INTERNATIONAL STANDARD

ISO 9856

Second edition
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Conveyor belts — Determination of elastic and permanent elongation and calculation of elastic modulus

Courroies transporteuses — Détermination de l'allongement élastique et permanent et calcul du module d'élasticité

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Foreword

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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 9856 was prepared by Technical Committee ISO/TC 41, *Pulleys and belts (including veebelts)*, Subcommittee SC 3, *Conveyor belts*.

This second edition cancels and replaces the first edition (ISO 9856:1989), which has been technically revised.

Introduction

This International Standard is used in a number of situations where the permanent elongation of the conveyor belt after mechanical conditioning is of some practical relevance and in particular in the implementation of ISO 3870 and the application of ISO 5293.

The equation for the calculation of the elastic modulus in the 1989 edition contained an error and omitted to calculate the permanent elongation of the conveyor belt. In addition the figure illustrating the hysteresis loop of the conveyor belt during mechanical conditioning was misleading and ambiguous.

These omissions and anomalies have been corrected in the present edition.

Conveyor belts — Determination of elastic and permanent elongation and calculation of elastic modulus

1 Scope

This International Standard specifies a method for determining the elastic and permanent elongation of a conveyor belt and the calculation of the elastic modulus.

It is not applicable or valid for light conveyor belts as described in EN 873.

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 282, *Conveyor belts — Sampling*

ISO 283-1, *Textile conveyor belts — Full thickness tensile testing — Part 1: Determination of tensile strength, elongation at break and elongation at the reference load*

ISO 7500-1:—[1)], *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*

ISO 18573, *Conveyor belts — Test atmospheres and conditioning periods*

3 Terms, definitions and symbols

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

3.1
tensile strength
greatest measured force during the tensile test (see ISO 283-1) divided by the width of the test piece, expressed in newtons per millimetre

3.2
nominal tensile strength
T
specified minimum value of the tensile strength, expressed in newtons per millimetre

3.3
upper reference force
F_U
force equivalent to 10 % of T multiplied by the test piece width, expressed in newtons

1) To be published. (Revises ISO 7500-1:1999 and will replace EN 10002-2:1991)

3.4
lower reference force
F_L
force equivalent to 2 % of T multiplied by the test piece width, expressed in newtons

3.5
specific force range factor
ΔF
specific force range applied during the test, i.e. the upper reference force minus the lower reference force divided by the test piece width, expressed in newtons per millimetre

$$\Delta F = F_U - F_L$$

3.6
permanent elongation
Δl_p
non-recoverable change in length of the test piece after defined loading cycles, expressed in millimetres

3.7
elastic elongation
Δl_e
recoverable change in length of the test piece after defined loading cycles, expressed in millimetres

NOTE The recovery from extension may be instantaneous or time-dependent, or a combination of both.

3.8
reference length
l_o
initial length of the test piece, expressed in millimetres

3.9
permanent strain
ε_{perm}
permanent elongation, Δl_p, expressed as a percentage of the reference length, l_o

NOTE This term is often referred to as “permanent stretch” in conveyor belt technology.

3.10
elastic strain
ε_{elast}
elastic elongation, Δl_e, expressed as a percentage of the reference length, l_o

NOTE This term is often referred to as “elastic stretch” in conveyor belt technology.

3.11
elastic modulus
M
ΔF divided by the fractional elastic elongation at the end of the specified number of cycles, expressed in newtons per millimetre

NOTE This definition of the term deviates from that normally used in engineering, in which the modulus is expressed in units of stress (i.e. a force per unit of cross-section), and is represented by the symbol E.

4 Principle

A test piece, cut from the full thickness of the conveyor belt in the longitudinal direction, is subjected to a force that varies sinusoidally between defined limits. After 200 cycles, the amount of permanent elongation of the test piece and the amount of elastic elongation produced by the force differential are recorded from a force-elongation graph.

5 Apparatus

5.1 Dynamic tensile testing machine, of appropriate capacity to enable up to at least 10 % of the nominal tensile breaking load of the conveyor belt to be applied and with a force measuring system in accordance with ISO 7500-1:—, class of machine 3 or better (e.g. class 2).

5.2 Extensometer, with a measuring length of at least 100 mm and accurate to 0,1 mm or more.

5.3 Recording device, to record the graph of the applied tensile stress as a function of actual elongation.

6 Sampling

Select a sample of conveyor belt in accordance with ISO 282 of sufficient size to enable all three test pieces described in 7.1 to be obtained. One test piece shall be taken from each edge of the belt and one test piece shall be taken from the middle of the belt. The sample shall be taken at least five days after manufacture.

7 Test pieces

7.1 Number, shape and dimensions

Cut three rectangular test pieces, each 50 mm wide × at least 300 mm long (plus the necessary clamping length at each end of the test piece) in the longitudinal direction from the full thickness of the conveyor belt.

