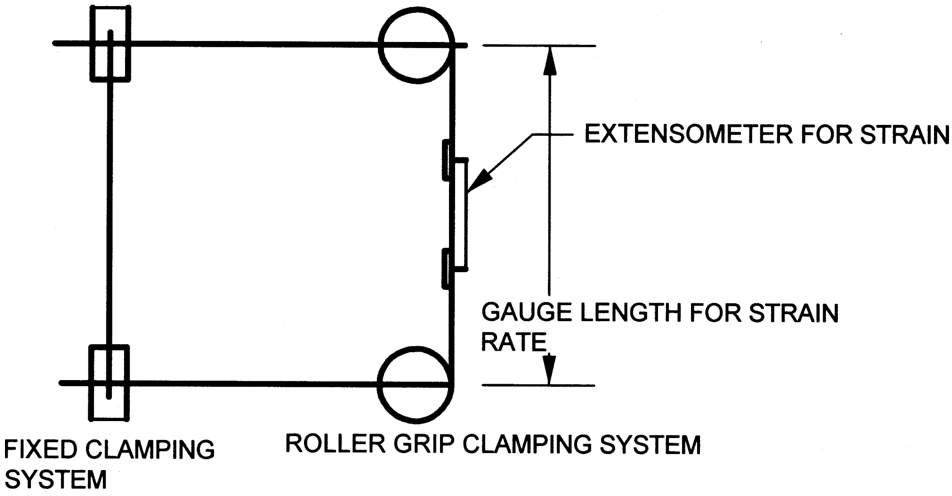

FIG. 3 GAUGE LENGTH FOR FIXED AND ROLLER GRIP CLAMPING SYSTEMS

used to determine displacement when roller clamps are used in testing. Documentation shall be provided, if a discrepancy arises when extensometers are not used during testing.

NOTES

1 Some modifications of clamping techniques may be necessary for a given geo-grid depending upon its construction. Special clamping configurations may be necessary for geo-grids constructed of coated fibres or yams to prevent them from slipping in the clamps or being damaged as a result of being gripped too tightly in the clamps. When roller clamps are used, an external extensometer,as per Fig. 3, is often used to determine displacement. In this case, the distance between the moving feet of the extensometer will determine the gauge length for use in elongation calculations and not test speed.

2 Care shall be taken while testing multiple geo-grid layers to assure even tensioning of the layers and uniform clamping pressure. The test result shall be discarded, if the result is a load at a small displacement or peak strength is reached without having all of the layers evenly tensioned.

10.4 Initiate the test by starting the testing machine and continue running the test until rupture occurs. Report the maximum force obtained to cause failure, the time to failure and the elongation at the measured maximum force.

10.4.1 If a specimen of one or more layers slips in the jaws, breaks at the edge of or in the jaws, or if, for any reason attributed to faulty operation the result falls markedly below average for the set of specimens (*see* **10.4.2**).

10.4.2 The decision to discard the results as given in **10.4.1** shall be based on observation of the specimen during the test of the geo-grid. In the absence of other criteria for such tests, all test which results in a value below 20 percent of the average of all the other breaks shall be discarded. No other break shall be discarded unless the test is known to be faulty.

10.4.3 It is difficult to determine the precise reason why certain specimens break near the edge of the jaws. If a jaw break is caused by damage to the specimen by the jaws, then the results shall be discarded. If, however, it is merely due to randomly distributed weak places, it is a perfectly legitimate result. In some cases, it may also be caused by a concentration of stress in the area adjacent to the jaws because they prevent the specimen from contracting in width as the force is applied. In these cases, a break near the edge of the jaws is inevitable and shall be accepted as a characteristic of the particular method of test.

10.5 If a geo-grid manifests any slippage in the jaws or if more than 24 percent of the specimens break at a point within 5 mm of the edge of the jaw, then (a) the jaws may be padded, (b) the geo-grid may be coated under the jaw face area, or (c) the surface of the jaw face may be modified. If any of the modifications listed above are used, state the method of modification in the report.

