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Footwear — Test method for the characterization of elastic materials — Tensile performance

Chaussures — Méthode d'essai de caractérisation des matériaux élastiques — Performances de traction

Reference number
ISO 10765:2010(E)

Foreword

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ISO 10765 was prepared by Technical Committee ISO/TC 216, *Footwear* and by Technical Committee CEN/TC 309, *Footwear* in collaboration, in accordance with the Vienna Agreement.

Footwear — Test method for the characterization of elastic materials — Tensile performance

1 Scope

This International Standard specifies a test method for the determination of some typical parameters of elastics for footwear using the strength/elongation graph, which is obtained from the tensile strength test. This method is applicable to any elastic material used for footwear.

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 18454, *Footwear — Standard atmospheres for conditioning and testing of footwear and components for footwear*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
elastic
tape, cord or fabric containing rubber or a similar substance allowing it to stretch and return to its original shape

NOTE Generally elastic materials are used in upper construction in the quarters or in the straps to hold the shoe on the foot.

3.2
elastic gradient
slope of the straight part of the graph, with reference to width

3.3
modulus
strength needed to stretch an elastic band until a given extension, with reference to width

3.4
limit of useful extension
extension value on the point of the graph where the slope is five times bigger than the average at the initial part of the curve

NOTE It is the point at which the stretching together of the textile material threads and the rubber threads that form elastic begins.

3.5
maximum resistance extension
extension at the maximum load point

3.6
extension at break
extension at the moment of rupture of the material

4 Apparatus and materials

4.1 Tensile testing machine, which can provide crosshead speeds of (100 ± 20) mm/min and (50 ± 10) mm/min and which permits autographic recording of the load/extension trace.

4.2 Steel ruler, accurate to the nearest 0,5 mm.

4.3 Sewing machine, with a round point needle metric size 90s or 70s, a nylon or polyester thread (approximately tex 17/3) and operating at 6 stitches/cm.

4.4 Polyurethane (PU) coagulated woven fabric, of thickness of approximately 1 mm.

5 Sampling and conditioning

5.1 Sampling

5.1.1 The standard test piece dimensions are shown in Figure 1.

5.1.2 In general the testing length is 100 mm, however if the available material is limited, this length can be reduced to 50 mm.

5.1.3 Cut three test pieces of elastic material measuring at least 150 mm in length. Draw two lines, exactly 90 mm apart on each of the test pieces, and so that none of the lines is less than 30 mm from the test piece ends.

If shorter test pieces are used, they shall have a minimum length of 80 mm and the lines must be drawn 40 mm apart, so that none of them is less than 20 mm from the ends.

5.1.4 Cut 12 rectangle pieces of coated fabric (4.4), 50 mm wide and the same length as the width of elastic test piece, plus an extra 30 mm. On six of them, draw a parallel line on the longest side at 5 mm from the edge.

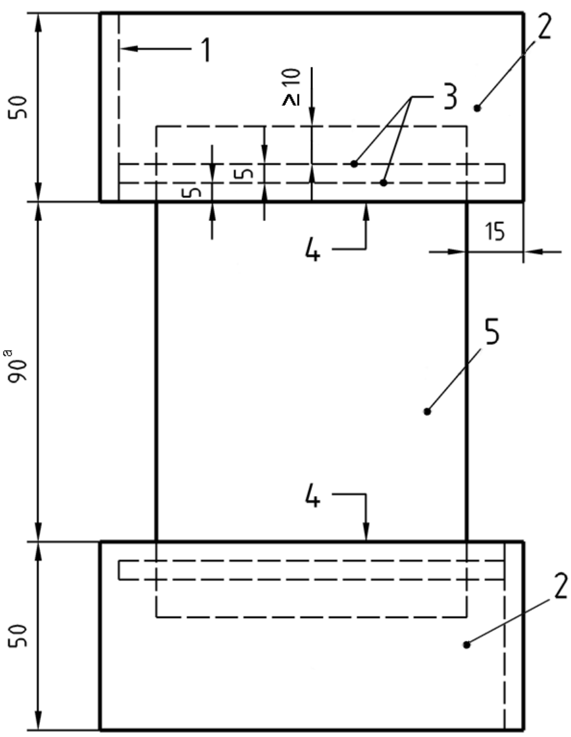
5.1.5 Place each marked rectangle piece with the coated side facing upwards, aligned with an unmarked rectangle, with the coating facing downwards. Between these rectangles introduce the elastic test piece so that the line drawn on the elastic aligns exactly with the edge of the textile rectangle and about 15 mm of this protrudes from either side of the elastic.

