भारतीय मानक

Indian Standard

IS 18928 : 2024
ISO 24281 : 2021

वस्त्रादि — बुने हुए कपड़े का द्विअक्षीय तन्यता गुणधर्म — ग्रैब विधि का प्रयोग कर अधिकतम बल एवं अधिकतम बल पर दीर्घीकरण ज्ञात करना

Textiles — Biaxial Tensile Properties of Woven Fabric — Determination of Maximum Force and Elongation at Maximum Force Using the Grab Method

ICS 59.080.30

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

October 2024 **Price Group 7**

Physical Methods of Test Sectional Committee, TXD 01

NATIONAL FOREWORD

This Indian Standard which is identical to ISO 24281 : 2021 ‘Textiles — Biaxial tensile properties of woven fabric — Determination of maximum force and elongation at maximum force using the grab method’ issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on recommendation of the Physical Methods of Test Sectional Committee and approval of the Textiles Division Council.

The text of ISO standard has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words ‘International Standard’ appears referring to this standard, they should be read as ‘Indian Standard’; and

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to the following International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with its degree of equivalence for the editions indicated.

International Standard	Corresponding IndianStandard	*Degree of Equivalence*
ISO 139 Textiles — Standard atmospheres for conditioning and testing	IS 6359 : 2023 Method for conditioning of textiles (*first revision*)	Technically Equivalent
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	IS 1828 (Part 1) : 2022/ISO 7500-1 : 2018 Metallic materials — Calibration and verification of static uniaxial testing machines: Part 1 Tension/compression testing machines — Calibration and verification of the force-measuring system (*fifth revision*)	Identical
ISO 10012 Measurement management systems — Requirements for measurement processes and measuring equipment	IS/ISO 10012 : 2003 Measurement management systems — Requirements for measurement processes and measuring equipment (*first revision*)	Identical
ISO 13934-1 Textiles — Tensile properties of fabrics — Part 1: Determination of maximum force and elongation at maximum force using the strip method	IS 1969 (Part 1) : 2018/ ISO 13934-1 : 2013 Textiles — Tensile properties of fabrics: Part 1 Determination of maximum force and elongation at maximum force using the strip method (*fourth revision*)	Identical
ISO 13934-2 Textiles — Tensile properties of fabrics — Part 2: Determination of maximum force using the grab method	IS 1969 (Part 2) : 2018/ ISO 13934-2 : 2014 Textiles — Tensile properties of fabrics: Part 2 Determination of maximum force using the grab method (*fourth revision*)	Identical

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

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TEXTILES — BIAXIAL TENSILE PROPERTIES OF WOVEN FABRIC — DETERMINATION OF MAXIMUM FORCE AND ELONGATION AT MAXIMUM FORCE USING THE GRAB METHOD

1 Scope

This document specifies a procedure to determine the maximum force and elongation at maximum force of textiles woven fabrics using a grab method in the biaxial testing machine.

The method is mainly applicable to woven textile fabrics, including fabrics which exhibit stretch characteristics imparted by the presence of an elastomeric fibre, mechanical, or chemical treatment. It can be applicable to fabrics produced by other techniques. It is not applicable to geotextiles[4], nonwovens[3], coated fabrics[5], textile-glass woven fabrics[2], and fabrics made from carbon fibres or polyolefin tape yarns.

The method is restricted to the use of constant rate of extension (CRE) testing machines to the same axis.

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 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*

ISO 13934-1, *Textiles — Tensile properties of fabrics — Part 1: Determination of maximum force and elongation at maximum force using the strip method*

ISO 13934-2, *Textiles — Tensile properties of fabrics — Part 2: Determination of maximum force using the grab method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13934-1, ISO 13934-2 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
biaxial
related to measurement or application along two axes simultaneously

3.2
constant-rate-of-extension (CRE) biaxial testing machine
tensile-testing machine provided with four clamp moves independently with a constant speed throughout the test, the entire testing system being virtually free from deflection

3.3
grab test
tensile test in which only the centre part of the test specimen is gripped in the jaws of the testing machine

[SOURCE: ISO 13934-2:2014, 3.2]

3.4
maximum force
maximum force recorded when a test specimen is taken to rupture during a test under the specified conditions

[SOURCE: ISO 13934-1:2013, 3.11]

3.5
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 e test specimen under defined pretension with carbon copy paper to produce a gripping pattern on the test specimen and/or the jaw faces.

