BS EN ISO 21182:2013

BSI Standards Publication

Light conveyor belts — Determination of the coefficient of friction

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee PRI/67, Conveyor belts.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

This document (EN ISO 21182:2013) has been prepared by Technical Committee ISO/TC 41 "Pulleys and belts (including veebelts)" in collaboration with Technical Committee CEN/TC 188 “Conveyor belts” the secretariat of which is held by SNV.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2013, and conflicting national standards shall be withdrawn at the latest by August 2013.

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Endorsement notice

The text of ISO 21182:2013 has been approved by CEN as EN ISO 21182:2013 without any modification.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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.

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ISO 21182 was prepared by Technical Committee ISO/TC 41, *Pulleys and belts (including veebelts)*, Subcommittee SC 3, *Conveyor belts*.

This International Standard is based on EN 1724:1998, prepared by CEN/TC 188.

This second edition cancels and replaces the first edition (ISO 21182:2005), of which it constitutes a minor revision.

Introduction

The coefficient of friction of light conveyor belts has to be seen from two different aspects relevant to the choice of the reference material. One aspect is the friction of the underside of the belt. In practice, this is not critical because it is low. Regardless of whether a table of steel or of wood is used, the coefficient of friction is within the range from 0,2 to 0,3 in most cases.

Contrary to this, the top face covers show values over an extended range dependent on their actual function. To achieve this function, the material itself can be modified as well as the surface pattern but the test procedure is the same in every case. So it becomes clear that the chosen steel panel represents a compromise. Its main properties are reproducibility of the surface finish and uncritical friction behaviour against any kind of belt cover.

This International Standard allows comparison of all kinds of conveyor belt to obtain reliable results as a reference. This can be helpful to buyers who need guidance in choosing the right belt for their particular application.

The tests in accordance with this International Standard are limited to dynamic coefficients of friction (μ_D) up to 1,0 and static coefficients of friction (μ_S) up to 1,5. Higher values can show a mixture of friction, adhesion, deformation and other effects occurring, especially where the surface texture is coarse and is therefore unsuitable for this test.

The method using the standardized metallic test panel is intended especially to compare the coefficients of friction of different light conveyor belts. The values received under practice conditions always depend on the frictional partners.

To determine these effects, it is possible to choose a different frictional partner instead of the panel if required. This is mentioned in the test report.

Light conveyor belts — Determination of the coefficient of friction

1 Scope

This International Standard specifies test methods for determining the dynamic and static coefficients of friction for light conveyor belts according to 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 3574, *Cold-reduced carbon steel sheet of commercial and drawing qualities*

ISO 4287, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 7500-1, *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*

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

3 Terms and definitions

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

3.1
dynamic coefficient of friction
μ_D
coefficient expressed by

$$\mu_D = \frac{F_D}{F_N}$$

where

F_D is the dynamic frictional force, sliding friction;

F_N is the normal force.

3.2
static coefficient of friction
μ_S
coefficient expressed by

$$\mu_S = \frac{F_S}{F_N}$$

where

F_S is the static frictional force, “stiction” (break-away force);

F_N is the normal force.

4 Principle

4.1 Dynamic coefficient of friction

A test piece cut from the full thickness of the conveyor belt in the longitudinal or transverse direction is clamped to a table. A metallic test panel subjected to a given normal force is pulled over the test piece at a defined speed. The μ_D value is then determined by calculation, using the dynamic frictional force, F_D, and the normal force (F_N).

4.2 Static coefficient of friction

A metallic test panel is subjected to a normal force as in 4.1. Additionally, a pulling force is exerted on the test panel, generated by a pulling mechanism moving at a defined speed. The μ_S value is determined by calculation, using the static frictional force, F_S, and the normal force (F_N).

5 Apparatus (see Figure 2)

5.1 Testing table, on to which the test piece shall be clamped.

5.2 Metallic test panel (see Figure 3) having the following dimensions:

— thickness, 0,8 mm;

— width, (76 ± 0,5) mm;

— length, 152 mm;

— testing area, (76 ± 0,5) mm × (131,5 ± 0,5) mm = (100 ± 1) cm^2.

The test panel shall be made of steel, type CR1 in accordance with ISO 3574, with a hardness of between HRB 60 and HRB 70, with a milled surface and surface roughness, *Ra*, of 0,9 µm to 1,3 µm in accordance with ISO 4287.

Because the surface can change due to the abrasion of the test piece, the metallic test panel should be replaced after a maximum of 50 applications, but after one day of use at the latest.

Because the test panel is not stainless, it shall be kept in its original pack in a dry place until first used. The personnel handling the panel shall wear clean cotton gloves and touch the panel only at the edges.

