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Surfaces for sports areas – Determination of rotational friction

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Surfaces for sports areas - Determination of rotational friction

Sols sportifs intérieurs - Détermination de la glissance en rotation

Sportböden für Innenbereiche - Bestimmung der Drehreibung

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (prEN 14903:2005) has been prepared by Technical Committee CEN/TC 217 “Surfaces for sports areas”, the secretariat of which is held by BSI.

This document is currently submitted to the second CEN Enquiry.

1 Scope

This European Standard specifies a method for determination of the friction between any type of sports surface and a rotating foot with a vertical load. The method is applicable to tests carried out in the laboratory and on site.

2 Normative references

This European Standard 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 Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 60051, *Direct acting indicating analogue electrical-measuring instruments and their accessories (all Parts)*

EN ISO 291, *Plastics – Standard atmospheres for conditioning and testing*

EN 21948, *Coated abrasives – Plain sheets*

3 Terms and definitions

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

3.1
friction coefficient
horizontal force between the test foot and the sports surface (derived from the measured torque) divided by the vertical load on the foot during rotation (see clause 9)

3.2
vertical load
vertical force exerted on the sports surface by the test foot

3.3
torque
result of forces occurring at the eccentrically positioned test soles when the test foot rotates onto the sport surface under vertical load

NOTE The torque equals the force multiplied by the distance of the skids from the centre of the test foot.

4 Principle

Friction is measured by allowing a circular test foot, with attached test soles, to rotate on the sports surface under a vertical load. The friction resistance is calculated by recording the torque when the rotating test foot touches the test surface and then slides in rotation until the foot comes to a complete stop. From this the coefficient of friction, μ, is calculated as described in clause 9.

5 Sampling

5.1 Laboratory testing

The supplied test sections shall be large enough to carry out tests in at least three different places. For area-elastic floors, only the top layers (wooden surface, PUR coating, PVC covering or linoleum) need to be used in the test.

For point-elastic and mixed-elastic floors, the total system shall be tested. For combi-elastic floors, a minimum of the top layer, including the elastic layer, shall be tested.

If necessary, the test pieces shall be glued to a stiff panel such as plywood to achieve a firm and stable support. The floor material under test shall be fixed to the laboratory floor to avoid movement during the test.

5.2 Testing on site

The entire sports surface shall be considered as the test surface, with the test points being chosen and noted.