[SOURCE: ISO 13934-1:2013, 3.3]

3.6
extension
increase in length of a test specimen produced by a force

Note 1 to entry: Extension is expressed in units of length.

[SOURCE: ISO 13934-1:2013, 3.6]

3.7
elongation
ratio of the *extension* (3.6) of the test specimen to its initial length

Note 1 to entry: Elongation is expressed as a percentage.

[SOURCE: ISO 13934-1:2013, 3.7]

3.8
pretension
force applied to a test specimen at the beginning of certain tests

Note 1 to entry: Pretension is used to determine the *initial length* (3.9) of the test specimen.

[SOURCE: ISO 13934-1:2013, 3.5]

3.9
initial length
length of a test specimen under specified *pretension* (3.8) between the two effective clamping points at the beginning of certain tests

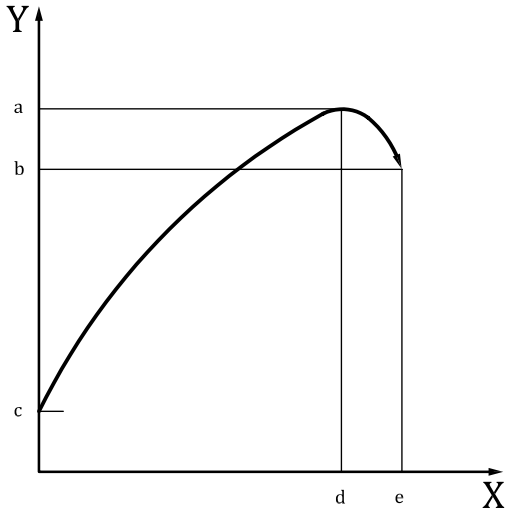
Note 1 to entry: See also 3.5.

[SOURCE: ISO 13934-1:2013, 3.4]

3.10
elongation at maximum force
elongation (3.7) of a test specimen produced by the maximum force

Note 1 to entry: See Figure 1.

[SOURCE: ISO 13934-1:2013, 3.8]



Key

X elongation
Y force
a Maximum force.
b Force at rupture.
c Pretension.
d Elongation at max. force.
e Elongation at rupture.

Figure 1 — Example of force-elongation curve

4 Principle

A test specimen of square shape is biaxially loaded in the plane of the fabric. The loads are applied in the warp and weft directions simultaneously. Measurements of maximum force and elongation are used to represent biaxial properties of the fabric.

5 Sampling

Select samples either in accordance with the procedure laid down in the material specification for the fabric or as agreed between the interested parties.

In absence of an appropriate material specification, the example of suitable sampling procedure given in Annex A may be used.

An example of a suitable pattern for cutting test specimens from the laboratory sample is given in Annex A. Avoid test specimens with folded or creased areas, selvedges, and areas not representative of the fabric.

6 Apparatus — Biaxial test machine

The testing apparatus shall be a constant-rate-of-extension (CRE) biaxial testing machine. Metrological confirmation system of the biaxial testing machine shall be in accordance with ISO 10012.

The biaxial test machine shall be capable of simultaneously applying loads to the test specimen with a specified load ration in the warp and weft directions. It shall be capable of measuring loads, strains and/or displacements at suitable locations simultaneously.

The clamping or holding devices shall be capable of holding the test specimen without allowing it to slip and designed so that they minimize damage to the test specimen.

6.1 The biaxial tensile testing machine shall be provided with means for indication or recording the force applied to the test specimen in stretching it to rupture. Under conditions of use, the 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.

6.2 The machine shall be capable of a specified constant rate of extension with an accuracy of ±10 %.

6.3 The machine shall be capable of setting the specified gauge length with in ±1 mm.

6.4 The machine shall be capable of measuring the distance of the clamp with the warp and weft directions simultaneously.

6.5 The clamping device shall be capable of holding the specimen without allowing it to slip and designed so that they do not cut or otherwise weaken the test specimen.

6.6 The faces of the jaws shall be smooth and flat, except that when, even with packing, the test specimen cannot be held satisfactorily with flat-faced jaws, engraved or corrugated jaws can be used to prevent slippage. Other auxiliary materials for use with either smooth or corrugated jaws to improve specimen gripping include paper, leather, plastics, or rubber.

