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Značilnosti cestnih in letaliških površin - Preskusne metode - 2. del: Ocena torne sposobnosti cestne vozne površine z uporabo dinamičnih merilnih sistemov

Road and airfield surface characteristics - Test methods - Part 2: Assessment of the skid resistance of a road pavement surface by the use of dynamic measuring systems

Verfahren zur Bestimmung der Griffigkeit von Fahrbahndecken durch Verwendung von dynamischen Messsystemen

Caractéristiques de surface des routes et aérodromes - Méthodes d'essai - Partie 2: Évaluation de l'adhérence d'un revêtement de chaussée à l'aide de systèmes de mesure dynamique

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Road and airfield surface characteristics - Test methods - Part 2: Assessment of the skid resistance of a road pavement surface by the use of dynamic measuring systems

Caractéristiques de surface des routes et aérodromes - Méthodes d'essai - Partie 2: Évaluation de l'adhérence d'un revêtement de chaussée à l'aide de systèmes de mesure dynamique

Oberflächeneigenschaften von Straßen und Flugplätzen - Prüfverfahren - Teil 2: Verfahren zur Bestimmung der Griffigkeit von Fahrbahndecken durch Verwendung von dynamischen Messsystemen

This Technical Specification (CEN/TS) was approved by CEN on 5 June 2009 for provisional application.

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Foreword

This document (CEN/TS 13036-2:2010) has been prepared by Technical Committee CEN/TC 227 "Road materials", the secretariat of which is held by DIN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document is one of a series of standards as listed below:

— EN 13036-1, *Road and airfield surface characteristics — Test methods — Part 1: Measurement of pavement surface macrotexture depth using a volumetric patch technique*

— CEN/TS 13036-2, *Road and airfield surface characteristics — Test methods — Part 2: Assessment of the skid resistance of a road pavement surface by the use of dynamic measuring systems*

— EN 13036-3, *Road and airfield surface characteristics — Test methods — Part 3: Measurement of pavement surface horizontal drainability*

— EN 13036-4, *Road and airfield surface characteristics — Test methods — Part 4: Method for measurement of slip/skid resistance of a surface — The pendulum test*

— prEN 13036-5, *Road and airfield surface characteristics — Test methods — Part 5: Determination of longitudinal unevenness indices*

— EN 13036-6, *Road and airfield surface characteristics — Test methods — Part 6: Measurement of transverse and longitudinal profiles in the evenness and megatexture wavelength ranges*

— EN 13036-7, *Road and airfield surface characteristics — Test methods — Part 7: Irregularity measurement of pavement courses: the straightedge test*

— EN 13036-8, *Road and airfield surface characteristics — Test methods — Part 8: Determination of transverse unevenness indices*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The skid resistance of a surface is determined by considering the friction measurement carried out using one of a number of permitted devices, and a measurement of surface texture also carried out using one of a number of permitted procedures. The permitted devices for friction measurements are those which have their measuring principle and procedure described in CEN/TS 15901-1 to CEN/TS 15901-10.

Where required, the procedures set out in this Technical Specification may be used for the measurement of friction only.

If there is a need to compare the skid resistance of a surface measured by different devices, Annex A (informative) may be used. That annex, by combining together the friction and texture for individual measuring devices, produces a skid resistance index (*SRI*).

NOTE The use of an informative annex is not obligatory.

1 Scope

This Technical Specification describes a method for determining the skid resistance of the pavement surface of a road or airfield.

This method defines a process for comparing the friction results from a number of devices. By combining together the friction and texture from individual measuring devices, it allows skid resistance determined by different dynamic methods to be expressed on a common scale, namely the Skid Resistance Index (*SRI*). As its precision has not been determined, the method should not be used in specifications for surface materials.

This standard excludes surfaces when they are in winter road condition. It also excludes road marking surfaces.

2 Normative references

The following referenced documents are indispensable for the application 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 13036-1, *Road and airfield surface characteristics — Test methods — Part 1: Measurement of pavement surface macrotexture depth using a volumetric patch technique*

CEN/TS 15901-1, *Road and airfield surface characteristics — Part 1: Procedure for determining the skid resistance of a pavement surface using a device with longitudinal fixed slip ratio (LFCS): RoadSTAR*

CEN/TS 15901-2, *Road and airfield surface characteristics — Part 2: Procedure for determining the skid resistance of a pavement surface using a device with longitudinal controlled slip (LFCRNL): ROAR (Road Analyser and Recorder of Norsemeter)*