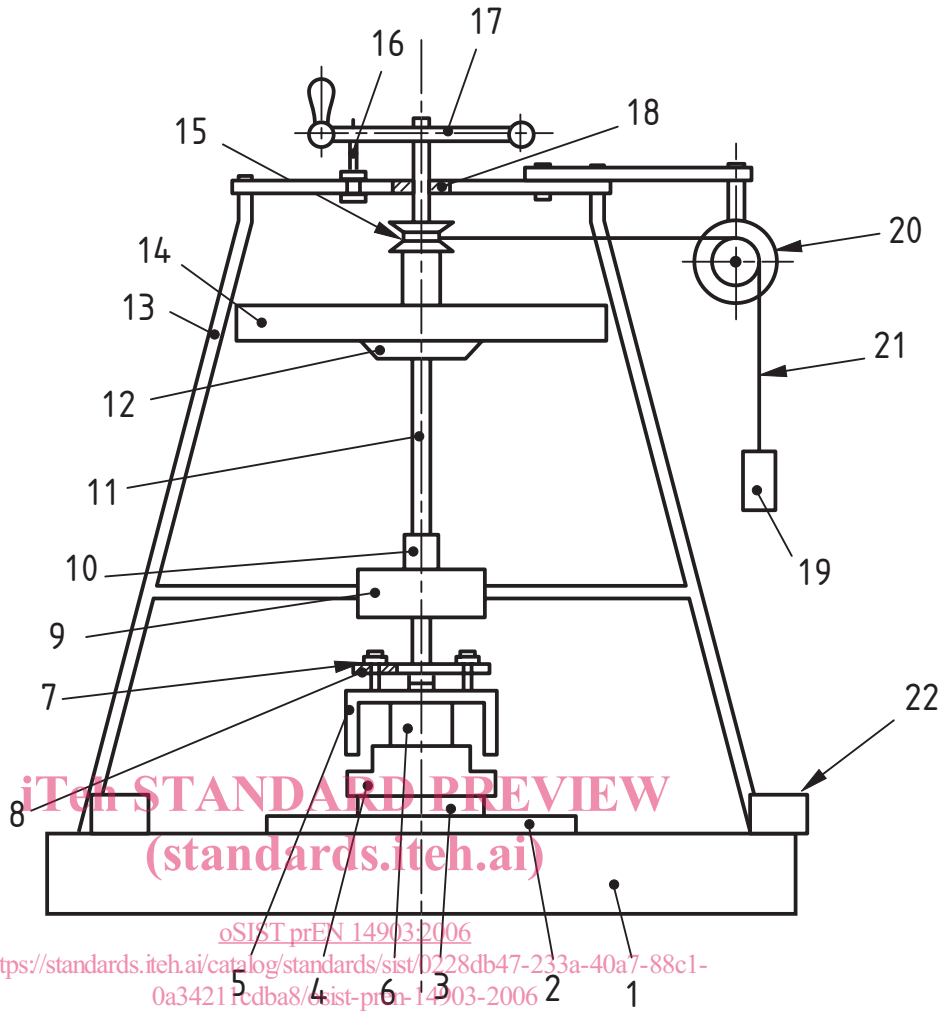
6 Apparatus

6.1 Test machine

NOTE The test machine is commonly known as the Stuttgart sliding machine.

6.1.1 The test machine is shown in Figure 1 and comprises a vertical shaft in a supporting frame with the measuring unit, comprising the test foot, fixed to the bottom end of the shaft with a wobble hinge. At the upper part of the shaft, a weight is flanged, the lower part of which is designed as a spindle. A constant impulse is exerted on the loaded shaft by means of a falling weight which is freely suspended and connected with a coiled polyester string which is guided over a rotating wheel.

The lower frame shall rest on a rubber lining to prevent movement of the apparatus during the test.



Key

1	Test base (laboratory)	12	Flange
2	Surface sample (laboratory)	13	Frame
3	Skid(s) with test sole	14	Weight/dead load
4	Base part of test foot	15	Coil
5	Top part of test foot	16	Stop pin/lever
6	Torque measuring cell	17	Hand wheel/bar
7	Rubber disc	18	Sliding bearing
8	Wobble hinge	19	Free hanging weight
9	Guide/cage of ball bearing	20	Wheel
10	Ball bearing of spindle	21	Polyester string
11	Spindle	22	Rubber lining

Figure 1 — Test machine

6.1.2 The test machine shall comprise the following:

a) supporting frame mounted on a base plate with a rubber lining;

b) shaft with a bottom and middle section formed as a ball bearing spindle, diameter 20 mm, spindle pitch 12 mm/U guided by a radially and axially acting ball bearing, the top section of the shaft guided by a sliding bearing;

c) test-foot (see Figure 2), comprising a steel disc having a diameter of (100 ± 1) mm;

d) either sliding skids (type A) having a width of 20 mm, a base length of 45 mm (segments of a cylinder with a diameter of 100 mm) the longitudinal axis of the skids being (33 ± 1) mm apart from axis of the shaft, or

a continuous sliding skid (ring-skid, type B) having a width of 20 mm, with the axis of the ring-skid (40 ± 1) mm from axis of the shaft;

e) torque measuring load cell, range 50 Nm, class 0,2.

f) free-hanging weight, having a mass of (5,0 ± 0,1)kg;

g) coil having a diameter of 54 mm.

The total mass of the shaft, the flanged weight and the test foot shall be (20 ± 1) kg;