10.6 Measurement of Elongation

Measure the elongation of the geo-grid at any stated force by means of a suitable recording device at the same time as the tensile strength is determined, unless, otherwise agreed upon, as provided for in an applicable material specification. Measure the elongation to three significant figures.

10.6.1 The strain within the specimen is calculated from the measurement of elongation as discussed in **10.6** and shown in Fig. 3. It can also be obtained independently of the cross head movement. These measurements can be made with extensometers or area measuring devices which are set to read the centre portion of the specimen and containing at least one transverse rib. When used, the minimum extensometer gauge length shall be 60 mm.

11 CALCULATION

11.1 For Method A (Single Rib Specimen)

From the test data, the average ultimate rib strength in (N) is calculated by averaging the value of maximum force at rupture for all accepted specimens results. The average elongation at failure shall be determined separately for machine direction specimen and cross-machine direction specimens and expressed as the percentage increase in length, based upon the initial gauge length of the specimen. Report this as the elongation at failure.

11.2 For Methods-B and C (Wide Width Specimen)

11.2.1 *Slack Displacement* (d_o) *and Slack Tension* (T_o)

Slack in the geo-synthetic reinforcement may have developed during test set-up or due to the testing equipment. For each test, the tensile load-displacement curve (*see* Fig. 4) may be examined to establish a point where the testing equipment fully engages the specimen, that is pick up load. The displacement where this occurs will be designated as the slack displacement d_o. The applied tension at the slack displacement will be designated as the slack tension, T_o. Both values must be recorded in the report.

11.2.1.1 The slack tension, T_o, shall be limited to 1.25 percent of the peak tensile strength or 225 N. The slack tension may only be applied once. The time between application of slack tension and test initiation must be less than 2 min. Slack displacement d_o shall be selected in which the slack tension T_o does not violate these criteria.

NOTE — The slack tension, T_o, and slack displacement, d_o, may both be designated as equal to zero even if there is some slack behavior.

11.2.2 Calculate the tensile strength for individual wide width specimens (see Note 1) that is, calculate the equivalent force per unit width expressed in N/m of width, using following equation:

$$\alpha_f = [(F_p - T_o)/N_r] \times N_t \quad \dots (2)$$

where

α_f = equivalent force per unit width, N/m;
F_p = observed maximum force, N;
T_o = slack tensile load, N;
N_r = number of tensile elements being tested; and
N_t = number of tensile elements per unit width, equal to N_c/b (*see* Note 2)

NOTES

1 This equation is only for use in the determination of wide width tensile strength of the specimen based on Methods B and C above. This standard does not address the possible correlation between single-rib and wide-width tensile strength.

2 N_t is determined by taking the average of three measurements from samples at are 95 percent of the manufactured product roll width. Each measurement is performed by measuring the distance from the central point of the starting aperture (centre line to centre line aperture dimension divided by 2) to the centre point of the aperture a distance equal to 95 percent of the