CEN/TS 15901-3, *Road and airfield surface characteristics — Part 3: Procedure for determining the skid resistance of a pavement surface using a device with longitudinal controlled slip (LFCA): The ADHERA*

CEN/TS 15901-4, *Road and airfield surface characteristics — Part 4: Procedure for determining the skid resistance of pavements using a device with longitudinal controlled slip (LFCT): Tatra Runway Tester (TRT)*

CEN/TS 15901-5, *Road and airfield surface characteristics — Part 5: Procedure for determining the skid resistance of a pavement surface using a device with longitudinal controlled slip (LFCRDK): ROAR (Road Analyser and Recorder of Norsemeter)*

CEN/TS 15901-6, *Road and airfield surface characteristics — Part 6: Procedure for determining the skid resistance of a pavement surface by measurement of the sideway force coefficient (SFCS): SCRIM®*

CEN/TS 15901-7*, Road and airfield surface characteristics — Part 7: Procedure for determining the skid resistance of a pavement surface using a device with longitudinal fixed slip ratio (LFCG): the GripTester®*

CEN/TS 15901-8, *Road and airfield surface characteristics — Part 8: Procedure for determining the skid resistance of a pavement surface by measurement of the sideway-force coefficient (SFCD): SKM*

CEN/TS 15901-9, *Road and airfield surface characteristics — Part 9: Procedure for determining the skid resistance of a pavement surface by measurement of the longitudinal friction coefficient (LFCD): DWWNL skid resistance trailer*

CEN/TS 15901-10, *Road and airfield surface characteristics — Part 10: Procedure for determining the skid resistance of a pavement surface using a device with longitudinal block measurement (LFCSK): the Skiddometer BV-8*

EN ISO 13473-1, *Characterization of pavement texture by use of surface profiles — Part 1: Determination of Mean Profile Depth (ISO 13473-1:1997)*

3 Symbols, terms and definitions

3.1 Symbols

B	Device-specific parameter
SRI	Skid Resistance Index
MPD	Mean Profile Depth
MTD	Mean Texture Depth
F	Measured friction value at speed S
F_0	Regression line intercept at speed zero
m	Number of valid results from a measurement series
M	Total number of valid results per device
N	Total number of friction testing devices meeting in a calibration exercise
N_R	Number of reference devices participating in a calibration exercise
n	Number of surfaces used for calibrating friction testing devices
r	Number of runs of a given device on a given surface
S	Slip speed
S_0	Speed parameter
V	Operating speed
β	Regression line slope
σ_{SRI}	Residual standard deviation of SRI
σ_{S_0}	Residual standard deviation of S_0

3.2 Terms and definitions

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

3.2.1
friction
resistance to relative motion between two bodies in contact

NOTE 1 The frictional force is the force which acts tangentially in the contact area.

NOTE 2 Friction is essential for a safe grip between vehicle and surface. Surfaces can be in different conditions and of different types, which can lead to varying friction. Another important factor is the climate and weather conditions that indeed affect the friction, in most cases for the worse.

3.2.2
friction measuring device
device that measures the frictional force acting tangentially in the contact area

NOTE The results from the friction measuring device are commonly known as a "device coefficient" or "friction value".

3.2.3
skid resistance
characterisation of the friction of a road surface when measured in accordance with a standardised method

NOTE 1 Numerous factors contribute to skid resistance, in particular:

- physical properties of specific friction measuring devices − the contact pressure, contact area, tread pattern and rubber composition of the tyre, or slider in the case of a some test devices;
- slip speed of the tyre/slider over the surface and the vehicle speed;
- surface conditions, i.e. wet or dry, clean or contaminated surface, as well as air and water temperature;
- surface texture characteristics of the road surface, i.e. the microtexture and macrotexture of the surface.

If these factors are held constant for a particular measuring device, or if the conditions of test are standardized, the skid resistance of the surface can be determined.

NOTE 2 The skid resistance of a road surface in Europe varies seasonally. Generally, wet skid resistance is higher in winter as a result of the effects of wet detritus and the effects of frost and wear by tyres on microtexture and macrotexture. Wet skid resistance is lower in summer as a result of dry polishing by tyres in the presence of fine detritus.

NOTE 3 The change in skid resistance of a surface in service is affected by the volume of traffic and the composition of the traffic, i.e. cars, buses, commercial vehicles of different sizes, as the tyres of these vehicles polish and/or wear away the surfacing material in different ways. The geometry of the road will affect the change in skid resistance. Generally, tyres polish less on straight roads than on bends.