6.7 For the grab test, the dimensional clamping area of the fabric shall be (50 mm ± 1 mm) × (60 mm ± 1 mm).

6.8 The machine shall be capable of constant rate of extension 50 mm/min with an accuracy of ±10 %.

6.9 The machine shall be capable of setting the gauge length to 200 mm, to within ±1 mm.

7 Atmosphere for conditioning and testing

The atmosphere for preconditioning, conditioning and testing shall be as specified in ISO 139.

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

8 Preparation of test specimens

8.1 General

From each laboratory sample, at least five test specimens shall be cut, no test specimens shall be cut from within 150 mm of either edge of the laboratory sample.

8.2 Dimensions

The length and width of each test specimen shall be 400 mm ± 2 mm.

8.3 Preparation of test specimens

One each test specimen, a line shall be drawn a distance of 170 mm from one end of the warp and weft direction and drawn the direction of the warp by an arrow. Example of test specimens is illustrated in Annex B.

9 Procedure

9.1 Gauge length

Set the gauge length of the biaxial tensile-testing machine to 200 mm within ±1 mm.

9.2 Rate of extension

Set the rate of extension of the biaxial tensile-testing machine to 50 mm/min.

9.3 Mounting of test specimens

Mount the test specimen by aligning one side of the clamp with the two lines drawn parallel to the warp and weft direction and refer to illustrated in Annex B. Zones “4-1” and “4-3” are mounted on the warp direction, and zones “4-2” and “4-4” are mounted on the weft direction.

The extension necessary to reach the pretension shall be added to the gauge length, thus determining the initial length needed for the calculation of the elongation at maximum force.

Apply the appropriate pretension specified as follows:

— for all fabrics with stretch characteristics: 0,5 N;

— for fabrics without stretch characteristics according to mass per unit area:

  a) ≤ 200 g/m^2: 2 N;

  b) > 200 g/m^2 to 500 g/m^2: 5 N;

  c) > 500 g/m^2: 10 N.

9.4 Operation

Engage the device for recording the maximum force and elongation at maximum force. Put the clamp in motion and extend the test specimen to the point of rupture in any direction. Perform the test at least on five specimens. Record the maximum force of each direction in newtons and the extension or the elongation at least to the nearest.

— 0,4 mm or 0,2 % for elongations < 8 %;

— 1 mm or 0,5 % for elongations 8 % to ≤ 75 %;

— 2 mm or 1 % for elongations > 75 %.

Record any break which occurs within 5 mm of the clamping line of jaws and report the result as a jaw break. At the end of the fives test, examine the results obtained. If any of the jaw break results falls above the lowest “normal” break result, then it can be included. If any of the jaw break results falls below the lowest “normal” break results, then it shall be excluded, and further test should be carried out to obtain five “normal” breaks.

If all the results are jaw breaks, or if five “normal” breaks cannot be obtained, then the individual results shall be reported without the coefficient of variation or confidence limits. Jaw break results shall be indicated as such in the report, and the results discussed between the interested parties.

10 Calculation and expression of results

For each specimen, the average of the two maximum force values calculated for each direction is used as the result in that direction.

Calculate the arithmetic mean of the maximum force of five specimens by two directions, in newtons. Round the results for values.

— < 100 N to the nearest 1 N;

— ≥ 100 N to < 1 000 N to the nearest 10 N;

— ≥ 1 000 N to the nearest 100 N.

For each specimen, the average of the two elongations at maximum force values calculated for each direction is used as the result in that direction.

Calculate the arithmetic mean of the elongation at maximum force of five specimens by two direction and round it to the nearest:

— 0,2 % for elongations < 8 %;

— 0,5 % for elongations 8 % to ≤ 75 %;

— 1 % for elongations > 75 %.

If required, calculate the coefficient of variation to the nearest 0,1 % and the 95 % confidence limits rounded to the same precision as the mean value.

