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Ugotavljanje odpornosti talnih površin proti zdrsu - Metoda vrednotenja

Determination of slip resistance of pedestrian surfaces - Methods of evaluation

Bestimmung des Gleitwiderstandes von Fußgängerbereichen - Ermittlungsverfahren

Détermination de la résistance à la glissance des surfaces piétonnières - Méthode d'évaluation

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English Version

Determination of slip resistance of pedestrian surfaces - Methods of evaluation

Détermination de la résistance à la glissance des surfaces piétonnières - Méthodes d'évaluation

Bestimmung des Gleitwiderstandes von Fußgängerbereichen - Ermittlungsverfahren

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (CEN/TS 16165:2016) has been prepared by Technical Committee CEN/TC 339 “Slip resistance of pedestrian surfaces - Methods of evaluation”, the secretariat of which is held by DIN.

This document supersedes CEN/TS 16165:2012.

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Introduction

This document describes the most commonly used test methods in Europe for the determination of the slip resistance of floorings in the most commonly encountered situations in which pedestrians walk.

The method in Annex A describes the test method based on the ramp with contaminant water and operator barefoot.

The method in Annex B describes the test method based on the ramp with contaminant oil and operator wearing specified shoes.

NOTE The contaminant oil is used only to make the test more sensitive.

The method in Annex C describes the test method based on the pendulum in dry and wet conditions using specified rubber sliders. This method can be used *in situ*.

The method in Annex D describes the test method based on the tribometer in dry and wet conditions using specified rubber sliders. This method can be used *in situ*.

The tests described in Annexes A and B are laboratory tests. The tests described in Annexes C and D are laboratory and *in situ* tests. It is recommended to use Annexes A to D in the situations described as follows:

The method in Annex A: Floorings in wet conditions where the pedestrian is barefoot.

The method in Annex B, C and D: Floorings in private and/or public and/or work areas in wet and/or dry conditions where the pedestrian is wearing shoes.

1 Scope

This Technical Specification specifies test methods for the determination of the slip resistance of surfaces in the most commonly encountered situations in which pedestrians walk.

This Technical Specification does not cover sports surfaces and road surfaces for vehicles (skid resistance).

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 438-4, *High-pressure decorative laminates (HPL) - Sheets based on thermosetting resins (usually called laminates) - Part 4: Classification and specifications for compact laminates of thickness 2 mm and greater*

EN ISO 868, *Plastics and ebonite - Determination of indentation hardness by means of a durometer (Shore hardness) (ISO 868)*

EN ISO 4287, *Geometrical product specifications (GPS) - Surface texture: Profile method - Terms, definitions and surface texture parameters (ISO 4287)*

ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

ISO 5725-5, *Accuracy (trueness and precision) of measurement methods and results — Part 5: Alternative methods for the determination of the precision of a standard measurement method*

ISO 7619-1, *Rubber, vulcanized or thermoplastic — Determination of indentation hardness — Part 1: Durometer method (Shore hardness)*

3 Terms and definitions

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

3.1
pedestrian surface
surface which is designed for people to walk upon

3.2
acceptance angle
lowest angle of the inclined ramp at which the test person reaches the limit of safe walking when slipping occurs

3.3
contaminant
material on the surface of the surface which is not an inherent part of the surface and which can affect the frictional properties of that surface

3.4
surface
pedestrian surface excluding road surfaces and sports surfaces

3.5
friction
resistance to relative motion between two bodies in contact, e.g. the test slider or the footwear sole and the pedestrian surface

Note 1 to entry: The frictional force is the force acting tangentially in the contact area.

3.6
slip
loss of traction which can cause the test persons to lose their footing

3.7
slip resistance
measure of dynamic friction between two surfaces in contact with or without the presence of a specified contaminant

Note 1 to entry: The frictional force opposing movement of an object across a surface, usually with reference to the sole (including the heel) of a shoe or to the barefoot contact area on a floor. Slip resistance of a pedestrian surface is the property of the surface which limits the relative sliding movement.

3.8
test person
person who walks on the test surface or calibration surface

3.9
test walk
walk to determine a single acceptance angle

3.10
pendulum test value
PTV
standardised value of the slip resistance as measure of the friction between the slider and the test surface obtained with the pendulum friction tester which incorporates a slider manufactured of rubber

3.11
dynamic coefficient of friction
coefficient of friction where movement of a body across a surface is maintained at constant speed

3.12
sliding friction coefficient for surfaces
μ
quotient of the horizontal frictional force and the vertically acting force between the slider and the horizontal surface during movement at a constant speed

3.13
sliding distance
distance over which the body is pulled during a single measurement

3.14
measuring distance
distance over which the sliding friction coefficient is determined

3.15
measurement series
series consisting of five single measurements on one measuring distance

3.16
test cycle
cycle consisting of three measurement series

4 Test methods

Carry out a test according to Annex A to Annex D. If tests are performed in the laboratory the room temperature should be (20 ± 5)°C unless otherwise stated.

