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BSI Standards Publication

Adhesives for paper and board, packaging and disposable sanitary products — Determination of friction properties of films potentially suitable for bonding

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National foreword

This British Standard is the UK implementation of EN 14713:2016. It supersedes BS EN 14713:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/52, Adhesives.

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

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Adhesives for paper and board, packaging and disposable sanitary products - Determination of friction properties of films potentially suitable for bonding

Adhésifs pour papier et carton, emballage et produits sanitaires jetables - Détermination des propriétés de frottement de films potentiellement adaptés au collage

Klebstoffe für Papier und Pappe, Verpackung und Hygieneprodukte - Bestimmung des Reibungsverhaltens potentiell klebefähiger Schichten

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European foreword

This document (EN 14713:2016) has been prepared by Technical Committee CEN/TC 193 “Adhesives”, the secretariat of which is held by AENOR.

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of an identical text or by endorsement, at the latest by February 2017, and conflicting national standards shall be withdrawn at the latest by February 2017.

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Introduction

The friction behaviour is described by a characteristic coefficient of friction, independent of the test apparatus and test conditions. As the coefficient of friction of potentially adhesive films or layers may be a function of the normal force, F_N, and the contact surface and, in the case of dynamic friction, also of the relative speed and other dynamic parameters, these parameters have also been specified in this European Standard.

The tests can be carried out with the potentially adhesive layers sliding over themselves or coated side over the reverse side of a substrate or other surfaces of metals or plastics.

The coefficient of friction does not allow a comprehensive assessment to be made of the machinability on packaging or processing machines as under the conditions encountered in practice, the friction phenomena are generally accompanied by other effects, e.g. electrostatic charges, air cushion, local rise of temperature, abrasion, etc.

SAFETY STATEMENT — Persons using this document should be familiar with the normal laboratory practice, if applicable. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any regulatory conditions.

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At the end of the test, the user of the standard should take care to carry out an appropriate disposal of the wastes, according to local regulation.

1 Scope

This European Standard specifies test methods to assess the coefficients of friction of potentially adhesive films or layers, such as coatings with reactivable adhesives, hot melts or waxes, for use with paper and board, packaging and disposable sanitary products.

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.

EN 1067, *Adhesives - Examination and preparation of samples for testing*

EN ISO 15605, *Adhesives - Sampling (ISO 15605:2000)*

3 Terms and definitions

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

3.1
friction
resistance against sliding of two surfaces in contact with each other

Note 1 to entry: A distinction is made between static friction and dynamic friction.

3.2
static friction
threshold value of the friction between two relatively static bodies, where the force applied is insufficient to cause relative motion which has to be overcome at the onset of sliding motion

3.3
dynamic friction
friction between two bodies in relative motion to each other which remains after the static friction has been overcome at the given sliding speed

3.4
static frictional force
F_S
force necessary to overcome the static friction

3.5
dynamic frictional force
F_D
force necessary to overcome the dynamic friction

3.6
normal force
F_N
force acting perpendicularly to the two surfaces in contact

3.7
coefficient of friction
ratio of the frictional force to the normal force

3.8
static coefficient of friction
μ_S
ratio of the static frictional force to the normal force

3.9
dynamic coefficient of friction
μ_D
ratio of the dynamic frictional force to the normal force

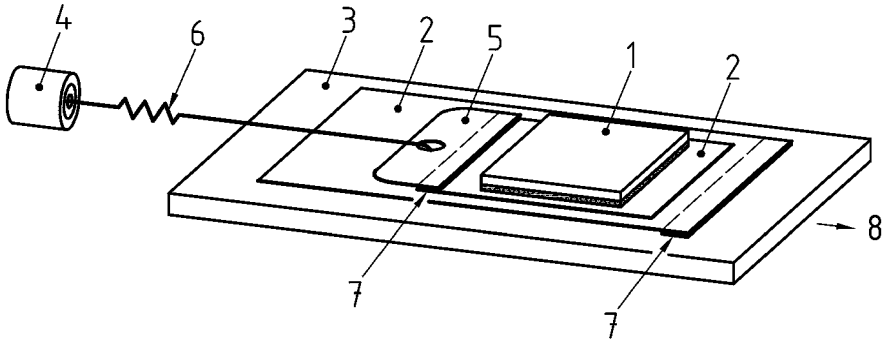
4 Apparatus

Specimens shall be conditioned for 24 h at 23 °C and 50% RH.