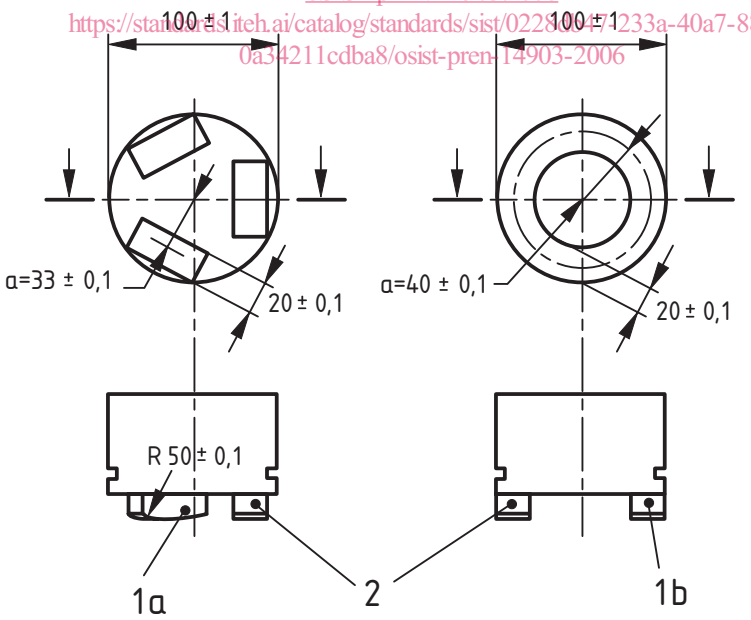
The moment of inertia of the shaft, the flanged weight and testing foot shall be approx. 2900 kg/cm²;
NOTE A lead disc of 250 mm diameter and 25 mm thickness will meet this requirement.

The test sole material for sliding skids type A shall be leather in accordance with EN 660-1, machine-split into 2 mm thick layers, the test surface being the newly split surface, which has been manually roughened with sand paper in accordance with ISO 21948, having a grain size 100 in the direction of sliding.

The test sole material for sliding skids type B shall be leather as used and specified for skid type A or rubber-like sole materials such as PUR, SBR or CR (Neoprene).

NOTE Experience has shown that sliding skid type A should preferably be used for testing. There is much less experience in the use of skid type B, which is still being evaluated.

Dimensions in millimetres



Key

1a Sliding skid type A
1b Sliding skid type B
2 Sole

Figure 2 — Test foot

6.2 Measuring and recording instruments

The measuring and recording instruments shall comprise a torque transducer as part of the test foot, an amplifier and a Y-t graphic recorder. The instruments shall comply with EN 60051-1 through to EN 60051-9, have a measuring range of 40 Nm and an accuracy class of 0,2.

7 Preparation of test pieces

7.1 Laboratory testing

The test pieces (5.1) shall be conditioned for a minimum of 16 h at a temperature of (23 ± 2) °C and a relative humidity of (50 ± 5) % according to EN ISO 291. The temperature and relative humidity used shall be recorded.

7.2 Field testing

No conditioning is required but the temperature and relative humidity during the test shall be recorded.

8 Procedure

Before starting the test, clean the area of the surface to be tested with a soft cloth or paper towel to remove any dust or dirt. Glue the test soles prepared according to 6.1 to the skid(s) and remove any dust from their surface with a brush.

Place the apparatus over the test location, such that the axis of rotation is perpendicular to the surface under test.

Turn up or reverse the test foot, resting on the floor, for one full rotation of the shaft. After release, the shaft shall move down helically such that the test foot contacts the test surface during the rotation phase. Immediately after touch-down of the test foot, the force which normally supports the shaft shall act with its flanged weight upon the test foot only. During rotation of the test foot on the test sample the ball bearing shall move upwards in its cage on the spindle so that the vertical load of the testing foot remains constant. Measure the frictional resistance caused by sliding the test foot across the surface by continuously recording the torque in the test foot (see Figure 3).

For each test section, test piece or test point on the surface take three consecutive recordings of the torque. Repeat the procedure on a minimum of five different test points on the surface. Before each measurement, clean the sole and the test surface with a brush. For each test location, "reface" the testing soles in accordance with 6.1.

9 Evaluation and expression of results

The principle characteristics of the graph plotting torque against time is shown in Figure 3. It is characterized by a steep incline immediately after the first contact of the test foot (contact phase) followed by a longer part of the graph with a lower slope as a consequence of the entire contact and following rotation of the test foot (sliding phase).

To determine the sliding resistance, first determine the torque as follows.

Plot a straight line in the level part of the graph (sliding phase) and intersected with the steep part of the graph (contact phase). The value of intersection is the decisive torque (D) in Ncm.

Determine the coefficient of friction, μ, using equation 1.

$$\mu = \frac{1}{R_m} \times \frac{T}{V} \quad [1]$$

where

μ is the coefficient of friction;

T is the decisive torque, expressed in Ncm;

V is the vertical load, expressed in N; and

R_m is 3,3 cm for skid type A and 4, 0 cm for skid type B.

Calculate the average value of the coefficient of friction, μ, for each of the test locations and express the result to the nearest 0,01.