Annex A
(normative)

Barefoot Ramp Test

A.1 Principle

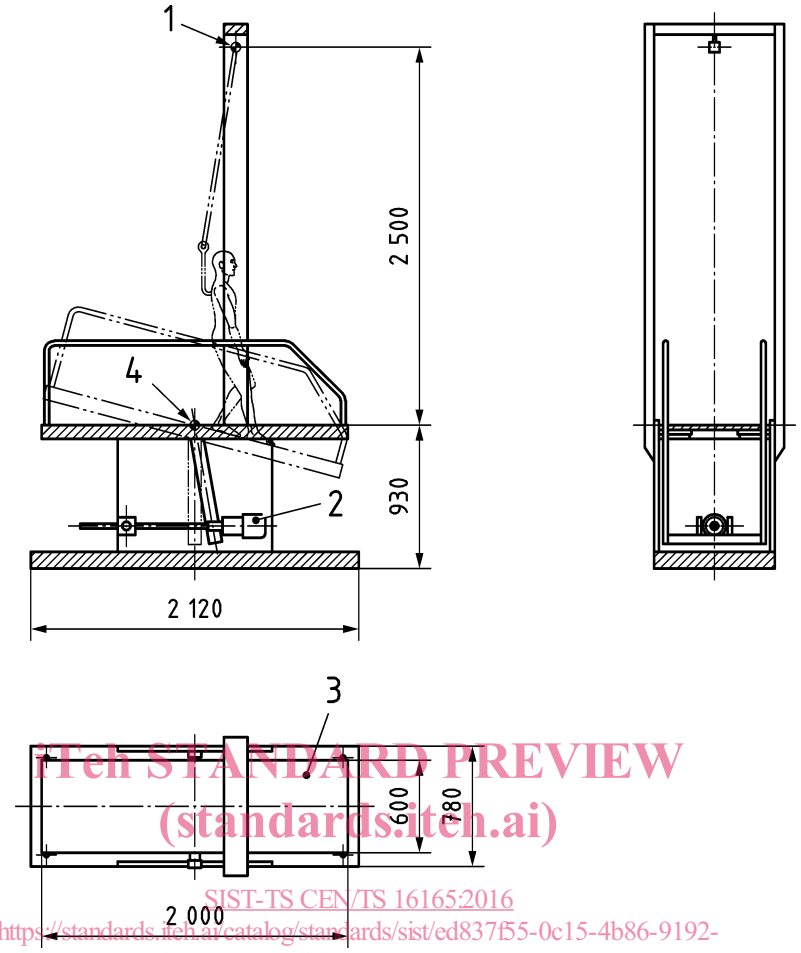
Two bare-foot test persons are used to determine the acceptance angle, after the pedestrian surface material being tested has been continuously coated with water containing a wetting agent. The test persons, each in turn, facing downhill and with an upright posture, move forwards and backwards over the test surface, as they increase their angle of inclination, until the safe limit of walking is reached and a slip occurs. The mean acceptance angle obtained is used to express the degree of slip resistance. Subjective influences on the acceptance angle are limited by means of a calibration procedure.

A.2 Test equipment

A.2.1 Test apparatus

The test device (Figure A.1) is a level and torsion-free platform of approximately 600 mm width and 2 000 mm length which can be adjusted longitudinally as a continuous movement to gradients from 0° to approximately 45°. The lifting stroke is controlled by the test person. An angle indicator on the test device shall show the platform tilt away from the horizontal plane at an accuracy of ± 0,2°. The test apparatus shall be rigid such that the angle does not vary by more than ± 0,5° during the walking. The display of the angle measurement system shall be fixed in such a way that the test person cannot read it during the test. The test person is safeguarded by railings along the sides and protected from falling by a safety harness which shall not cause a hindrance to the test person when walking on the pedestrian surface material under test.

Dimensions in millimetres



Key

1 safety harness and fall arrest system

2 drive unit

3 inclinable walkway area on which the test surface or verification/calibration surface is fixed

4 angle indicator

Figure A.1 — Example of a typical test apparatus

A.2.2 Test surface

The test surface area shall be approximately 100 cm × 50 cm. The test surface shall be clean. The test surface shall be either self-supporting, or securely mounted on a suitable flat surface.

If the slip resistance differs depending on the direction of walking, then it will be necessary to determine the direction of lowest slip resistance.