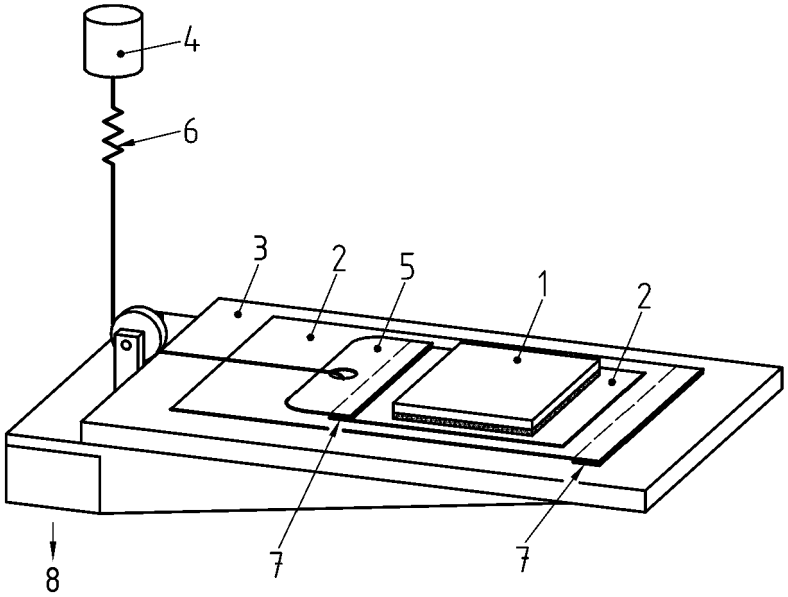
The test apparatus consists generally of a driving mechanism to produce a uniform relative motion between two sliding surfaces and a load cell to record the frictional force.

The relative motion between the two surfaces may be produced in any suitable way, e.g. by means of a moving table (see Figure 1a)) or by moving the measuring device in the opposite direction. Even the vertical motion of a tensile testing machine may be utilized if the frictional force or the motion that induces the friction is deflected in the vertical direction by a pulley (see Figure 1b).

The force is recorded continuously by means of a suitable recording device.



a) horizontal motion



b) vertical motion

Key

1 sledge
2 test specimens
3 testing table (rigid or movable)
4 load cell
5 reinforcement plate
6 spring
7 double-faced adhesive tape
8 direction of motion

Figure 1 — Test apparatus for the determination of friction properties

The test apparatus shall meet the following requirements:

1) supporting surface of the testing table (see 3 in Figure 1) shall be flat and smooth;

2) normal force shall be generated by a sledge (see 1 in Figure 1) with a square-shaped contact surface of approximately 4 000 mm² and an edge length of 63 mm. For the purpose of uniform distribution of pressure, the base of the sledge shall be covered with an elastic material 2 mm to 3 mm thick, e.g. rubber. Care shall be taken to ensure that the structure of this material is smooth enough to avoid embossing thin layers. The total mass of the sledge shall be (200 ± 2) g;

3) motion that induces the friction process shall be free of vibration and shall have a speed of (100 ± 10) mm/min;

4) deviation of the force measuring system, including the recording instrument, shall not exceed ± 2,5 %. The direction in which the frictional force is applied shall be in line with the frictional plane;

5) for the measurement of static friction, the coefficient of elasticity of the force measuring system shall be adjusted to (2 ± 0,2) N/cm by means of an interconnected spring. For the measurement of the dynamic friction, the spring shall be replaced by a rigid connection if the vibromotive force effect occurs.

The inertia of the mass of the sledge induces an additional force at the beginning of the sledge movement. Thus, the coefficient of friction is increased by a slight amount $\Delta\mu$:

$$\Delta\mu = v\frac{\sqrt{D/m}}{g} \quad (1)$$

where

v is the speed of the sledge relative to the testing table;

m is the mass of the sledge;

g is the acceleration of gravity (= 9 810 mm/s²);

D is the coefficient of elasticity.

5 Test specimens

5.1 Sampling

Take a sample of the adhesive to be tested in accordance with EN ISO 15605. Examine and prepare it for testing in accordance with EN 1067.

5.2 Preparation of test specimens

For each measurement two test specimens, each measuring approximately 80 mm × 200 mm, are required. At least three such pairs, uniformly distributed over the width of the sheeting, or in the case of tubular film, over the circumference, shall be tested.

