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Truck and bus tyres — Method for measuring relative wet grip performance — Loaded new tyres

Pneumatiques pour camions et autobus — Méthode de mesure de l'adhérence relative sur revêtement mouillé — Pneumatiques neufs en charge

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 15222 was prepared by Technical Committee ISO/TC 31, *Tyres, rims and valves*, Subcommittee SC 4, *Truck and bus tyres and rims*.

Truck and bus tyres — Method for measuring relative wet grip performance — Loaded new tyres

1 Scope

This International Standard specifies the method for measuring relative wet grip braking performance index to a reference under loaded conditions for new tyres for use on commercial vehicles on a wet-paved surface.

The methods developed in this International Standard are meant to reduce the variability. The use of a reference tyre is necessary to limit the variability of the testing method procedures.

This International Standard applies to all truck and bus tyres (commercial vehicle tyres).

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 4209-1, *Truck and bus tyres and rims (metric series) — Part 1: Tyres*

EN 13036-1:2010, *Road and airfield surface characteristics — Test methods — Part 1: Measurement of pavement surface macrotexture depth using a volumetric patch technique*

ASTM E303:2008, *Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester*

ASTM E501, *Standard Specification for Standard Rib Tire for Pavement Skid-Resistance Tests*

ASTM E965, *Standard Test Method for Measuring Pavement Macrotexture Depth Using a Volumetric Technique*

ASTM E1136, *Standard Specification for P195/75R14 Radial Standard Reference Test Tire*

ASTM F2870, *Standard Specification for 315/70R22.5 154/150L Radial Truck Standard Reference Test Tire*

ASTM F2871, *Standard Specification for 245/70R19.5 136/134M Radial Truck Standard Reference Test Tire*

ASTM F2872, *Standard Specification for 225/75R16C 116/114S M+S Radial Light Truck Standard Reference Test Tire*

3 Terms and definitions

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

3.1 General terms and definitions

3.1.1
test run
single pass of a loaded tyre over a given test surface

3.1.2
candidate tyre "T" (set)
test tyre (or a test tyre set) that is part of an evaluation programme

3.1.3
reference tyre "R" (set)
standard reference test tyre
special test tyre (or a test tyre set) that is used as a benchmark in an evaluation programme

NOTE These tyres usually have carefully controlled design features to minimize variation.

3.2 Terms and definitions for the vehicle testing method described in Clause 6

3.2.1
control tyre "C" (set)
tyre (set) that is part of an evaluation programme

NOTE It is an intermediate set of tyres which is used when the candidate tyre and the reference tyre cannot be directly compared on the same vehicle.

3.3 Terms and definitions for the trailer or tyre test vehicle testing method described in Clause 7

3.3.1
braking force of a tyre
longitudinal force, expressed in newtons, resulting from braking torque application

3.3.2
braking force coefficient of a tyre
BFC
ratio of braking force to vertical load

3.3.3
peak braking force coefficient of a tyre
μ_{peak}
maximum value of tyre braking force coefficient that occurs prior to wheel lockup as the braking torque is progressively increased

3.3.4
lockup of a wheel
condition of a wheel in which its rotational velocity about the wheel spin axis is zero and it is prevented from rotating in the presence of applied wheel torque

3.3.5
vertical load
normal (Z-direction) reaction of the tyre on the road

3.3.6
trailer or tyre test vehicle
special purpose tyre evaluation vehicle which has instruments to measure the longitudinal force on one tyre during braking

3.3.7
coupling (hitch) height
height when measured perpendicularly from the centre of the articulation point of the trailer towing coupling or hitch to the ground, when the towing vehicle and trailer are coupled together

NOTE The vehicle and trailer shall be standing on level pavement surface in its test mode complete with the appropriate tyre(s) to be used in the particular test.

4 Methods for measuring wet grip

Relative wet grip braking performance for loaded commercial vehicle new tyres travelling straight ahead on a wet, paved surface can be measured by one of the following methods:

— a vehicle method consisting of testing a set of tyres mounted on a standard vehicle;

— a test method using a trailer or a tyre test vehicle equipped with one or several test tyre(s).

5 General test conditions

5.1 Track characteristics

5.1.1 General

The surface shall be a dense asphalt surface with a uniform gradient of not more than 2 % and shall not deviate more than 6 mm when tested with a 3 m straight edge.

The test surface shall have a pavement of uniform age, composition, and wear. The test surface shall be free of loose material or foreign deposits.

The maximum chipping size shall be from 8 mm to 13 mm.

