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Značilnosti cestnih in vzletnih površin - 8. del: Postopek določanja torne sposobnosti vozne površine z meritvijo količnika trenja poševno vodenega kolesa (SFCD) : SKM

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

Verfahren zur Bestimmung der Griffigkeit von Fahrbahndecken durch Messung des Seitenreibungsbeiwertes (SFCD): das SKM-Griffigkeitsmessgerät

Caractéristiques de surface des routes et aéroports - Partie 8: Mode opératoire de détermination de l'adhérence d'un revêtement de chaussée en procédant au mesurage du coefficient de frottement transversal (CFTD): le SKM

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93.080.10	Gradnja cest	Road construction
93.120	Gradnja letališč	Construction of airports

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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

Caractéristiques de surface des routes et aéroports - Partie 8 : Mode opératoire de détermination de l'adhérence d'un revêtement de chaussée en procédant au mesurage du coefficient de frottement transversal: le SKM

Oberflächeneigenschaften von Straßen und Flugplätzen - Teil 8: Verfahren zur Bestimmung der Griffigkeit von Fahrbahndecken durch Messung des Seitenreibungsbeiwertes (SFCD): das SKM-Griffigkeitsmessgerät

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Foreword

This document (CEN/TS 15901-8:2009) has been prepared by Technical Committee CEN/TC 227 “Road materials”, the secretariat of which is held by DIN.

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1 Scope

This Technical Specification describes a method for determining the wet-road skid resistance of a surface by measurement of the sideway-force coefficient SFCD.

The method provides a measure of the wet-road skid resistance properties of a bound surface by measurement of sideway-force coefficient at a controlled speed.

This Technical Specification covers the operation of the sideway-force Coefficient Machine (SKM) developed in Germany.

The SKM skid resistance measurement technique determines the sideway-force acting on a particular, angled wheel.

The SKM measurement technique has been developed for Network-wide measurements of skid resistance during road monitoring and assessment of pavement surfaces on German federal motorways and highways. It is also applicable to skid resistance measurements for road construction contracts.

The skid resistance of a pavement is determined by friction measurements and measurements of pavement texture. Where measurement of pavement texture is required the standard for this measurement and the device is described in EN ISO 13473-1.

2 Recommended uses

The SKM measuring technique is suitable for use for the following applications:

— monitoring of networks (Pavement Management);

— approval of new surfacing;

— measurements for project-level compliance;

— investigation of surface skid resistance;

— comparative measurements among different devices;

— research measurements.

3 Terms and definitions

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

3.1
skid resistance
property of a trafficked surface that limits relative movement between the surface and the part of a vehicle tyre in contact with the surface

NOTE Factors that contribute to skid resistance include the tyre pressure, contact area, tread pattern, and rubber composition; the alignment, texture, surface contamination, and characteristics of the road surface; the vehicle speed; and the weather conditions.

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.

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.

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.

3.2
roughness
surface texture
geometric design of the pavement surface in wavelengths ranging from a few micrometres to several decimetres

NOTE A distinction is made between micro-, macro- and mega-roughness:

— Micro-roughness: Roughness elements with a horizontal length of less than 0,5 mm; roughness of up to 1/100 mm strongly influences wet friction between rubber and pavement surface;

— Macro-roughness: Roughness elements with a horizontal length of 0,5 mm to 50 mm; only roughness values of up to 10 mm influence skid resistance through drainage properties;

— Mega-roughness: Roughness elements with a horizontal length of 50 mm to 500 mm. Roughness of this magnitude can influence accumulations of water on the pavement surface (for instance, in unevenness).