5.3 Mass, generating a normal force of 50 N ± 1 N together with the metallic test panel. The mass shall be made of steel having a density of 7,85 g/cm^3 and have the following dimensions:

— length (120 ± 0,2) mm;

— width (75 ± 0,2) mm;

— height (71 ± 0,2) mm.

5.4 Device for the measurement of the frictional force

5.4.1 Load cell, with a range up to 100 N.

The force measuring system shall be in accordance with ISO 7500-1, class of machine 3 or better (e.g. class of machine 2).

5.4.2 Recording instrument for recording the signal of the load cell

5.5 Pulling mechanism, for example a tensile testing machine, to produce a uniform relative motion between test piece and metallic test panel.

5.6 Deflection roller, having a diameter of 40 mm to 50 mm and ball bearings to ensure smooth rotation.

5.7 Pulling cable, parallel to the sliding surface and with a low elasticity, e.g. steel cable with a diameter of approximately 1 mm.

6 Test piece

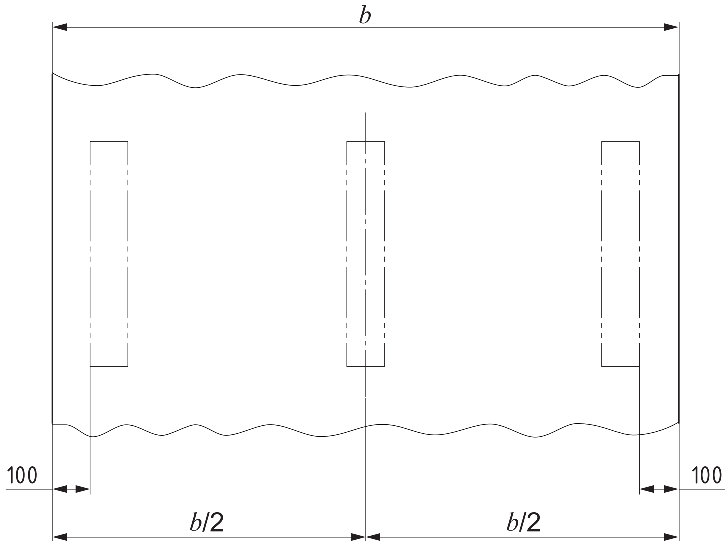
6.1 Test piece material

Test piece material shall be new, unused ("virgin"), but shall not be tested sooner than five days after manufacture. It shall be free from contamination and superficial damage.

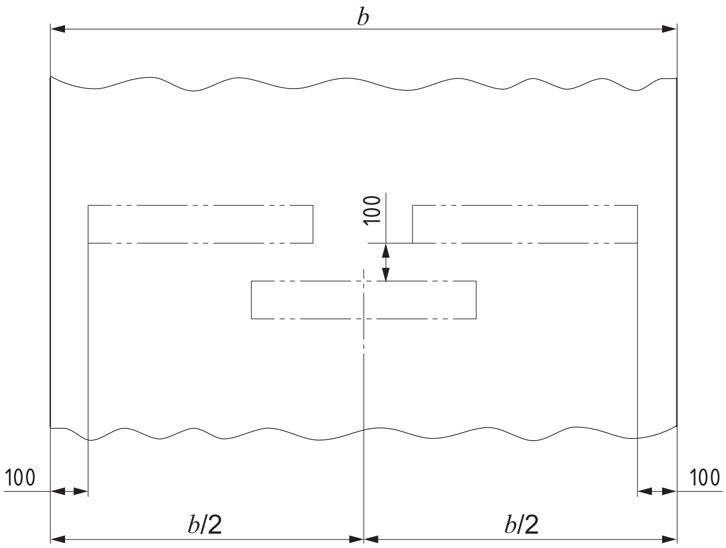
6.2 Number and dimensions of test pieces

Three test pieces shall be cut from the full thickness of the conveyor belt in the longitudinal direction [see Figure 1 a)] and/or the transverse direction [see Figure 1 b)].

