



SLOVENSKI STANDARD
oSIST prEN 16165:2020
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Ugotavljanje odpornosti talnih površin proti zdrsni - 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 - Méthodes d'évaluation

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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

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 339.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (prEN 16165:2020) 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 is currently submitted to the CEN Enquiry.

This document will supersede CEN/TS 16165:2016.

The main changes compared to the previous edition are as follows:

- a) description of test surface used in the barefoot ramp test and the shod ramp test changed;
- b) calibration procedure of the test device used in the barefoot ramp test changed;
- c) procedure for selecting and checking of test persons used in the barefoot ramp test changed;
- d) description of the test procedure used in the barefoot ramp test changed;
- e) description of test footwear used in the shod ramp test changed;
- f) acceptance angles for the three standard surfaces used in the shod ramp test changed;
- g) information when slider pads and slider assemblies shall be re-prepared or discarded added to the pendulum test;
- h) description of the verification procedure used in the pendulum test changed;
- i) float glass plate removed as reference surface used in the tribometer test;
- j) description of the verification of the slider material and test apparatus used in the tribometer test changed;
- k) description of the procedures for the preparation of test surfaces and sliders used in the tribometer test changed.

prEN 16165:2020 (E)**Introduction**

This document describes four test methods commonly used in Europe for the determination of the slip resistance of floorings.

The method in Annex A describes the test method based on the ramp using water as the contaminant and with the operator barefoot. This method cannot be used *in situ*. It is referred to as the “Barefoot ramp method”.

The method in Annex B describes the test method based on the ramp using oil as the contaminant and with the operator wearing specified shoes. This method cannot be used *in situ*. It is referred to as the “Shod ramp test”.

NOTE Oil is used as the contaminant 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*. It is referred to as the “Pendulum test”.

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*. It is referred to as the “Tribometer test”.

The purpose of this document is to harmonize the procedures used when using any of the above test methods. It is not intended to promote any particular test method to Product Group Technical Committees or to limit their choice.

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1 Scope

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

NOTE It is also possible to use this document for measurements where persons might walk on trafficked areas.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. 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)*

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*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 General terms

3.1.1

pedestrian surface

surface which is designed for people to walk upon

3.1.2

contaminant

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

3.1.3

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.

prEN 16165:2020 (E)**3.1.4****slip**

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

3.1.5**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.

3.2 Terms related to ramp tests**3.2.1****angle of slip**

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

3.2.2**test person**

person who walks on the test surface or calibration surface

3.2.3**test walk**

walk to determine a single angle of slip

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3.3 Terms related to pendulum tests

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3.3.1**pendulum test value****PTV**

standardized 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

3.4 Terms related to tribometer tests**3.4.1****dynamic coefficient of friction** **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

3.4.2**sliding distance**

distance over which the body is pulled during a single measurement

3.4.3**measuring distance**

distance over which the sliding friction coefficient is determined

3.4.4**measurement series**

series consisting of five single measurements on one measuring distance

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.

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Annex A (normative)

Barefoot ramp test

A.1 Principle

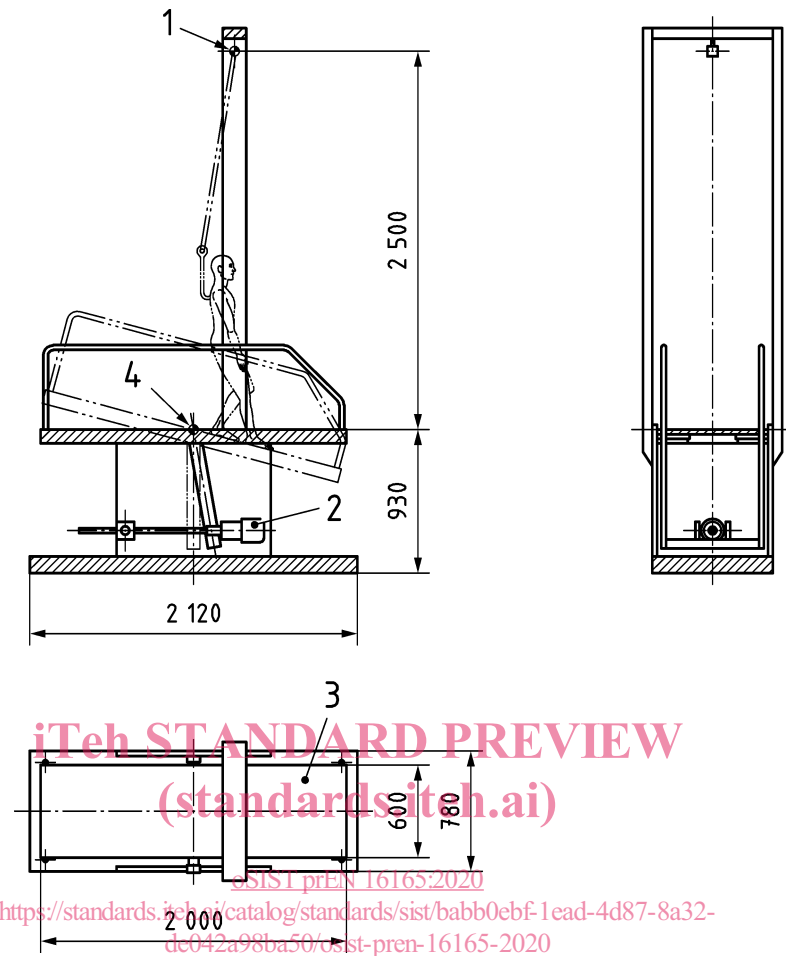
Two bare-foot test persons are used to determine the angle of slip, after the pedestrian surface material being tested has been continuously coated with water containing a wetting agent. The test persons, each in turn, facing downhill and with an upright posture, move forwards and backwards over the test surface, as they increase their angle of inclination, until the safe limit of walking is reached and a slip occurs. The mean angle of slip obtained is used to express the degree of slip resistance. Subjective influences on the angle of slip 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 $\pm 0,2^\circ$. The test apparatus shall be rigid such that the angle does not vary by more than $\pm 0,5^\circ$ 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 have a minimum length of 1 000 mm and a minimum width of 400 mm. 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. It is recommended that tests are carried out in at least two directions (longitudinally and laterally) to establish whether there is directionality of the slip resistance of the sample. Once a lack of directionality has been established, it is acceptable to test in a single direction. If the test surface is produced by the customer, he is responsible that the direction of the lowest slip resistance is mounted in the longitudinal direction of the test surface.

