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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®

Verfahren zur Bestimmung der Griffigkeit von Fahrbahndecken mit einem Gerät mit festgelegtem Schlupf in Längsrichtung: der "GripTester"

Caractéristiques de surface des routes et aéroports - Partie 7 : Mode opératoire de détermination de l'adhérence d'un revêtement de chaussée à l'aide d'un dispositif à coefficient de frottement longitudinal fixe (CFLG) : le GripTester

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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(r)

Caractéristiques de surface des routes et aéroports - Partie 7 : Mode opératoire de détermination de l'adhérence d'un revêtement de chaussée à l'aide d'un dispositif à coefficient de frottement longitudinal fixe (CFLG): le GripTester

Oberflächeneigenschaften von Straßen und Flugplätzen - Teil 7: Verfahren zur Bestimmung der Griffigkeit von Fahrbahndecken durch Verwendung eines Geräts mit festem Schlupfverhältnis in Längsrichtung (LFCG): der GripTester

This Technical Specification (CEN/TS) was approved by CEN on 27 June 2009 for provisional application.

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

Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (CEN/TS 15901-7:2009) 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.

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1 Scope

This Technical Specification describes a method for determining the skid resistance of a surface by measurement of the longitudinal friction coefficient LFCG.

The method provides a measure of the wet skid resistance properties of a bound surface by measurement of the longitudinal friction coefficient using a continuous reading small braked wheel fixed-slip device.

The test tyre is dragged over a pre-wetted pavement under controlled speed conditions while the test tyre is parallel to the direction of motion and perpendicular to the pavement.

Test speeds can vary from 5 km/h to 130 km/h depending on the application. The measured values can be affected by the test speed.

The method has been developed for use on paved areas such as roads and airport runways and may also be used indoors.

This Technical Specification covers the operation of the GripTester.

The GripTester® is a device developed by Findlay Irvine Ltd in the United Kingdom that uses the braked-wheel fixed-slip principle with a small test wheel to make measurements of skid resistance continuously on airfields, roads and other surfaces. The fixed slip ratio is 15 %.

A machine conforming to the general characteristics of the GripTester and the specific provisions of this Technical Specification may also be used for the tests.

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 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.

ISO 48, *Rubber, vulcanized or thermoplastic – Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 4662, *Rubber – Determination of rebound resilience of vulcanizates*

3 Recommended uses

The method is applicable to the following types of pavements, for example:

— road surfacings;

— road markings;

— airport runways;

— flight decks;

— footways;

— pedestrian precincts;

— test panels of surfaces intended for any of the above.

The device may be used for the following fields of application:

— 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.

4 Terms and definitions

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

4.1
friction
resistance to relative motion between two bodies in contact

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

4.2
skid resistance
characterisation of the friction of a road surface when measured in accordance with a standardised method

4.3
wet road 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, when lubricated with a film of water

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.

4.4
pedestrian slip resistance
property of the trafficked surface to maintain the adhesion of a pedestrian shoe sole

4.5
bound surface
top layer or surface course of a road with the aggregates secured permanently in place

NOTE Aggregates are commonly secured in place by bitumen or Portland cement.

4.6
operating speed
speed at which the device traverses the test surface

4.7
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 can be in contact at any instant.

4.8
slip speed
relative speed between the test tyre and the travelled surface in the contact area

4.9
slip ratio
slip speed divided by the operating speed

NOTE For devices meeting the requirements of this Technical Specification the slip ratio is fixed by the geared braking system of the test wheel.

4.10
fixed slip
condition in which a braking system forces the test wheel to roll at a fixed reduction of its operating speed

4.11
braked wheel friction tester
apparatus that can be moved over the test surface at a known, steady speed and that includes a test wheel, a system for braking the test wheel and instrumentation for measuring the resulting friction between the test tyre and test surface

4.12
vertical force
load
force applied by the wheel assembly on the contact area

NOTE Some devices use an assumed load based on the static load.

4.13
horizontal force
drag
force acting tangentially on the test wheel in line with the direction of travel

4.14
GripTester
device developed by “Findlay Irvine Ltd in the United Kingdom” in the form of a trailer which can be towed by a vehicle that contains the recording and control computer and a water supply, which is not manufactured under license

4.15
instantaneous LFC
drag divided by the vertical load

4.16
longitudinal friction coefficient
LFC
ratio between horizontal force (drag) and vertical load (load) for a braked wheel in controlled conditions, which is normally a decimal number quoted to two significant figures

NOTE LFC varies depending on the slip ratio of the device and the operational speed.