Dimensions in millimetres



a) Distribution of test piece selection in longitudinal direction



b) Distribution of test piece selection in transverse direction

Key

b belt width

Figure 1 — Distribution of test piece selection

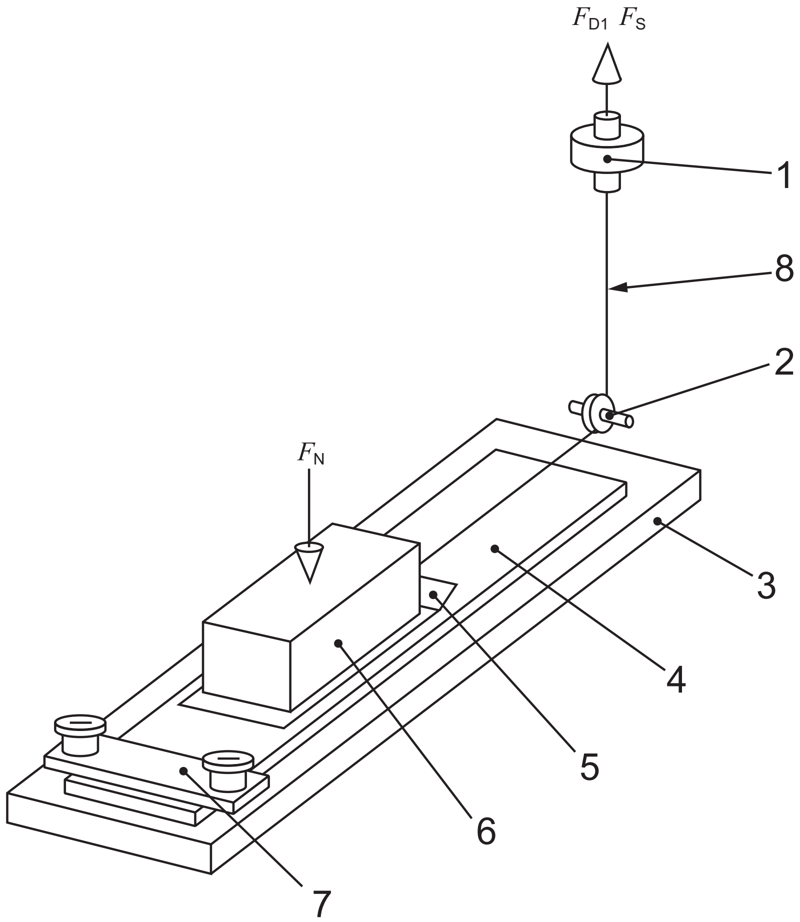
If both surfaces of the belt are to be tested, additional test pieces shall be taken accordingly.

The test pieces shall measure 600 mm long × 100 mm wide.

Each test piece shall be used only once.

6.3 Conditioning

Before testing, condition the test pieces in accordance with ISO 18573, Atmosphere B, for at least 24 h.



Key

1 load cell
2 deflection roller
3 test piece table
4 test piece
5 metallic test panel
6 mass
7 clamp
8 pulling cable

Figure 2 — Friction testing apparatus

Dimensions in millimetres

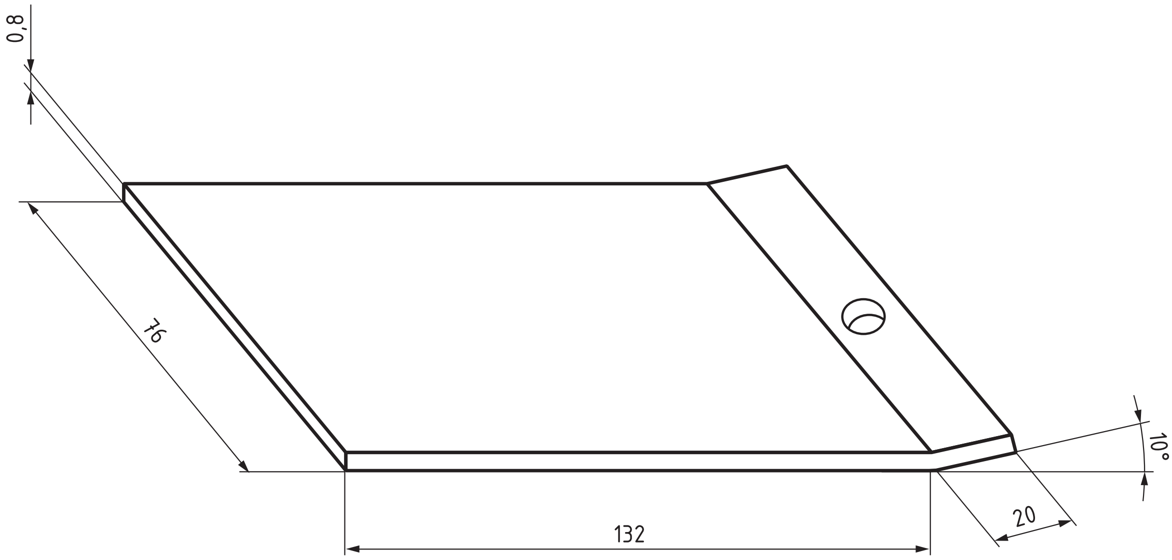


Figure 3 — Metallic test panel

7 Procedure

The temperature and relative humidity in the test room shall be in accordance with ISO 18573, Atmosphere B.

Adjust the testing table (5.1) to the horizontal position in the longitudinal and transverse directions.

Clamp the test piece to the table.

Visually inspect the metallic test panel (5.2) to check that it is free from rust.

Connect the pulling cable (5.7) to the panel and place the mass (5.3) on the panel.