5.1.6 Holding the three pieces of material in this position, sew along the marked line on the coated fabric (4.4). On reaching the edge, turn the sample and sew parallel to and 5 mm from the previous seam. Double-sided tape can be used when preparing the test piece to avoid any of the materials being displaced whilst they are being sewn.

5.1.7 Likewise, sew the other two rectangles on the other end of the elastic test piece.

5.1.8 Repeat the procedure in order to prepare the other two samples.

Dimensions in millimetres



Key

1 stitch line
2 coated fabric
3 stitching
4 line drawn on elastic
5 elastic

[a] In the case of shorter test pieces the lines between the two samples are spaced at 40 mm.

Figure 1 — Dimensions of a standard test piece in millimetres

5.2 Conditioning

Samples and test pieces shall be conditioned for at least 24 h at (23 ± 2) °C and (50 ± 5) % relative humidity (RH) before testing,, in accordance with ISO 18454.

6 Procedure

6.1 Using the steel ruler (4.2), measure the distance between the seams of the elastic test piece ends, 5 mm from the edges of the coated material. Measure this distance twice and record the average length, L. Furthermore, measure the sample width at three different points, to the nearest 1 mm; record the average of the three values, b.

6.2 Calibrate the tensile testing machine (4.1) to a force range between 100 N and 500 N and a speed of separation of the jaws of (100 ± 20) mm/min. The recorder speed should be equal to the crosshead speed. If the test pieces are 50 mm long, the crosshead speed shall be (50 ± 10) mm/min and if possible the recorder speed shall be twice the jaws separation speed so as to improve precision of extension measurements on the graph.

6.3 Clamp one of the test pieces symmetrically in the jaws of the tensile testing machine so that the edge of the jaws aligns exactly with the material's seam, at 5 mm from the edge. If the edges of the material protrude from the jaws and there is not enough space, they may be cut off.

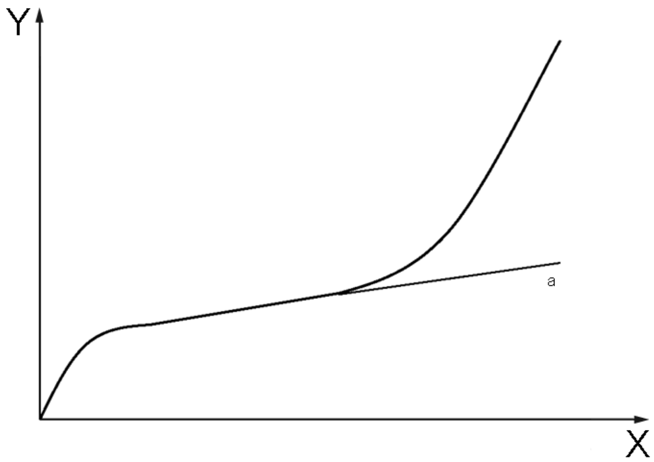
6.4 Keep the tensile testing machine switched on until the elastic test piece breaks.

6.5 Repeat the procedure for the other test pieces.

7 Expression of results

7.1 General

The strength/elongation graph shown in Figure 2 was obtained from the elastic material tensile strength test.



Key

X percent extension

Y force, in newtons

[a] Elastic gradient (EG).

Figure 2 — Graph showing the relationship between load and percentage extension for the tensile strength of elastic materials

7.2 Modulus

7.2.1 20 % **modulus**

Mark the point with the coordinate $x = 20$ % on the graph. The coordinate, y, of this point corresponds to the load needed for reaching said extension, y_{20}. Divide this value by the width of the test piece, b, in centimetres, to obtain the 20 % modulus using Equation (1).

$$20\ \%\ \text{modulus} = \frac{y_{20}}{b} \quad (1)$$

7.2.2 50 % **modulus**

This is obtained in the same manner as in 7.2.1 but in this case, mark the point on the graph with the coordinate $x = 50$ % (y_{50}) using Equation (2).

$$50\ \%\ \text{modulus} = \frac{y_{50}}{b} \quad (2)$$

In all cases calculate the average of three test pieces.