3.3
operating speed
speed at which the device traverses the test surface

3.4
slip speed
relative speed between the test tyre and the travelled surface in the contact area

3.5
slip ratio
slip speed divided by the operating speed

3.6
sideway-force measurement
SKM
dynamic friction measurement technique making use of a skewed measurement wheel as described in these technical test specifications

3.7
adhesion
transmission of forces by friction against tyre contact surfaces, which results from the interaction between tyres and pavement surface and is influenced by surface roughness, tyre characteristics, the nature and thickness of any intermediate medium such as water or mud, and speed

3.8
adhesion coefficient
μ
quotient of the force transmitted by adhesion to the pavement and the normal force

3.9
adhesion coefficient on a skewed wheel
μ_y
quotient of the sideway-force generated between the tyre on a skewed wheel and the pavement surface, and the normal force

3.10
adhesion coefficient on a skewed wheel in terms of μ_{SKM}
corrected adhesion coefficient on a skewed wheel

3.11
slip angle
angle between the mid-plane of the test tyre and the direction of travel projected on the contact surface in operation

3.12
sideway-force coefficient
ratio between the horizontal force (side load) and vertical force (load) in controlled conditions

3.13
theoretical water film thickness
theoretical water film thickness of a water film between a measuring tyre and a test surface, assuming the surface has zero texture depth

3.14
water flow rate
rate at which water is deposited on the surface to be measured in front of the test tyre

NOTE Water flow rate is expressed in litres per second (l/s).

3.15
wheelpath
part of the pavement surface where the majority of vehicle wheel passes are concentrated

3.16
nearside wheelpath
wheelpath that is closest to the edge of the road in the normal direction of travel

NOTE For countries that normally drive on the right, this is the right-hand side, and, for countries that normally drive on the left, this is the left-hand side.

3.17
subsection
defined length of surface for which one set of the measured variables is reported by the device

3.18
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

3.19
calibration
periodic adjustment of the offset, gain and 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 in identical conditions within given boundaries or range of parameters

3.20
precision
repeatability
r
maximum difference expected between two measurements made by the same machine, with the same tyre, using the same crew on the same section of road in a short space of time, with a probability of 95 %

3.21
precision
reproducibility
R
maximum difference expected between two measurements made by different machines with different tyres using different crews on the same section of road in a short space of time, with a probability of 95 %

4 Safety

Safety measures shall be in place to maintain safe working practice in accordance with current regulations, and to ensure the safety of other road users, including measures to control traffic as necessary.

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.

When measuring skid resistance on trafficked roads the device may operate at speeds different to normal road speeds and as a result can create a hazard to other road users. The test speed specified when calling for tests in accordance with this Technical Specification should take this into account.

Testing should not be carried out if there is a risk of water freezing on the road.

5 Essential Characteristics

5.1 Principle of measurements

Machines meeting this Technical Specification operate on the sideway-force principle using a special narrow test wheel, similar to a motorcycle wheel, set an angle to the direction of travel which generates a slipping condition as it is towed along the wetted pavement surface. The slipping force and load on the wheel are measured. A typical device is illustrated in Figure 1.

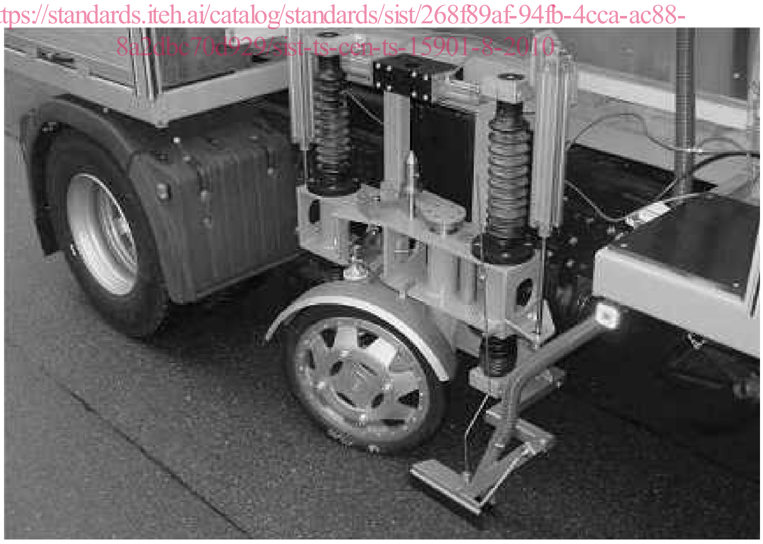


Figure 1 — A typical SKM device (in this case BASt SKM)