Materials designed to be used in one direction should be tested in the direction of slip of the intended use.

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A.2.3 Contaminant

Aqueous solution of a low foaming non-ionic surfactant such as LS45 (CAS-No. 68439-51-0) in a concentration of 1 g/l (aqueous solution: 0,1 % LS45 in water) shall be used as the contaminant. Prior to and during testing the aqueous solution shall be applied at $(6,0 \pm 1,0)$ 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 $(29,0 \pm 2,0)$ °C.

The contaminant may only be used once and shall not be re-circulated.

A.3 Calibration of the test device

The inclination of the inclinable walkway surface shall be calibrated annually and checked periodically. When testing barefoot the standard surfaces can become contaminated with body fats/oils. This may affect the performance of the surface. It is important to know, when calibrating or checking that any changes in the surface are due to wear or the operator and not contamination and it is recommended that the surfaces are thoroughly and properly cleaned before use.

A.4 Selecting and checking of the test persons

The test persons shall be qualified and trained for the test (e.g. gait, walking speed, skin condition). This shall be checked with the following procedure.

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

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.

Table A.1 — Angle of slip and critical difference values of the three standard surfaces

Standard surface	$\alpha_{S,i}$	CrD_{95}
St-A	12,4°	3,9°
St-B	20,9°	4,3°
St-C	26,7°	4,4°

Each test person j shall walk according to A.5, a) to l) on each standard surface four times and the average calibration values are determined out of the last three values:

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

For each test-person the individual differences according to Formula (A.1):

$$\Delta\alpha_{i,j} = \alpha_{S,i} - \alpha_{Q,i,j} \quad (A.1)$$

$$(i = \text{St-A, St-B and St-C})$$

are calculated and result in Formula (A.2):

$$\Delta\alpha_{St-A,j} \quad \Delta\alpha_{St-B,j} \quad \Delta\alpha_{St-C,j} \quad (A.2)$$

If each of the individual differences $\Delta\alpha_{St-A,j}$; $\Delta\alpha_{St-B,j}$; $\Delta\alpha_{St-C,j}$ are inside of the critical differences the test person is qualified for the test. The test person shall be rejected if the condition in Formula (A.3) is met.

$$|\Delta\alpha_{i,j}| > CrD_{95} \text{ (see Table A.1)} \quad (A.3)$$

This qualification test shall be carried out periodically, at least every 2 months.

The qualification test should not be carried out on every test day.

A.5 Test procedure

- a) The test surface shall be mounted on the test device so that the direction of the lowest slip resistance properties is in the direction of walking movement. For determining the slip resistance characteristics of surfaces with directional surface profiles or texture, see A.2.2.
- b) The test surface (see A.2.2) shall be clean.
- c) The test person shall soak their feet in water containing the contaminant for ten minutes before starting the test.
- d) The test person shall put on the harness (see A.2.1). The test person shall then attach to the fall arrest system (see A.2.1).
- e) The test person shall mount the ramp (which shall be set to the horizontal position) so as to stand on the test surface.
- f) Application of the aqueous low foaming non ionic surfactant solution (see A.2.3).
- g) Facing down the ramp and looking at their feet, the test person, using a half-step gait and using the flat of the foot, 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.
- h) It is essential to maintain a rhythm of about 144 half steps per minute. A metronome or similar should be used to keep pace. Above a ramp angle of 20°, the pace is less important.
- i) 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.
- j) 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.
- k) It is important that around the point of slip the angle is not raised too much in one step. Incremental rises shall therefore be small at this point.
- l) If it is suspected that the angle has been raised by too great an amount around the point of slip then the angle shall be lowered to below the angle of slip and the run repeated using smaller increments.