A.2.3 Contaminant

Aqueous solution of Dehypon LS45 (CAS-No. 68439-51-0) in a concentration of 1 g/l (aqueous solution: 0,1 % Dehypon LS45 in water) shall be used as the contaminant. Prior to and during testing the aqueous solution shall be applied at (6,0 ± 1,0) l/min using appropriate jets so as to form a largely uniform spray of contaminant across the test specimen. The temperature range of the solution shall be in between 29,0 ± 2,0 °C.

The contaminant shall run in an open circle (no recirculation).

A.3 Calibration

A.3.1 General

The inclination of the inclinable walkway surface shall be calibrated annually and checked periodically. Verification of the data produced by test persons shall be undertaken daily prior to testing. The latter shall be achieved by use of an appropriate set of standardized surfaces. The calibration processes as specified below shall be used to select and familiarise the test persons.

A.3.2 Validation of the test person

Three standard surfaces, St-A, St-B and St-C, are used for the calibration process. The acceptance angle (α) of these surfaces are given in Table A.1 and are specified as acceptance angles $\alpha_{S,St\text{-}A}$, $\alpha_{S,St\text{-}B}$ and $\alpha_{S,St\text{-}C}$ of the three standard surfaces.

On the same day, but prior to testing the test surfaces, each test person (j) shall walk on each standard surface (i = St-A, St-B and St-C) three times (see A.4) and the mean calibration (C) values $\alpha_{C,St\text{-}A,j}$, $\alpha_{C,St\text{-}B,j}$ and $\alpha_{C,St\text{-}C,j}$ shall be determined.

Each individual correction value $\Delta\alpha_{i,j} = \alpha_{S,i} - \alpha_{C,i,j}$ (i = St-A, St-B and St-C) of the calibration prior to testing shall be calculated and gives $\Delta\alpha_{St-A,j}$, $\Delta\alpha_{St-B,j}$ and $\Delta\alpha_{St-C,j}$.

Each of the individual correction values shall be less than the corresponding critical differences CrD_{95} that are given in Table A.1, i.e. $|\Delta\alpha_{i,j}| \leq CrD_{95}$. If one of the absolute values is greater, the test person in question shall be excluded from the test and replaced by another test person for that day.

Table A.1 — Acceptance angle and critical difference values of the three standard surfaces

Standard surface	$\alpha_{S,i}$	CrD_{95}
St-A	11,5°	2,1°
St-B	18,5°	2,1°
St-C	23,9°	2,1°

NOTE The critical difference of CrD_{95} indicates the spreading of measured values during measurements on the same object at various test locations, or coincidental deviations during repeated measurements at the same test location.

The critical differences of CrD_{95} are determined for the three standard surfaces for a significance level of 95 % from the comparison and repetition limits according to ISO 5725-2 or ISO 5725-5.

Calculation as follows:

a) Each test person *j* walks on a standard surface three times and the average calibration values are determined:

$\alpha_{C,St-A,j}$ $\alpha_{C,St-B,j}$ $\alpha_{C,St-C,j}$

b) The individual correction value:

$\Delta\alpha_{i,j} = \alpha_{S,i} - \alpha_{C,i,j}$ (i = St-A, St-B and St-C)

is calculated and results in:

$\Delta\alpha_{St-A,j}$ $\Delta\alpha_{St-B,j}$ $\Delta\alpha_{St-C,j}$

c) Rejection of test person if:

$|\Delta\alpha_{i,j}| > \mathrm{CrD}_{95}$ (see Table A.1)

A.4 Test procedure

a) The test surface (see A.2.2) shall be clean.

b) The test person shall put on the harness (see A2.1). The test person shall then attach to the fall arrest system (see A.2.1).

c) The test person shall mount the ramp (which shall be set to the horizontal position) so as to stand on the test surface.

d) Application of the aqueos Dehypon-solution

e) Facing down the ramp and looking at their feet, the test person, using a half-step gait, shall take a minimum of four steps down the test surface (walking forwards), and then take half-steps up the test surface (walking backwards) to return to their starting position. The test person shall walk up and down the test surface twice before raising the ramp by a small amount. This continues until a slip occurs.

f) It is essential to maintain a rhythm of about 144 half steps per minute. A metronome or similar should be used to keep pace.

NOTE Above a ramp angle of 15°, the pace is less important.

g) Once a slip occurs the walk shall be repeated at the angle of slip and if a further slip occurs then this angle is recorded.

h) If there is no second slip the test is continued, raising the angle by a small amount until two slips occur at the same angle.

i) Record the angle, $\alpha_{\mathrm{barefoot}}$ rounded to the nearest 0,2°.

j) Repeat the procedure from the horizontal two more times and record all three angles.