7.2 Preparation

Remove the covers from each test piece so that the thickness of the remaining cover is between 0,5 mm and 1 mm.

8 Conditioning

Condition the test pieces in accordance with ISO 18573.

9 Procedure

Place the ends of the test piece between the jaws or clamps of the tensile testing machine (5.1) so that it is held securely and the free length between the faces of the jaws is at least 300 mm.

Apply an initial force to the test piece equal to 0,5 % of the nominal tensile strength, T, multiplied by the test piece width in millimetres.

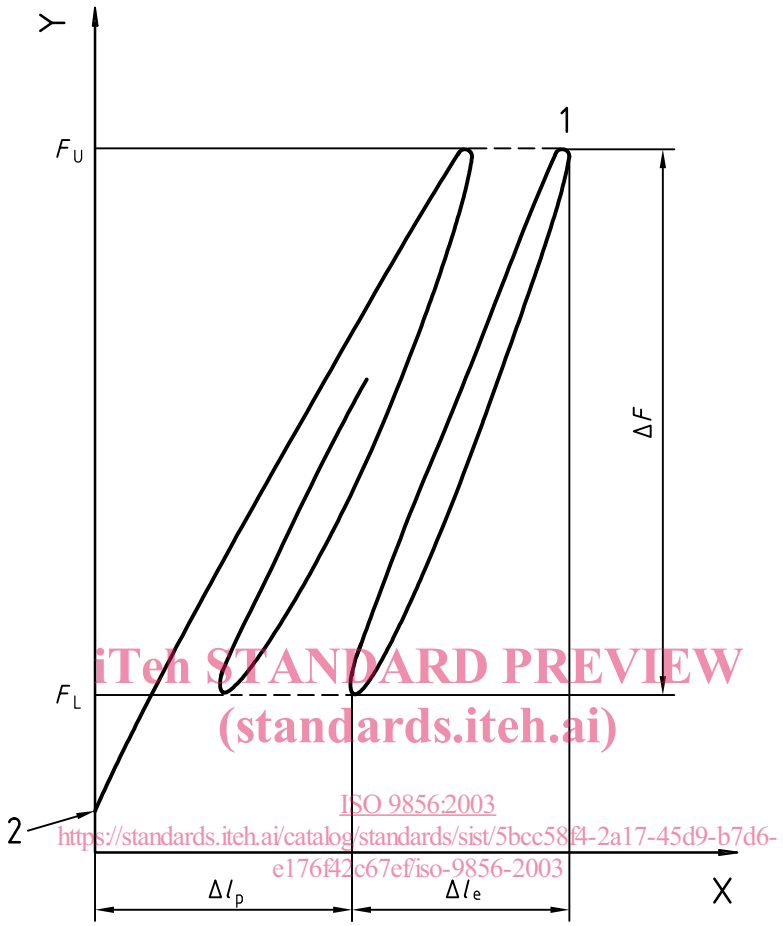
Position the two grids of the extensometer (5.2) on the axis of the test piece with a known reference length of at least 100 mm.

Set the graphical recorder (5.3) to zero elongation.

Apply force to the test piece approximately sinusoidally and at a frequency of 0,1 Hz between the upper and lower reference forces as defined in 3.3 and 3.4.

Record graphically at least the first and the 200th cycles (see Figure 1).

From the graph obtained (see Figure 1) record the value of ΔF in newtons per millimetre of test piece width and record from the graph at the 200th cycle the value of Δl_e and Δl_p.



Key

1	200th cycle
2	initial force
X	actual elongation
Y	force applied, N

Figure 1 — Graph illustrating the variation in extension of a test piece in relation to cyclic applications of a load

10 Calculation and expression of results

10.1 Calculate the percentage permanent elongation, ε_{perm}, of the belt in accordance with the following formula:

$$\varepsilon_{perm} = \frac{\Delta l_p}{l_o} \times 100$$

10.2 Calculate the percentage elastic elongation, ε_{elast}, of the belt in accordance with the following formula:

$$\varepsilon_{elast} = \frac{\Delta l_e}{l_o} \times 100$$

10.3 Calculate the elastic modulus, M, of the belt in accordance with the following formula and express the results in newtons per millimetre width of belt, or multiples thereof:

$$M = \frac{\Delta F}{\varepsilon_{\text{elast}}} \times 100$$

or

$$M = \frac{\Delta F \times l_{\text{o}}}{\Delta l_{\text{e}}}$$

10.4 Calculate the arithmetic mean of the three results so obtained for each of the values in 10.1, 10.2 and 10.3, rounding the value to the first decimal place.

11 Test report

The test report shall contain the following information:

a) identification of the belt tested;

b) a reference to this International Standard;

c) the results of the test: the individual values and the arithmetic mean values;

d) the conditioning period and the conditioning atmosphere;

e) the temperature and the relative humidity in the test room throughout the test;

f) the details of any deviation from this International Standard or from the International Standards to which reference is made, and details of any operations regarded as optional.