The sand depth measured as specified in EN 13036-1:2010 and ASTM E965, shall be (0,7 ± 0,3) mm.

In order to verify the wetted frictional properties of the surface, one of the methods in 5.1.2 or 5.1.3 shall be used.

5.1.2 British Pendulum Number (BPN) method

The averaged BPN British Pendulum Tester method as specified in ASTM E303 using the Pad as specified in ASTM E501 shall be (50 ± 10) BPN after temperature correction.

BPN shall be corrected by the wetted road surface temperature. Unless temperature correction recommendations are indicated by the British pendulum manufacturer, Equation (1) can be used:

$$\text{Temperature correction} = \left(-0{,}001\ 8\ T^2\right) + 0{,}34T - 6{,}1 \quad (1)$$

where "T" is the wetted road surface temperature in degrees Celsius.

Effects of slider pad wear: the pad should be removed for maximum wear when the wear on the striking edge of the slider reaches 3,2 mm in the plane of the slider or 1,6 mm vertical to it in accordance with ASTM E303:2008, 5.2.2 and Figure 3.

Check the test track testing surface BPN consistency for the measurement of wet grip on a standard vehicle. To decrease the dispersion of test results, the BPN values of the track should not vary over the entire stopping distance. The operation shall be repeated five times at each point of the BPN measurement. Measurements for BPN shall be taken every 10 m on the braking lane and the coefficient of variation of the BPN averages shall not exceed 10 %.

5.1.3 Standard Reference Test Tyre (SRTT) method

The average peak braking coefficient ($\mu_{peak,ave}$) of the ASTM E1136 reference tyre (see Clause 7) shall be (0,7 ± 0,1) at 65 km/h.

For the trailer method, testing is run in such a way that braking occurs within 10 m of where the surface was examined.

The average peak braking coefficient ($\mu_{peak,ave}$) of the ASTM E1136 reference tyre shall be corrected by the wetted road surface temperature according to Equation (2):

$$\text{Temperature correction} = 0{,}003\,5 \times (T - 20) \tag{2}$$

where "T" is the wetted road surface temperature in degrees Celsius.

5.2 Wetting conditions

The surface may be wetted from the track-side or by a wetting system incorporated into the test vehicle or the trailer.

If "external watering" is used, water the test surface at least half an hour prior to testing in order to equalize the surface temperature and water temperature. External watering should be supplied continuously throughout testing.

For the whole testing area, the water depth shall be between 0,5 mm and 2 mm.

5.3 Atmospheric conditions

The wind conditions shall not interfere with wetting of the surface (wind-shields are allowed).

The ambient and the wetted surface temperatures shall be between 5 °C and 35 °C and shall not vary during the test by more than 10 °C.

5.4 Reference tyres

In order to cover the range of the tyre sizes fitting the commercial vehicles, three SRTT sizes shall be used to measure the relative wet index:

— SRTT 315/70R22.5 LI=154/150, ASTM F2870

— SRTT 245/70R19.5 LI=136/134, ASTM F2871

— SRTT 225/75R16C LI=116/114, ASTM F2872

The three SRTT sizes shall be used to measure the relative wet index as shown in Table 1.

Table 1 — Measurement of the relative wet index

SRTT for rim codes > 17 ➔ 2 Families	
FAMILY Rim Code > 17 NARROW $S_{Nominal}$ < 285 mm	**FAMILY Rim Code > 17 WIDE** $S_{Nominal} \geq$ 285 mm
SRTT 245/70R19.5 LI=136/134	**SRTT 315/70R22.5** LI=154/150

SRTT for Rim Codes ≤ 17 ➔ Unique Family
SRTT 225/75 R 16 C LI=116/114

$S_{Nominal}$ = *tyre nominal section width*

6 Measurement of tyre wet grip on a standard vehicle

6.1 Principle

The test method covers a procedure for measuring the deceleration performance of commercial vehicle tyres during braking, using a commercial vehicle having an Antilock Braking System (ABS).

Starting with a defined initial speed, the brakes are applied hard enough on the two axles at the same time to activate the ABS. The average deceleration (AD) is calculated between two defined speeds, with an initial speed of 60 km/h and a final speed of 20 km/h. When the braking system is not operating automatically, a minimum of 600 N pedal effort is required.

6.2 Equipment

6.2.1 Vehicle

The standard equipment is a two axle standard-model commercial vehicle equipped with 4 disc brakes and an ABS. In case tyre fitting is not possible, e.g. multi-purpose tyres (MPT) or free rolling tyres (FRT), a vehicle model with drum-brakes and ABS is allowed.

