SLOVENSKI STANDARD
SIST ENV 12448:1997

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Papir - Tiskovni papir in papirji za poslovne namene - Določanje koeficienta statiļnega trenja

Paper - Printing and business paper - Determination of the coefficient of static friction

Papier - Druck- und Büropapiere - Bestimmung des statischen Reibungskoeffizienten

Papier - Papier d'impression et de bureau - Détermination du coefficient de frottement statique

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English version

Paper - Printing and business paper - Determination of the coefficient of static friction

Papier - Papier d'impression et de bureau - Détermination du coefficient de frottement statique

Papier - Druck- und Büropapiere - Bestimmung des statischen Reibungskoeffizienten

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CEN

European Committee for Standardization
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Foreword

This European Prestandard has been prepared by Technical Committee CEN/TC 172 "Pulp, paper and board", the secretariat of which is held by DIN.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to announce this European Prestandard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Prestandard specifies the determination of the coefficient of static friction by the horizontal plane method.

The condition of a paper surface depends on the characteristic properties of the paper. Its frictional properties are largely determined by its coefficient of static friction, μ_s, which is measured when a sheet of paper slides over another identical sheet of paper in the horizontal plane with a perpendicular force applied between the sheets. It relates to the force required to initiate movement between the two paper surfaces.

The coefficient of friction is an empirical property of a particular material under specified testing conditions. It describes the condition of the surfaces at the moment of test. This may or may not relate to the condition of the surfaces in a specific end-use situation.

Nevertheless the test results are useful in determining the combined properties of the surfaces tested.

The coefficient of static friction of machine made paper can be different when measured in the machine direction (MD) or in the cross direction (CD). In the machine direction there can also be a difference between the manufacturing direction (MD+) and the counter-manufacturing direction (MD−). Often there is a difference between the two sides of the paper.

1 Scope

This European Prestandard specifies a test method for the determination of the coefficient of friction using the horizontal plane method. This European Prestandard is applicable to cut-size printing and business papers.

2 Normative references

This European Prestandard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Prestandard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN ISO 186
Paper and board - Sampling to determine average quality (ISO 186 : 1994)

EN 20187
Paper, board and pulps – Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples (ISO 187 : 1990)

3 Definitions

For the purposes of this Prestandard the following definitions apply:

3.1 static friction: Force that resists initial movement of one surface sliding over another surface.

3.2 coefficient of friction: Ratio of the static friction to the load applied normally to the surface tested.

4 Principle

Test pieces of the paper under test are mounted upon a sled and table friction test apparatus. A load is normally applied in a direction parallel to the interface between the test pieces. The force required to initiate sliding is measured.

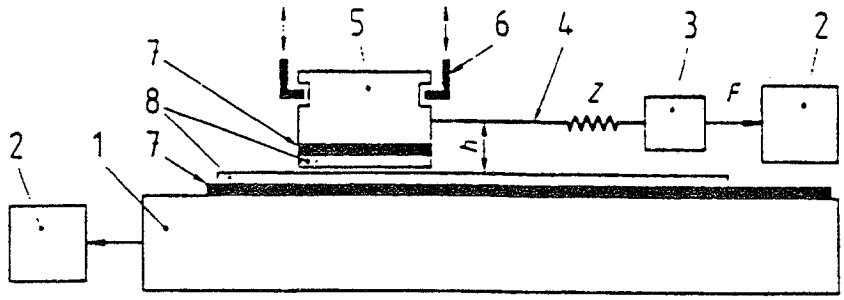
5 Apparatus

5.1 Friction tester

Friction tester (see figure 1) comprises essentially of a horizontal table (1) and a sled (5). Test pieces of the material to be tested are fixed to the underside of the sled (5) and to the top of the horizontal table (1).

The force, parallel to the plane of contact which is required to initiate movement of the sled (5) over the horizontal table (1) is measured. The force F can be applied by using a drive mechanism (2) on either the sled (5) or the horizontal table (1).

Designs having two drive mechanisms (2) are also permitted. The force F may then be applied to either the sled (5) or to the horizontal table (1). It shall however be kept parallel with the plane of contract between the materials under test. The friction tester has the following parts as described in figure 1:



1 horizontal table (5.2)
2 driving mechanism for the sled or, alternatively, the horizontal table (5.7);
3 load cell (5.7);
4 connection between the sled and the load cell (5.6);
5 sled (5.3);
6 elavator for the sled (5.4);
7 backings of foam rubber (5.9);
8 test pieces for the sled and the horizontal table;
Z elasiticity in the connection between the load cell and the sled;
h distance between the horizontal table and the plane of action of the force F.

Figure 1: General lay out of the friction tester

5.2 Horizontal table

A horizontal table (1) with a flat top surface of imcompressible material (metal, hard wood, glass, etc.) wide enough to accomodate the sled (5) with a margin of at least 5 mm on each side. The horizontal table (1) shall be provided with means for mounting the test piece (8) firmly so that there is no slippage between the test piece (8) and the horizontal table (1) during the test.

5.3 Sled

A sled (5) shall have of total mass (900 ± 100) g. The underside, where the test piece (8) is mounted, is flat, 60 mm square and made of an incompressible material.

The sled (5) shall be provided with means for mounting the test piece (8) firmly so that there is no slippage between the test piece (8) and the sled (5) during the test.

NOTE 1: Preferably these means should be such that the test pieces (8) can be mounted without bending or folding it.

The orientation of the sled (5) shall remain parallel to that of the horizontal table (1) during the entire test.