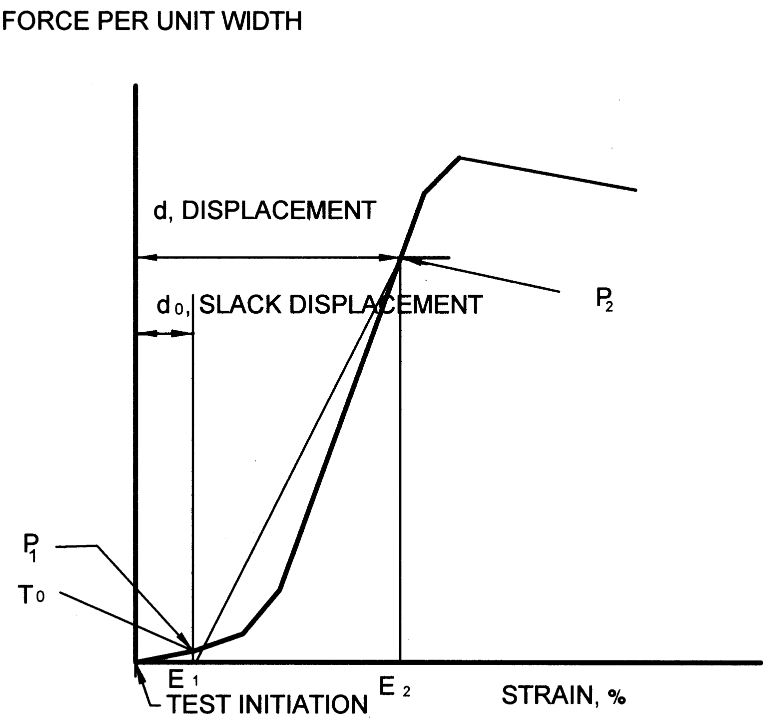

FIG. 4 STRESS-STRAIN CURVE WITH COMPLETE TEST RESULTS

manufactured product roll width away from the starting aperture (This establishes the *b* value). As such, this measurement will result in a fractional value. The number of tensile elements, N_c, within the distance, »*b*¼, are counted and multiplied by the number of layers found in the test specimen.

12.3 Strain

Calculate the percent strain for individual specimens (*see* Fig. 4), that is, calculate the elongation of specimens, expressed as the percentage increase in length of the specimen using equation given in **11.2.2** for XY type recorders and following equation for manual readings:

$$€\rho = (\Delta L \times R \times 100)/C_c \times L \quad \text{... (3)}$$

$$€\rho = (\Delta L \times 100)/ L$$

where

$€\rho$ = elongation, percent;

do = distance from zero force to the point where the curve leaves the zero load axis, mm;

d = distance along the zero load axis from the point the curve leaves the zero load axis to a point of corresponding force, mm;

R = testing speed rate, m/min;

C_c = recording chart speed, m/min;

$L = L_o + d_o$ = slack displacement plus the initial nominal gauge length, mm; and

$\Delta L = (d - d_o)$ = unit change in length from the slack displacement point to the corresponding measured force, mm.

11.2.4 Gauge marks or extensometers are preferred to define a specific test section of the specimen (*see* Fig. 3); when these devices are used, only the length defined by the gauge marks or extensometers shall be used in the calculation. Gauge marks must not damage the geo-grid.

11.2.5 *Secant Modulus*

See Fig. 4, select a force per unit width for a specified elongation $€_2$, and label the corresponding point on the force-elongation curve as P_2. Likewise, label a second point P_1, at a specified elongation, $€_1$, taken at d_o. Draw a straight line (secant) through both points P_1 and P_2 intersecting the zero load axis. Calculate secant tensile modulus using the following equation:

$$J_{sec} = (\alpha_f \times 100)/€_p \quad \text{... (4)}$$

where

J_{sec} = secant tensile modulus at corresponding elongation, N/m;

α_f = peak force minus slack tension times the number of tensile elements in a unit width (m) divided by the number of elements tested. This is the equivalent force per unit width, N/m at a designated percent strain; and

$€_p$ = corresponding percent strain with respect to the force per unit width (*see* equation 4).

12 REPORT

12.1 For Test Method A

The report for geo-grid rib tensile strength shall include the following:

a) The maximum individual rib tensile strength, *N*, and elongation at failure for each specimen and the average ultimate rib tensile strength, *N*, average elongation at failure, and standard deviation for each set of specimens;
b) Make and model of the testing machine;
c) Type, size, and facing of grips, and description of any changes made to the grips;
d) The number of specimen tested;
e) Test conditions;
f) Any departures from stan9ard procedure;
g) Identification and description of geo-grid sample(s);
h) Description of type and location of failure of each test;
j) Direction of testing; and
k) Full set of load versus strain charts.

12.2 For Test Methods B and C

Report that the specimens were tested as directed in this test method, or any deviations from this test method. Describe all materials or products sampled and the method of sampling for each material.