If measuring the dynamic coefficient of friction, μ_D, adjust the speed of the pulling mechanism to (1 000 ± 20) mm/min, except that if the maximum speed of the machine is less than 1 000 mm/min, the speed of the pulling may be reduced, but not to below (500 ± 20) mm/min. Ensure that the path of motion is 300 mm.

If measuring the static coefficient of friction, μ_S, adjust the speed of the pulling mechanism to (100 ± 10) mm/min. Stop the measurement as soon as the test panel begins to move.

8 Calculation and expression of results

8.1 Dynamic friction, μ_D

The μ_D value shall be determined as a median, preferably in accordance with ISO 6133.

The values registered during the last 200 mm of the path of motion shall be used.

$$\mu_D = \frac{F_D}{F_N}$$

where

F_D is the median of the dynamic frictional force;

F_N is the normal force.

8.2 Static friction μ_S

For the static coefficient of friction, the first peak of the graph represents μ_S:

$$\mu_S = \frac{F_S}{F_N}$$

where

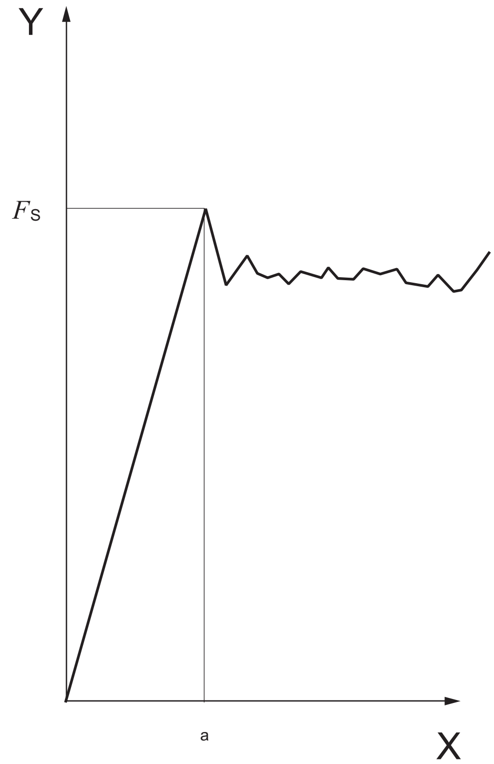
F_S is the static frictional force (break-away force);

F_N is the normal force.

8.3 Examples for recorded graph of μ_S (force/path diagrams)

If the recorded graph gives a peak as shown in Figure 4, the force, F_S, can be read very easily and the μ_S value can be calculated.

If the graph is as shown in Figure 5, the μ_S value is determined by noting the force F_S, at point, P, where the curve deviates from the initial straight line.



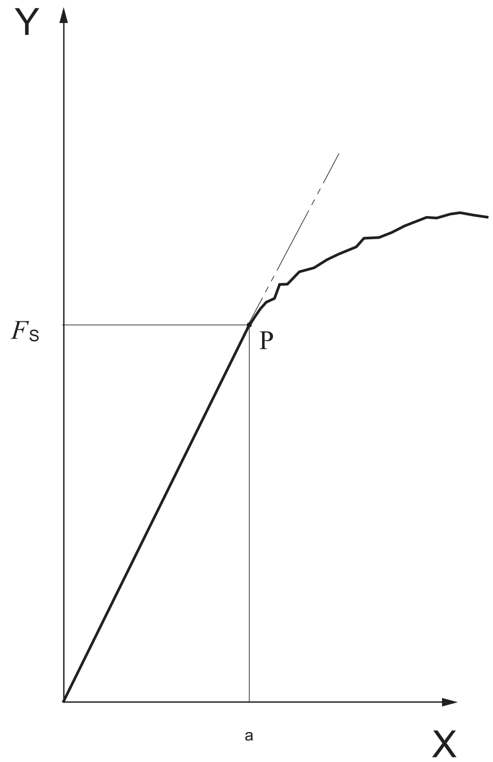
Key

X path of pulling mechanism

Y force

a Start of test panel motion.

Figure 4 — Typical example of recorded graph of μ_S with force peak



Key

X path of pulling mechanism

Y force

[a] Start of test panel motion.

Figure 5 — Example of untypical graph of μ_S without force peak

9 Test report

The test report shall include the following information:

a) values of each measurement (rounded to two decimal places);

b) arithmetic mean value (rounded to two decimal places);

c) complete designation of the tested conveyor belt material and the date of manufacture;

d) reference to this International Standard (and details of any deviations);

e) test room temperature and relative humidity;

f) conditioning period;

g) designation and manufacturer of metallic test panel;

h) if applicable, the material used instead of metallic test panel;

i) test speed for determination of μ_D value if different from 1 000 mm/min;

j) separate values for the undersides and the top face covers;

k) date of test.

Bibliography

[1] ISO 6133, *Rubber and plastics — Analysis of multi-peak traces obtained in determinations of tear strength and adhesion strength*

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