NOTE 2: Excessive rotational motion of the sled (5) in the plane of the horizontal table (1) before the rectilinear motion starts can cause low results. It has been shown that rotational motion within the tolerance specified has no measurable effect.

5.4 Elevator

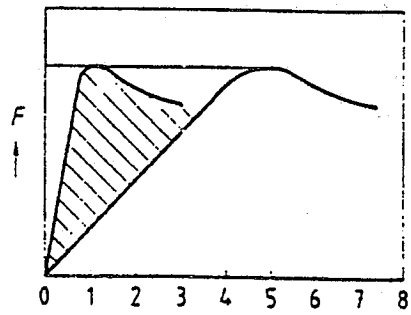
An elevator (6) for lowering and lifting the sled (5) with respect to the horizontal table (1). When lowering the elevator, the entire area of the two surfaces shall meet simultaneously. There shall be no sliding of the sled (5) as it makes contact with the horizontal table (1), before the force F is applied.

It is important for the result of the test that there is no repositioning of the sled (5) once the surfaces have met. Even the slightest motion may influence the result. The sled (5) must neither be placed on to, nor lifted from the horizontal table (1) by hand.

NOTE: The purpose of the elevator (6) is to avoid the influence of the person performing the test. The test can be carried out without the elevator (6), providing that the necessary measures are taken to avoid any motion.If the test is made without the elevator (6) it shall be noted in the test report.

5.5 Load cell

The load cell (3) shall measure the force F applied to the sled (5) (or the horizontal table (1)) by the driving mechanism (2) with an accuracy of 2 % of the scale reading. Means to record and display a force-time curve shall be provided. The recording means shall have a response capability adequate to accurately portray the dynamic force-time curve (see figure 2).



Ramp- time in s

Figure 2: Force-time curve

5.6 Means for connecting the load cell to the sled

A variety of means may be used to communicate the force F between the sled (5) and load cell (3). The resultant force shall be aplied centrally with respect to the square test area. The displacement h (see figure 1) of the resultant force above or below the plane of contact between the test pieces (8) is not critical but shall not exceed 5 mm. The direction of the resultant force shall be parallel to the surface of the horizontal table (1).

NOTE: Some instruments may employ a variable degree of elasticity Z for the purpose of altering the time from initial application of the pulling force to the moment at which the sliding begins (see ramp time, figure 2). In other instruments the degree of elasticity is not a variable.

5.7 Drive mechanism

To impart a vibration free incremental force to the sled (5) which will subsequently move the sled (5) in relation to the horizontal table (1) as specified herein. As long as the driving force F is kept parallel to the plane of contact between the test pieces (8) either the sled (5) or the horizontal table (1) may be driven.

The rate of force increase shall be such that the ramp time is between 1 s and 5 s. (Hatching in figure 2 indicates the range of acceptable ramp times.)

Since the intention is to determine only the first coefficient of static friction, there is no specific requirement for relative motion between the sled and horizontal table test pieces beyond the point at which slinding begins.

5.8 Backing

Backing (7) to ensure a uniform pressure distribution. At least one of the test pieces (8) shall be backed by a compressible backing made from a sheet of medium density sponge rubber with a hardness of 40 IRHD to 60 IRHD (International Rubber Hardness Degrees). It shall have a uniform thickness of between 1,5 mm and 2,5 mm.

NOTE: Replace the backing if its edges are worn or the surface damaged.

6 Conditioning

Condition the test pieces at standard atmosphere 23/50 in accordance with EN 20187 and keep them in the conditioning room during the entire test.

7 Preparation of test pieces

The size of the test pieces depends on the design of the friction tester. Prepare a number of test pieces sufficient to perform five tests for each configuration to be applied. Mark each test piece (or its envelope) so that it can be clearly identified.

8 Procedure

8.1 General

Friction test results are extremely sensitive to contamination of the surfaces to be tested. These surfaces shall not be touched by hands and shall not come into contact with unknown surfaces in any of the preparation stages.

NOTE 1: Friction tests are extremely sensitive to very slight abrasion of test pieces. Neither the test pieces nor the bulk samples should be allowed to rub against each other at any stage in the procedure.

From the bulk samples remove two consecutive sheets which shall be tested against each other. Keep the sheets together and ensure that the surfaces are not allowed to rub.

Alternatively, test pieces may be taken in accordance with EN ISO 186. Mark or identify the machine direction and/or the manufacturing direction.

If it is not possible to identify the manufacturing direction then arbitrarily mark one of the sheet dimensions as the + direction. Take care not to mix sheets with differing grain orientations.

Three different configurations shall be considered for the test:

- Machine (+) against machine (+): marked M +;
- Machine (−) against machine (−): marked M −;
- Cross against cross: marked C.

NOTE 2: By taking the two sheets used in a slide from consecutive sheets in the ream, top and wire sides will always be tested against each other.

8.2 Performance of sliding test

Fasten test pieces (8) to the horizontal table (1) and to the sled (5) so that the direction of both test pieces (8) are parallel to the pulling direction. Make sure that top side is tested against wire side.

Lower the sled (5) on to the horizontal table (1) slowly using the elevator (6) so that the entire area of the two surfaces meet simultaneously.

Do not move or reposition the sled (5) even slightly once the two test pieces (5) have been in contact. Allow the sled (5) to rest for 1 s to 3 s before initiating the linear increase of force (5.7).

Start the driving mechanism (2) and check that force reading increases so that the sliding starts in between 1 s and 5 s. Record the force F required to initiate the motion.

Repeat the test 5 times for each surface configuration.