भारतीय मानक

Indian Standard

IS 16388 : 2023
ISO 9856 : 2016

कन्वेयर बेल्ट — लोचदार का निर्धारण और स्थायी बढ़ाव और लोचदार मापांक की गणना

(पहला पुनरीक्षण)

Conveyor Belts — Determination of Elastic and Permanent Elongation and Calculation of Elastic Modulus

(First Revision)

ICS 53.040.20

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Conveyor Belts Sectional Committee, PGD 40

NATIONAL FOREWORD

This Indian Standard (First Revision) which is identical with ISO 9856 : 2016 'Conveyor belts — Determination of elastic and permanent elongation and calculation of elastic modulus' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on recommendation(s) of the Conveyor Belts Sectional Committee and approval of the Production and General Engineering Department.

This Indian Standard was first published in 2017 in line with ISO 9856 : 2003. This revision is taken up to align it with the latest version of the ISO standard published in 2016.

The text of ISO Standard has been approved as suitable for publication as an 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' appear referring to this standard, they should be read as 'Indian Standard'.
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 certain International Standards for which IndianStandards also exist. The corresponding Indian Standards, which are to be substituted in their respective places, are listed below along with their degree of equivalence for the editions indicated.

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 282 Conveyor belts — Sampling	IS 17056 : 2019 Conveyor belts — Sampling	Identical with ISO 282 : 1992
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 Metallic materials — Verification of static uniaxial testing machines: Part 1 Tension/compression testing machines — Verification and calibration of the force-measuring system (*fourth revision*)	Identical with ISO 7500-1 : 2018
ISO 18573 Conveyor belts — Test atmospheres and conditioning periods.	IS 17527 : 2021 Conveyor belts —Test atmospheres and conditioning periods	Identical with ISO 18573 : 2012

In reporting the result of a test or analysis made in accordance with this standard, 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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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.

Indian Standard

CONVEYOR BELTS — DETERMINATION OF ELASTIC AND PERMANENT ELONGATION AND CALCULATION OF ELASTIC MODULUS

(First Revision)

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 ISO 21183-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 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 18573, *Conveyor belts — Test atmospheres and conditioning periods*

3 Terms and definitions

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

3.1
tensile strength
greatest measured force during the tensile test divided by the width of the test piece

Note 1 to entry: It is expressed in newtons per millimetre.

Note 2 to entry: See ISO 283 for tensile test.

3.2
nominal tensile strength
T
specified minimum value of the *tensile strength* (3.1)

Note 1 to entry: It is expressed in newtons per millimetre.

3.3
upper reference force
F_U
force equivalent to 10 % of T (3.2)

Note 1 to entry: It is expressed in newtons per millimetre.

3.4
lower reference force
F_L
force equivalent to 2 % of T (3.2)

Note 1 to entry: It is expressed in newtons per millimetre.

3.5
specific force range factor
ΔF
specific force range applied during the test, i.e. the *upper reference force* (3.3) minus the *lower reference force* (3.4):

$$\Delta F = F_U - F_L$$

Note 1 to entry: It is expressed in newtons per millimetre.

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

Note 1 to entry: It is expressed in millimetres.

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

Note 1 to entry: It is expressed in millimetres.

Note 2 to entry: The recovery from extension may be instantaneous or time-dependent, or a combination of both.

3.8
reference length
l_0
initial length of the test piece

Note 1 to entry: It is expressed in millimetres.

3.9
permanent strain
ε_{perm}
permanent elongation, Δl_p, (3.6) expressed as a percentage of the *reference length*, l_0 (3.8)

Note 1 to entry: This term is often referred to as “permanent stretch” in conveyor belt technology.

3.10
elastic strain
ε_{elast}
elastic elongation, Δl_e, (3.7) expressed as a percentage of the *reference length*, l_0 (3.8)

Note 1 to entry: This term is often referred to as “elastic stretch” in conveyor belt technology.

3.11
elastic modulus
M
ΔF (3.5) divided by the fractional *elastic elongation* (3.7) at the end of the specified number of cycles

Note 1 to entry: It is expressed in newtons per millimetre.

Note 2 to entry: 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.