The permitted modifications are:

— those allowing the number of tyre sizes that can be mounted on the vehicle to be increased;

— those permitting automatic activation of the braking device to be installed.

Any other modification of the braking system is prohibited.

6.2.2 Measuring equipment

Measuring device(s) suitable for measuring speed on wet surface and distance covered between two speeds shall be used.

To measure vehicle speed, a fifth wheel or non-contact precision (including radar, GPS, etc.) speed-measuring system shall be used.

The following tolerances shall be respected:

— for speed measurements: ± 1 % km/h or ± 0,5 km/h, whichever is greater,

— for distance: $\pm 1 \times 10^{-1}$ m.

The measured speed or the difference between the measured speed and the reference speed for the test should be displayed inside the vehicle, so that the driver can adjust the speed of the vehicle.

A data acquisition system can be used for storing the measurements.

6.3 Conditioning of the test track

Condition the pavement by conducting at least ten test runs with tyres not involved in the test programme at an initial speed higher or equal to 65 km/h (which is higher than the initial test speed to guarantee that a sufficient length of track is conditioned).

6.4 Measurement requirements for test speeds

The speed at the start of braking shall be (65 ± 2) km/h.

The average deceleration shall be calculated between 60 km/h and 20 km/h.

6.5 Tyres and rims

6.5.1 Vehicle equipment

The rear axle may be indifferently fitted with 2 or 4 tyres.

For the reference tyre testing, both axles are fitted with reference tyres (a total of 4 or 6 reference tyres depending on the choice mentioned above).

For the candidate tyre testing, 3 fitting configurations are possible:

— configuration “Conf.1”: candidate tyres on front and rear axles (standard configuration that should be used whenever possible);

— configuration “Conf.2”: candidate tyres on front axle and reference tyre or control tyre on rear axle (allowed where fitting the candidate tyre on the rear position is not possible);

— configuration “Conf.3”: candidate tyres on rear axle and reference tyre or control tyre on front axle (permitted where fitting the candidate tyre on the front position is not possible).

6.5.2 Tyre preparation and break-in

Fit the test tyres on rims in accordance with ISO 4209-1 using conventional mounting methods. Ensure proper bead seating by the use of a suitable lubricant. Excessive use of lubricant should be avoided to prevent slipping of the tyre on the wheel rim.

Place the fitted test tyres in a location for a minimum of two hours.

Place the fitted test tyres in a location such that they all have the same ambient temperature prior to testing, and shield them from the sun to avoid excessive heating by solar radiation.

For tyre break-in, perform two braking runs.

6.5.3 Tyre load

The static load on each axle tyre shall lie between 60 % and 100 % of the tested tyre load capacity. Tyre loads on the same axle should not differ by more than 10 %.

The use of fitting as per Conf.2 and Conf.3 shall fulfil the following additional requirements:

— Conf. 2: Front axle load > Rear axle load;

  — The rear axle shall be indifferently fitted with 2 or 4 tyres.

— Conf.3: Rear axle load > Front axle load × 1,8.

6.5.4 Tyre inflation pressure

For a vertical load higher or equal to 75 % of the load capacity of the tyre, the test inflation pressure p_t shall be calculated using Equation (3):

$$p_t = p_r \times \left(\frac{Q_t}{Q_r} \right)^{1,25} \tag{3}$$

where

p_r is inflation pressure marked on the sidewall. If p_r is not marked on the sidewall, refer to the specified pressure in applicable tyre standards manuals corresponding to maximum load capacity for single applications;

Q_t is the static test load of the tyre;

Q_r is the maximum mass associated with the load capacity index of the tyre.

For a vertical load lower than 75 % of the load capacity of the tyre, the test inflation pressure, p_t shall be calculated using Equation (4):

$$p_t = p_r \times (0,75)^{1,25} = (0,7) \times p_r \tag{4}$$

where p_r is inflation pressure marked on the sidewall.

NOTE If p_r is not marked on the sidewall, refer to the specified pressure in applicable tyre standards manuals corresponding to maximum load capacity for single applications.

Check the tyre pressure just prior to testing at ambient temperature.

6.6 Procedure

First, mount the set of reference tyres on the vehicle. Accelerate the vehicle in the starting zone up to (65 ± 2) km/h.

The brakes shall always be activated at the same place on the track, with a longitudinal tolerance of 5 m and transverse tolerance of 0,5 m.

According to the type of transmission, two cases are possible.