4.17
LFCG
LFCG measured by a small braked wheel fixed slip device meeting the requirements of this Technical Specification

NOTE 1 It is the mean of a number of instantaneous friction readings over a defined length.

NOTE 2 The range of the LFCG is 0,00 to 1,20.

4.18
sampling length
distance over which responses of the sensors are sampled to determine a single measurement of the recorded variables

NOTE 1 The sampling length depends upon the detailed operation of device and its recording system; a number of samples may be combined to determine a measurement for a subsection.

NOTE 2 This should not be confused with horizontal resolution which is the shortest distance over which a change in the measured parameter can be detected.

4.19
subsection
defined length of surface for which one set of the measured variables is reported by the device

NOTE Different devices may use different subsections depending on the context of the measurements, such as 1 m, 5 m, 10 m or 20 m.

4.20
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

4.21
water delivery system
system for depositing a given amount of water in front of the test tyre so that it then passes between the tyre and the surface being measured

4.22
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).

4.23
theoretical water film thickness
theoretical thickness of a water film deposited on the surface in front of the measuring tyre, assuming the surface has zero texture depth

4.24
wheelpath
part of the pavement surface where the majority of vehicle wheel passes are concentrated

NOTE The wheelpath is not a fixed location on a pavement surface. On a worn pavement, the wheelpath is usually easily identified visually. On a newly laid surface, the position of the wheelpath needs to be estimated by experienced operators.

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.

4.25
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.

4.26
routine testing
measurement of the skid resistance of a surface in standardized test conditions, which normally include a defined water flow rate

4.27
airfield operational testing
measurement of the skid resistance of a surface on an airfield in response to an operational need and in whatever conditions exist at the time of the test, which can include contamination by ice, snow, slush or water

NOTE These tests do not include water deposition.

4.28
push mode
mode in which the device is pushed by a pedestrian

4.29
tow mode
mode in which the device is towed by a vehicle

5 Safety

Safety measures shall be in place to maintain safe working practice in accordance with current regulations, and to ensure the safety of other users of the area being measured, 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.

Tests that involve water delivery should not be carried out if there is a risk of water freezing on the pavement.

When carrying out a friction survey at an airport, ensure that all activities are under the control of the airport operators.

6 Essential characteristics

6.1 Principle of measurements

Devices complying with this Technical Specification operate on the principle that the measuring wheel is to give a fixed slip ratio of 15 % between it and the speed of travel along the wetted pavement surface. The wheel slips as it is towed along the wetted pavement surface at a constant speed and the slipping force is measured. A typical device is illustrated in Figure 1.

6.2 Description of GripTester®

The device is a trailer having two drive wheels and a single small test wheel similar to a "go-kart" wheel. It is capable of being manually pushed or being towed behind a vehicle at speeds between 5 km/h and 100 km/h. The test wheel is mounted on a stub axle and is mechanically braked by a fixed gear and chain system with a ratio of 27:32 in relation to the drive wheels so that there is a slip ratio of just over 15 %. The static load on the test wheel is (250 ± 30) N when towed or (260 ± 30) N when used in push mode. During operation, the stub axle becomes elastically deformed by the horizontal drag and vertical load forces acting on the test tyre.

The drive wheel tyres have a patterned tread and carry just over three quarters of the weight of the instrument. The test wheel tyre has a smooth tread. The two drive wheels are mounted on the main axle, which also carries a toothed wheel. A proximity sensor is mounted adjacent to this toothed wheel in such a way that signals from this sensor can be transmitted to a signal processing unit (SPU) for calculation of distance. Two strain gauge bridges on the stub axle continuously measure the horizontal drag and vertical load forces, transmitting these signals to the SPU, which calculates instantaneous LFG. These readings are sent to a data capture device where the LFCG, distance, and speed are computed and stored.

When used for routine testing of a pavement in wet condition, water is deposited in front of the test tyre from a water tank fitted with a control valve. A water nozzle is mounted directly in front of the test wheel delivering a controlled amount of water to the road surface under investigation. In towing mode, water flow rate is further controlled by a pump and may be monitored with a flow meter.

When the device is used in towing mode, the towing vehicle shall comply with the following technical requirements:

— tow bracket (central and/or right and/or left);

— sufficient space for the water tank;

— electricity supply for the water supply system, data acquisition computer and guidance system.

7 Key Characteristics

7.1 General

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

7.2 Test equipment

The test equipment shall include the following features:

— trailer containing a test and drive wheel assembly;

— water supply and flow control mechanism;