11 Test report

The test report shall include the following information:

a) reference to this document, i.e. ISO 24281:2021;

b) date of test;

c) identification of the test sample and sampling procedure, if required;

d) number of test specimens, including the number of tests rejected and reasons for this;

e) gauge length in millimetre;

f) rate of extension in mm/min;

g) pretension applied, in newtons;

h) preconditioning, conditioning and testing atmosphere;

i) arithmetic mean of the maximum force, in newtons;

j) arithmetic mean of the elongation at maximum force, in percent;

k) coefficient of variation of the mean value, in percent, if required;

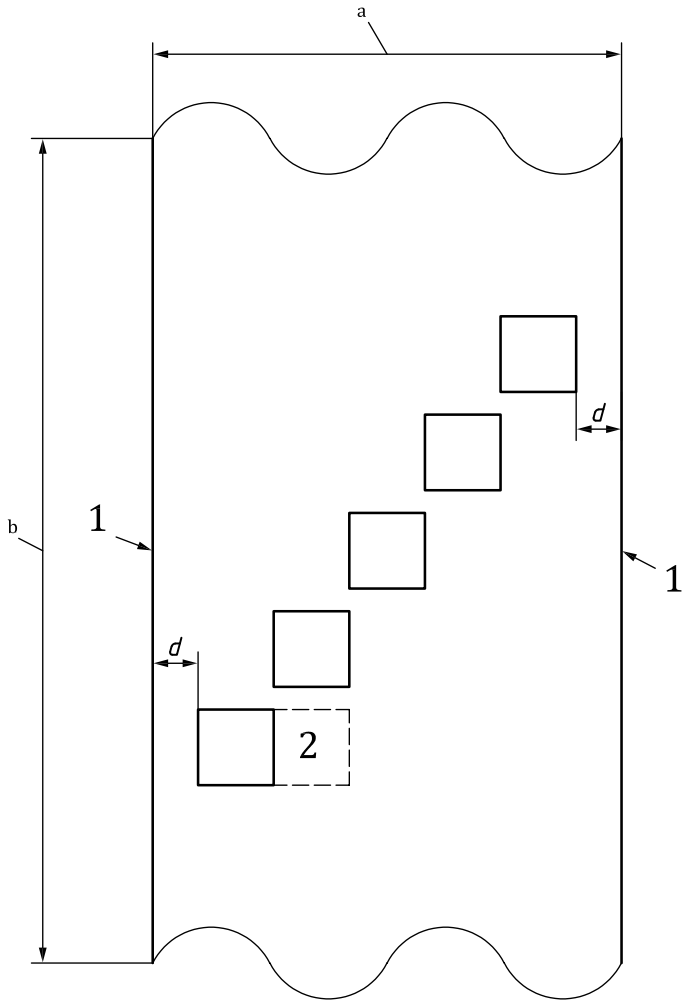
l) 95 % confidence limits of the mean value, in newtons, and of the relevant elongation, in percent, if required;

m) any deviation from the given procedure.

Annex A
(informative)