7.3 Elastic gradient (EG)

The EG is calculated by dividing the slope of the straight line (straight slope) of the graph by the width of the sample using Equation (3).

$$\text{EG} = \frac{\text{straight slope}}{b} \quad (3)$$

where

straight slope = $\dfrac{(y - y_0)}{(x - x_0)}$;

(x,y) (x_0,y_0) are any two points on the straight line;

b is the width of the sample, in centimetres.

The final result shall be the arithmetic mean of three test pieces.

7.4 Limit of useful extension (LUE)

The procedure shown in Figure 3 is used to calculate the LUE.

a) Draw a tangent through the origin that touches the lower part of the curve.

b) Choose a convenient point, C, of the tangent that has a "round number" y value.

c) Draw point, D, on the graph, with the same coordinate x than point C but with coordinate y being five times bigger.

d) Draw a straight line that joins the origin with point D, and trace a line parallel to it that is a tangent to the curve; thus point A is obtained. This is the point that indicates the elastic material's useful extension.

e) Equation (4) shall be used to calculate the limit value, expressed as a percentage:

$$\text{LUE} = \frac{x_{\text{A}}}{L} \times 100 \quad (4)$$

where

x_{A} is the coordinate x of point A of the graph, expressed in millimetres;

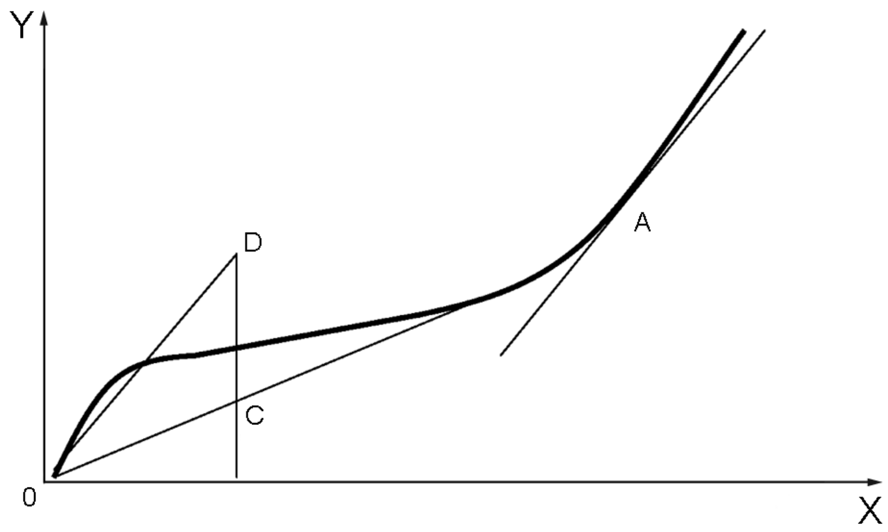
L is the tested length, expressed in millimetres.

When shorter test pieces and a recorder speed double than that of the crosshead speed is used, Equation (5) shall be used.

$$\text{LUE} = \frac{x_A}{L} \times 50 \qquad (5)$$

f) If any damage to the elastic occurs before the calculated extension (fibres or rubber breaking, ladders, etc.), then the limit of useful extension shall be considered as the time of said damage ocurring.

The final result shall be the average of the three test pieces.



Key

X percent extension

Y force, in newtons

Figure 3 — Procedure for calculating the limit of useful extension

7.5 Maximum extension resistance

Mark on the graph the greatest peak of the force curve. The coordinate "x" of said point will be the maximum extension resistance value.

The final result shall be the average of the three test pieces, expressed as a percentage.

7.6 Calculating extension at break point

Mark on the graph the point where the elastic material appears to break. The coordinate "x" of this point will be the extension at break point.

The final result shall be the average of the three test pieces, expressed as a percentage.

8 Test report

The test report shall include, at least, the following information:

a) reference to this International Standard (i.e. ISO 10765:2010);

b) a complete description of the elastic material;

c) the average value of the modulus at 20 % elongation and 50 % elongation, expressed in newtons per centimetre;

d) the average value of the limit of useful extension, expressed as a percentage;

e) the average value of elastic gradient, expressed in newtons per centimetre per 1 % elongation;

f) the average value of the maximum extension resistance, expressed as a percentage;

g) the average value of the extension at break point, expressed as a percentage;

h) any deviations from this method.

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