NOTE 4 Where the surface contains aggregate with a coating of binder, e.g. bitumen, resin or Portland cement, the skid resistance will change as the coating is worn away by tyres.

NOTE 5 Skid resistance is a particular friction characteristic. Devices for measuring this surface characteristic may be known as skid resistance or friction measuring devices.

3.2.4
Skid Resistance Index
SRI
objective estimate of skid resistance which is independent of the friction measuring device used

NOTE 1 Being a surface-related property, skid resistance is (ideally) independent of speed, measuring device and measuring method. Currently, there is no method available to measure it. However, a common index (Skid Resistance Index, *SRI*), which constitutes an estimate of skid resistance, can be determined as described in Clause 6.

NOTE 2 The *SRI* is intended to facilitate objective comparison of surfaces, and is based on friction and macrotexture measurements and subsequent calculations. The friction measured with a particular device is combined with corresponding macrotexture data as well as pre-determined device-related constants representing most devices used in Europe, normalized to a certain fixed slip speed, to estimate the Skid Resistance Index.

3.2.5
microtexture
deviation of a pavement surface from a true planar surface with characteristic dimensions along the surface of less than 0,5 mm, corresponding to texture wavelengths with one-third-octave bands with up to 0,5 mm of centre wavelengths

NOTE 1 Peak to peak amplitudes normally vary in the range 0,001 mm to 0,5 mm.

NOTE 2 Those devices that utilize a relatively low slip speed measure primarily the component of friction affected by microtexture. Microtexture makes the surface feel harsh but is normally too small to be observed with the unaided eye. It is produced by the surface characteristics of the individual aggregate or other particles that come into direct contact with the tyre. It is a primary component in skid resistance at slow speeds.

3.2.6
macrotexture
deviation of a pavement surface from a true planar surface with characteristic dimensions along the surface of 0,5 mm to 50 mm, corresponding to texture wavelengths with one-third-octave bands including the range 0,63 mm to 50 mm of centre wavelengths

NOTE 1 Peak to peak amplitudes normally vary in the range 0,1 mm to 20 mm.

NOTE 2 This type of texture has wavelengths of the same order of size as the tyre-tread elements. It is normally produced by suitable proportioning of the aggregate and mortar of the mix or by surface treatments. It is a major factor influencing skid resistance at high speeds but it also has an effect at low speeds.

3.2.7
wheel path
parts of the pavement surface where the majority of vehicle wheel passes are concentrated

NOTE 1 The wheel path is not a fixed location on a pavement surface. On a worn pavement, the wheel path is usually easily identified visually. On a newly laid surface, the position of the wheel path should be estimated by experienced device operators.

NOTE 2 For special circumstances such as acceptance tests, a particular path may be defined, for example, (700 ± 150) mm from the edge of the running lane of a road.

3.2.8
Mean Profile Depth
MPD
descriptor of macrotexture, obtained from a texture profile measurement as defined in EN ISO 13473-1

3.2.9
Mean Texture Depth
MTD
result of the volumetric measurement of macrotexture in accordance with EN 13036-1

3.2.10
calibration
periodic adjustment of the offset, the gain and the linearity of the output of a measurement method so that all the calibrated devices of a particular type deliver the same value within a known and accepted range of uncertainty, when measuring under identical conditions within given boundaries or range of parameters, e.g. speed, texture, wetting, temperature

NOTE The method of calibration of devices used to produce a Skid Resistance Index is given in Clause 7.

3.2.11
calibrated device
device that holds a valid calibration certificate following a Type 1, Type 2 or Type 3 calibration

3.2.12
new device
any device which has not been calibrated

3.2.13
reference device
any friction device calibrated in accordance with a Type 1 or Type 2 calibration procedure

NOTE The reference device is used in conjunction with the procedure to determine the Skid Resistance Index.

3.2.14
operating speed
speed at which the device traverses the surface

3.2.15
slip speed
relative speed between the tyre and the travelled surface in the contact area

3.2.16
slip ratio
slip speed divided by the operating speed

NOTE This may be expressed in tables or reports as a percentage but in any calculation, as part of the procedure of the Technical Specification, its decimal value should be used.

3.2.17
contact area
overall area of the road surface instantaneously in contact with a tyre

NOTE This term describes the overall area generally covered by the tyre. Due to the effects of surface texture or any tyre tread pattern, not all of the tyre or road surface in the contact area may be in contact at any instant.