Locations of test specimens cut from a laboratory sample

See Figure A.1



Key

1 edge
2 test specimen
a Width of fabric.
b Length of fabric.
d = 150 mm

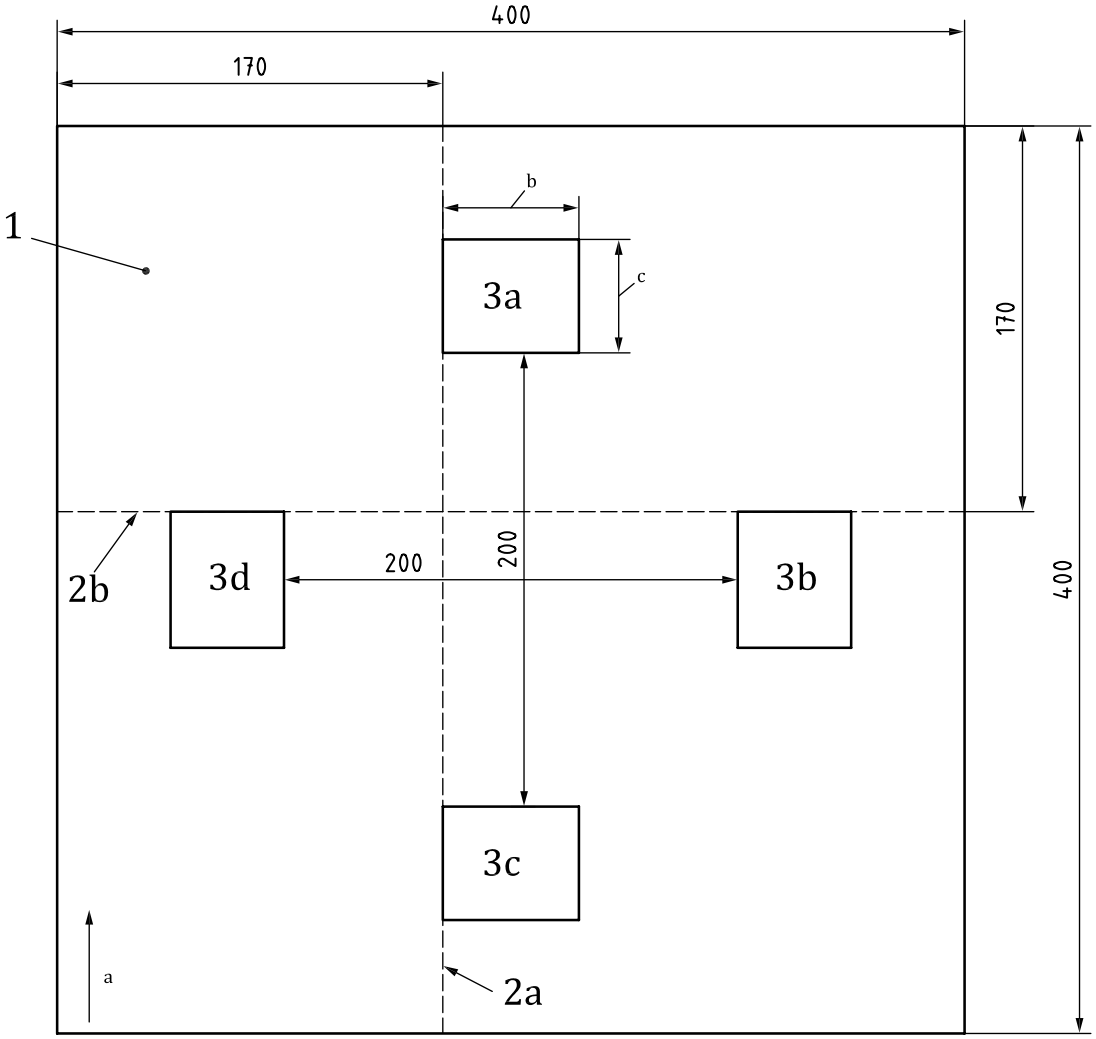
Figure A.1 — Locations of test specimens cut from a laboratory sample

Annex B
(normative)

Preparation of test specimens

See Figure B.1.

Dimensions in millimetres



Key

1 test specimen

2 lines for mounting:
"2a" line at 170 mm from the test specimen edge in the warp direction
"2b" line at 170 mm from the test specimen edge in the weft direction

3 jaw face zones:
zones "3a" and "3c" mounted on the warp direction
zones "3b" and "3d" mounted on the weft direction

a Direction of warp.

b Jaw face dimension: width 60 mm.

c Jaw face dimension: length 50 mm.

Figure B.1 — Preparation of test specimen

Bibliography

[1] ISO 1421, *Rubber- or plastics-coated fabrics — Determination of tensile strength and elongation at break*

[2] ISO 4606, *Textile glass — Woven fabric — Determination of tensile breaking force and elongation at break by the strip method*

[3] ISO 9073-3, *Textiles — Test methods for nonwovens — Part 3: Determination of tensile strength and elongation*

[4] ISO 10319, *Geosynthetics — Wide-width tensile test*

[5] EN 17117-1, *Rubber or plastics-coated fabrics— Mechanical test methods under biaxial stress states—Part 1: Tensile stiffness properties*

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 website-www.bis.gov.in or www.standardsbis.in.

This Indian Standard has been developed from Doc No.: TXD 01 (24993).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices: *Telephones*

Central : 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002 { 2323 7617

Eastern : 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091 { 2367 0012 2320 9474

Northern : Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019 { 265 9930

Southern : C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113 { 2254 1442 2254 1216

Western : Manakalya, 5th Floor/MTNL CETTM, Technology Street, Hiranandani Gardens, Powai Mumbai 400076 { 25700030 25702715

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Published by BIS, New Delhi