The special application conveyor belts may be used with higher elongation in the tensile member. For these belts, the permanent elongation measured according to the stated test procedure does not allow a conclusion regarding the permanent elongation of the belt in real-life operation. A higher number of load cycles (jointly agreed upon by the supplier and the customer) can be of help.

5 Apparatus

5.1 Dynamic tensile testing machine, of appropriate capacity to enable up to at least 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.

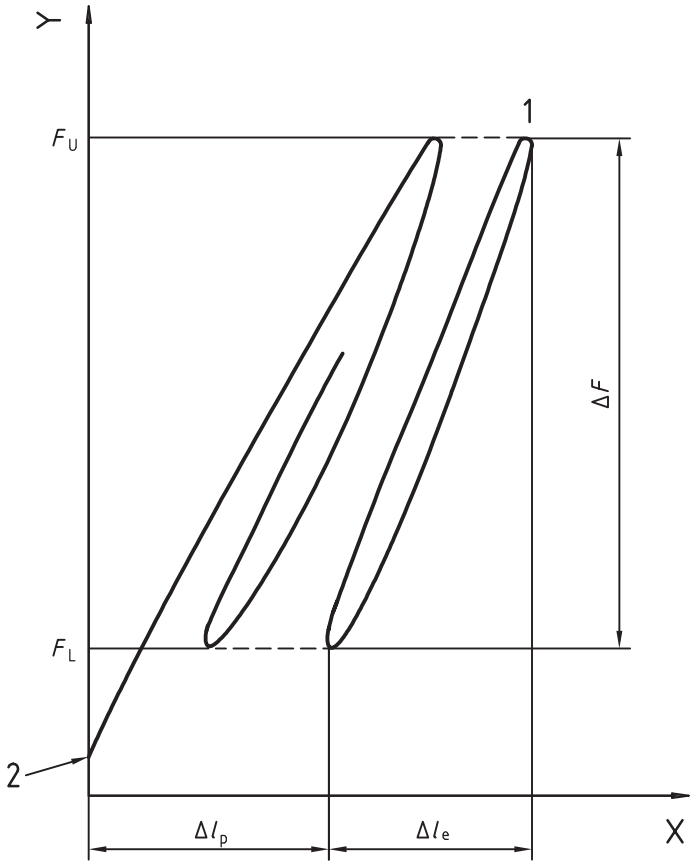
Apply force to the test piece approximately sinusoidally and at a frequency of 0,1 Hz between the upper and lower reference forces as defined in 3.3 and 3.4.

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 of test piece width, in newtons per millimetre, and

— the value of Δl_e and Δl_p at the 200th cycle.



Key

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

Figure 1 — 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 Formula (1):

$$\varepsilon_{perm} = \frac{\Delta l_p}{l_o} \times 100 \quad (1)$$

10.2 Calculate the percentage elastic elongation, ε_{elast}, of the belt in accordance with Formula (2):

$$\varepsilon_{elast} = \frac{\Delta l_e}{l_o} \times 100 \quad (2)$$

10.3 Calculate the elastic modulus, M, of the belt in accordance with Formula (3) or Formula (4) and express the results in newtons per millimetre width of belt, or multiples thereof:

$$M = \frac{\Delta F}{\varepsilon_{elast}} \times 100 \quad (3)$$

or

$$M = \frac{\Delta F \times l_o}{\Delta l_e} \quad (4)$$

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, i.e. ISO 9856;

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.

Bibliography

[1] ISO 283, *Textile conveyor belts — Full thickness tensile strength, elongation at break and elongation at the reference load — Test method*

[2] ISO 583, *Conveyor belts with a textile carcass — Total belt thickness and thickness of constitutive elements — Test methods*

[3] ISO 3870, *Conveyor belts (fabric carcass), with length between pulley centres up to 300 m, for loose bulk materials — Adjustment of take-up device*

[4] ISO 5293, *Conveyor belts — Determination of minimum transition distance on three idler rollers*

[5] ISO 21183-1, *Light conveyor belts — Part 1: Principal characteristics and applications*

NATIONAL ANNEX A

(*National Foreword*)

A-1 BIS CERTIFICATION MARKING

The product may also be marked with the Standard Mark.

A-1.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations made thereunder. The details of conditions under which the license for use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 2016 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

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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.

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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