3.2.18
test section
length of road between defined points (e.g. location references, specific features, or measured distances) comprising a number of subsections over which a continuous sequence of measurements is made

4 Safety

Appropriate safety measures shall be in place to maintain a safe working area in accordance with regulations, including measures to control traffic as necessary.

All devices should be operated safely and fitted with safety devices in accordance with the relevant procedures and regulations.

NOTE The wetting of surfaces can have an effect on other users of the site and every effort should be made to ensure that they do not have to make any sudden changes in speed or direction.

5 Measurement procedure

5.1 Friction measurement

The skid resistance of the surface at the time of test is reported as the friction measurement carried out by one of the devices included in CEN/TS 15901-1 to -10 and according to the specific procedure described in the relevant Technical Specification. The information required to be reported by the relevant specification procedure for the device and this Technical Specification shall be reported.

NOTE Measurements should not be made when rainfall significantly increases the depth of water applied by the friction measuring device.

5.2 Macrotexture measurement

The macrotexture measurement shall be carried out either in accordance with EN ISO 13473-1 or EN 13036-1.

5.3 Measurement location

Under normal circumstances the friction as well as the macrotexture measurement shall be taken along a line nominally in the nearside wheel path of the most heavily trafficked lane; the actual distance from the edge will vary. However when required other tracks across the surface may be measured. The transverse location of all tests shall be defined and reported.

NOTE 1 Other transverse locations may need to be measured for example to demonstrate that a surface is consistent transversely when first constructed.

NOTE 2 The locations for testing airfield pavements may be given in ICAO International Standards and recommended practices: Annex 14 to the Convention on International Civil Aviation.

Devices that measure macrotexture or friction as they travel, sample the surface at discrete intervals, the longitudinal test location is given in the operating procedure of the device. Static devices measure at sampling intervals defined in the procedure or as defined by the physical constraints of the site, the tests location shall be recorded. In addition for all devices, the start and finish location, referenced along the test section from a known point, shall be recorded.

5.4 Time interval between friction and macrotexture measurements

The time interval between the friction measurement, on one hand, and the macrotexture measurement, on the other hand, shall not exceed seven days.

NOTE If macrotexture measurements cannot be carried out on the same area at the same time as the friction measurement, they should be taken on the same area at a time as close as practicable.

6 Determination of the Skid Resistance Index (*SRI*)

6.1 General

Where required, this procedure enables the measurement of friction made with different devices to be brought to a common index, known as the Skid Resistance Index (*SRI*) using a complementary macrotexture measurement.

The measurement of friction shall deliver a friction coefficient value (F, dimensionless) and the actual slip speed (S, in kilometres per hour).

The slip speed (S) shall be derived from the operating speed (V) using the following formulae depending on the test principle used by the device:

— Longitudinal force measurement: $S = V$* Slip ratio;

NOTE 1 For locked-wheel systems, the slip ratio equals 1.

— Sideway force measurement: $S = V$* sin(Yaw angle).

NOTE 2 The yaw angle is the angle formed by the equatorial plane of a wheel and the direction of travel of the vehicle.

The macrotexture measurement shall deliver the Mean Profile Depth (MPD) of the tested section as defined in EN ISO 13473-1. This is the preferred method. If no adequate profilometer is available, the macrotexture can be measured by means of the volumetric method in accordance with EN 13036-1, which gives the Mean Texture Depth of the tested section (MTD, in millimetres).

6.2 Calculations

The estimate of the Skid Resistance Index (SRI) shall be computed by means of the following equations:

$$SRI = BFe^{[(S-30)/S_0]} \quad (1)$$

with

$$S_0 = aMPD^b \quad (2)$$

where

F is the measured friction coefficient at slip speed (S, in kilometres per hour);

a, b and B are parameters specific to the friction measuring device used.

From an MTD value, one can best estimate MPD by the formula:

$$MPD = (5\ MTD - 1)/4 \quad \text{for } MTD > 0{,}2 \quad (3)$$

$$MPD = 0 \quad \text{for } MTD < 0{,}2 \quad (4)$$

which has been obtained by correlating MTD with MPD.

6.3 Device-specific parameters

Parameters a, b and B are determined in the course of a calibration exercise as described in Clause 7.

6.4 Precision

The precision has not been determined. Research is still ongoing.

6.5 Test report

The report shall include the following:

a) date and time of the measurement(s);

b) identification of the operator(s);

c) identification of the test section;

d) identification of the friction testing device;

e) values of constants a, b and B together with the reference to their determination;

f) identification of the texture measuring device;

g) value of MPD or MTD of the section;

h) friction value of the section;