12.2.1 Report all of the following applicable items for the machine direction and where appropriate, the cross machine direction of all materials tested:

a) Ultimate tensile strength, a_f, in kN/m;
b) Elongation at the ultimate tensile strength in percent, and the method of measuring elongation;
c) Secant modulus, in kN, of width (*see* Fig. 4), and **11.2.4**. If the secant modulus is reported, state that portion of the force-elongation curve used to determine the modulus, that is, $€_1$ to $€_2$ at zero tension, elongation reported as $€_2$ secant modulus. If it is agreed between parties that the secant modulus be reported then the entire load-strain curve shall be recorded and reported as shown in Fig. 4.
d) The standard deviation or the coefficient of variation of the test results;

e) Number of tensile elements, ribs, within the width of specimens;
f) Number of specimens tested;
g) Make and model of the testing machine;
h) Grip separation (initial);
j) Type, size, and facing of grips, and description of any changes made to the grips;
k) Conditioning of specimens, including details of temperature, relative humidity, and conditioning time; and;
m) Anomalous behaviour, such as tear failure or failure at the grip.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Geo-synthetics Sectional Committee, TXD 30

Organization	*Representative(s)*
The Bombay Textile Research Association, Mumbai	Dr. A. N. Desai (***Chairman***) Shri V. K. Patil (*Alternate*)
Brahmaputra Board, Guwahati	Representative
Business Coordination House, New Delhi	Shri Samir Gupta Shrimati Ritika Gupta (*Alternate*)
Central Coir Research Institute, Alappuzha	Director Joint Director (*Alternate*)
Central Road Research Institute, New Delhi	Shri Sudhir Mathur Shri Jai Bahagwan (*Alternate*)
Central Soil and Materials Research Station, New Delhi	Shri Nripendra Kumar Shri Manish Gupta (*Alternate*)
CIDCO, Mumbai	Representative
Department of Jute and Fibre Technology, Kolkatta	Dr Swapan Ghosh Shri K. R. Gupta (*Alternate*)
Directorate General of Supplies and Disposals, New Delhi	Additional Director General (QA)
Ganga Flood Control Commission, Patna	Shri S. Masood Husain Shri Ravi Bhushan Kumar (*Alternate*)
Garware Wall Ropes Ltd, Pune	Shri Tirumal Kulkarni Shri S. J. Chitnis (*Alternate*)
Gujarat Engineering Research Institute , Vadodara	Shri L. V. Ashara Research Officer (*Alternate*)
Indian Jute Industries' Research Association, Kolkata	Shri P. K. Choudhury Shri Koushik Das (*Alternate*)
Indian Jute Manufacture Association, Kolkatta	Representative
In Personal Capacity	Shri V. N. Gore
Kusumgar Corporates, Mumbai	Shri Y. K. Kusumgar Dr M. K. Talukdar (*Alternate*)
Macaferri Environmental Solutions Pvt Ltd, Navi Mumbai	Dr Ratnakar Mahajan
Maharashtra Maritime Board, Mumbai	Representative
National Highways Authority of India, New Delhi	Shri R. K. Gandhi Shri R. P. Singh (*Alternate*)
National Jute Board, Kolkatta	Shri T. Sanyal Shri A. K. Khastagir (*Alternate*)
National Institute of Research on Jute and Allied Fibre Technology, Kolkatta	Dr Gautam Bose Dr Sanjoy Debnath (Alternate)
Office of the Textile Commissioner, Mumbai	Shri Ajay Pandit Shri M. Balasubramanian (*Alternate*)
Premier Polyfilms Ltd, Ghaziabad	Dr Sanjeev K. Verma Shri Harinder Kumar (*Alternate*)
Reliance Industries Ltd, New Delhi	Shri M. S. Verma Shri V. Ravikanth (*Alternate*)
Strata Geosystems (I) Pvt Ltd, Mumbai	Shri Narendra Dalmia Shri Shahrokh Bagli (*Alternate*)
Techfab India, Mumbai	Shri Anant Kanoi Shri Saurabh Vyas (*Alternate*)
The Synthetics & Art Silk Mills Research Association, Mumbai	Dr Manisha Mathur Shrimati Ashwini Sudam (*Alternate*)

Organization	*Representative(s)*
Veermata Jijabai Technological Institute, Mumbai	DR PRASHANT BHAVE
BIS Directorate General	SHRI PRABHAKAR RAI, Scientist 'E' and Head (TXD) [Representing Director General (*Ex-officio*)]

Member Secretary
SHRI J. K. GUPTA
Scientist 'C' (TXD), BIS

Bureau of Indian Standards

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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