5.2 Operating Principle

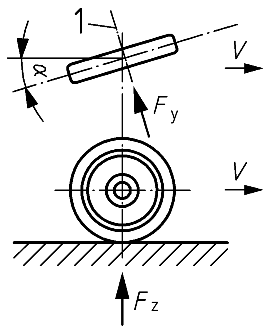
The sideway-force measurement procedure (SKM) determines the sideway-force acting on a defined, skewed wheel (additional test wheel centred on the measurement vehicle's right-hand wheel track). The measurement principle is shown in Figure 2. The sideway-force coefficient μ_y is the quotient between the measured sideway-force F_y and the known wheel load (normal force) F_z.

The wheel load is defined specifically by the mass of the measuring components suspended movably via linear guides.

A controlled flow of water wets the road surface immediately in front of the test wheel, so that when the vehicle moves forward, the test wheel slides in the forward direction along the surface.

The sideway-force coefficient essentially depends on the carriageway's properties, measurement tyre's skew angle, speed, water-film thickness, road soiling and temperatures (of the tyre, applied water, carriageway surface, atmosphere). Relevant tyre characteristics include its dimensions and type, wheel load, internal tyre pressure and rubber properties.

The sideway-force coefficient μ_y is used to evaluate friction.



$$\mu_y = F_y / F_z$$

Key

1 skewed wheel

Figure 2 — Determination of the sideway-force coefficient

6 Key Characteristics

6.1 General

The minimum requirements to ensure a good repeatability and reproducibility of the devices results are listed below.

6.2 Test equipment

The test equipment shall include the following features:

— measurement tyre (skewed);

— load cell;

— carriageway wetting unit;

— temperature measuring instruments;

— distance control system.

6.3 Measurement tyre

- Test tyre: SKM tyre, size 3 × 20" (treadless, narrow, diagonal, motorcycle-type). Only measurement tyres tested and certified by the “BASt (Federal Highway Research Institute) in Bergisch Gladbach” in compliance with internal test regulations shall be used.
- Tyre properties: Shore-A hardness is determined at the “BASt” on a new tyre at 20 °C in accordance with DIN 53505. This value shall lie between 65 and 69 points. Tyres outside this range are not supplied to operators.
- Tyres exhibiting a ruptured or deeply scored contact surface shall not be used.
- Test wheel rim: 1,75 × 20".
- Tyre inflation pressure: (350 ± 10) kPa.
- Tyre monitoring bore: Tyres are produced with seven monitoring bores with a depth of 0,5 mm to 3,5 mm at 0,5 mm intervals.
- Tyre abrasion: < 3 mm (the second last of the seven bores shall be clearly visible and documented).

The tyre overpressure shall be checked before every new measurement and after every interruption in measurement; deviations shall be corrected.

To ensure comparability of measurement results, a standardized handling of the test tyres is required with regard to storage, running in, etc.

- Tyres shall be stored on racks in a cool, dry and dark environment.
- For breaks in operation lasting more than one month, the tyre shall be stored as described above.

- Tyres older than two years shall no longer be used.
- Prior to the first measurement, new or unused tyres shall be run in for at least 20 km in the measurement mode (including pavement wetting, etc.) on a carriageway surface providing an average friction coefficient of $0,4 < \mu_{SKM} < 0,7$.

The measurement tyre shall be checked immediately before first use on the internal-monitoring test sections – following the run-in phase – and at the end of the operating period by measuring, comparing and documenting the friction on these sections.

Follow-up tyre measurements are required for a determination of friction as part of roadmonitoring and assessment (ZEB):

Before every tyre change, perform a measurement on a route section at least 2 km long and then repeat this measurement immediately after new, run-in tyre has been mounted. The results of this comparative measurement should be documented, evaluated as part of internal control procedures and submitted to the client and to the BASt.

6.4 Load cell

Temperature fluctuations between 5 °C and 50 °C around the test equipment or load cell must not lead to any significant changes exceeding $\Delta\mu_y = \pm 0,005$ in measurement values. The load cell’s functionality is verified as part of temporary operating approval using procedures specified by the BASt.