Unless otherwise specified, the longitudinal axis and thus the testing direction shall be parallel to the direction of the film or of the wax or adhesive coating.

Extreme care shall be taken when handling the test specimens. Fingerprints, dust and any other foreign matter shall be avoided.

Testing of three pairs of test specimens represents a minimum for estimating the scatter. Depending on the intended precision and the homogeneity of the material under test, the number of tested specimens may have to be increased.

Many films contain additives, which may migrate to the surface during the conditioning period and alter the frictional properties. As these effects are time-dependent, results of measurements made on these films shall be related to the date of manufacture of the film.

6 Procedure

6.1 General

For the tests described in 6.2 and 6.3, apparatus as shown in Figure 1 shall be used. If a different, but equivalent arrangement is used, the procedure shall still be the same. Any deviations from the parameters specified, in response to special conditions encountered in practice, shall be stated in the test report [see 8 h)].

6.2 Friction measurement A: Coating against coating

Fix the first specimen (see Figure 1) to the testing table with double-faced adhesive tape, the longitudinal axis of the specimen coinciding with that of the testing table.

Lay the second specimen on top of the first one and place the sledge on top gently without shock or additional pressure, connect to the load cell via the spring, the connection to the load cell shall not yet be tensioned. The clearance shall not exceed 2 mm. After 15 s, start the motion of the testing table and the recording of the frictional force.

After approximately 60 mm travel, the test may be ended.

If, after the static friction has been overcome, the *vibromotive force* effect occurs, the oscillations of the force on the graph mean that the dynamic frictional force cannot be determined. In this case, the dynamic coefficient of friction shall be determined by a separate measurement (on new specimens), the spring being replaced by a rigid connection.

6.3 Friction measurement B: Coating against the uncoated side of the test specimen or surface of other material

If the frictional behaviour of a coated surface of a substrate is to be determined against its reverse side or against a surface made of another material, the material under test shall be fixed to the testing table. Otherwise, the same test procedure shall be used in accordance with 6.2.

The coefficients of friction so determined are not material-specific parameters, but are dependent on both the materials and the surface finishes of the two sliding surfaces.

If different coated surfaces are measured against the same metal surface, it should be remembered that the surface properties may change as a result of abrasion through repeated use. Also, the transfer of additives from the adhesive coating to the other surface should be noted. Any deposits of this sort shall be carefully removed by cleaning.

7 Expression of results

7.1 Static friction

From the force recorded, the maximum of the linear rise in force represents the static frictional force, F_S. Measurement without a spring (leading to high coefficients of elasticity), which have been carried out for determining the dynamic friction, cannot be used to assess the static friction as the first force peak is falsified by the effects of inertia.

The static coefficient of friction, μ_S, is calculated using the following equation:

$$\mu_S = \frac{F_S}{F_N} \quad (2)$$

where

F_S is the static frictional force, in Newtons;

F_N is the normal force, in Newtons (F_N = 1,96 Newtons for a sledge with mass 200 g).

7.2 Dynamic friction

The frictional force acting during the sliding motion often differs from the ideal of a constant level due to secondary effects involved with the increasing length of path.

Only the force during the first approx. 60 mm is used for determining the dynamic coefficient of friction. If no constant level is reached, the value is extrapolated from the start of the motion. The dynamic frictional force, F_D, so determined gives the dynamic coefficient of friction, μ_D, by the following equation:

$$\mu_D = \frac{F_D}{F_N} \quad (3)$$

where

F_D is the dynamic frictional force, in Newtons;

F_N is the normal force, in Newtons (F_N = 1,96 Newtons for a sledge with mass 200 g).

8 Test report

The test report shall include:

a) reference to this European Standard;

b) method used (friction measurement A or B);

c) type and designation of the adhesive, e.g. description, supplier;

d) type and designation of the coating, e.g. description, supplier;

e) area of tested surface in square millimetres;

f) static coefficient of friction, μ_S;

g) dynamic coefficient of friction, μ_D;

h) any deviation from this European Standard;

i) date of test.

j) In addition, if the test results are evaluated statistically, the following details shall be included in the test report:

— number of measurements, *n*;

— all individual values, *I*;

— arithmetic mean value, *x;*

— standard deviation, *s.*

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[2] ASTM D 1894, *Standard test method for static and kinetic coefficients of friction of plastic film and sheeting*

[3] ASTM D 2534, *Standard test method for coefficient of kinetic friction for wax*

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