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Passenger car, commercial vehicle, truck and bus tyres — Methods for measuring snow grip performance — Loaded new tyres

Pneumatiques pour voitures particulière, véhicules utilitaires, camions et autobus — Méthodes de mesurage de l´adhérence sur neige — Pneumatiques neufs en charge

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 31, *Tyres, rims and valves*.

Passenger car, commercial vehicle, truck and bus tyres — Methods for measuring snow grip performance — Loaded new tyres

1 Scope

This International Standard specifies the method for measuring relative snow grip performance index of a candidate tyre compared to a reference, under loaded conditions for new tyres intended to be used on passenger car, commercial vehicle, truck and bus vehicles on a snow packed surface.

The methods developed here are meant to reduce the variability of the performance measurement. The use of the proper reference tyres is necessary to limit the variability of the testing method procedures.

This International Standard applies to all passenger car, commercial vehicle, truck and bus tyres.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4000-1, *Passenger car tyres and rims (metric series) — Part 1: Tyres*

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

ASTM F1805, *Standard Test Method for Single Wheel Driving Traction in a Straight Line on Snow- and Ice-Covered Surfaces*

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
passenger car tyre
tyres conforming to ISO 4000-1

3.2
commercial vehicle tyre
tyres conforming to ISO 4209-1 and identified by a load index in single configuration lower or equal to 121 and a speed symbol higher or equal to “N”

3.3
truck and bus tyre
tyres conforming to ISO 4209-1 and identified by

a) a load index in single configuration higher or equal to 122, or

b) a load index in single configuration lower or equal to 121 and a speed symbol lower or equal to “M”

3.4
test run
single pass of a loaded tyre over a given test surface

3.5
tyre set
group of two or four same tyres

3.6
candidate tyre
T
test *tyre set* (3.5) that is part of an evaluation program

3.7
reference tyre
R
special test *tyre set* (3.5), also known as a Standard Reference Test Tyre (SRTT), that is used as a benchmark in an evaluation program

Note 1 to entry: In order to minimize their variation, these tyres have carefully controlled design features and for this reason, they are produced, controlled and stored in accordance with the following ASTM (ASTM International) standards:

— ASTM E1136, SRTT P195/75R14;

— ASTM F2870, SRTT 315/70 R 22.5 - 154/150 L;

— ASTM F2871, SRTT 245/70 R 19.5 - 136/134 M;

— ASTM F2872, SRTT 225/75 R 16 C - 116/114 S.

3.8
control tyre
C
tyre set (3.5) that is part of an evaluation program

Note 1 to entry: 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.

3.9
braking test
series of a specified number of ABS-braking *test runs* (3.4) of the same tyre repeated within a short time frame

3.10
mean fully developed deceleration
mfdd
average deceleration calculated on the basis of the measured distance recorded when decelerating a vehicle between two specified speeds

3.11
acceleration test
series of a specified number of traction controlled acceleration *test runs* (3.4) of the same tyre repeated within a short time frame

3.12
acceleration force of a tyre
longitudinal force resulting from acceleration torque application

Note 1 to entry: It is expressed in newtons, N.

3.13
acceleration force coefficient of a tyre
AFC
ratio of acceleration force to vertical load

3.14
average acceleration
AA
average acceleration calculated on the basis of the measured distance recorded when accelerating a vehicle between two specified speeds

3.15
Snow Grip Index
SG
ratio between the performance of the candidate tyre to the performance of the proper standard reference test tyre

3.16
loaded radius
distance from wheel axis of rotation to supporting surface (ground) at a given load and stated inflation pressure

4 Test methods

4.1 Braking on snow method for passenger car tyres

4.1.1 General

Snow performance is based on a test method by which the mean fully developed deceleration in a braking test, of a candidate tyre is compared to that of a standard reference test tyre.

The relative performance shall be indicated by a Snow Grip Index (SG).

4.1.2 Test course

The braking tests shall be done on a flat test surface of sufficient length and width, with a maximum 2 % gradient, covered with packed snow.

The snow surface shall be composed of a hard packed snow base at least 3 cm thick and a surface layer of medium packed and prepared snow about 2 cm thick.

The air temperature, measured about one meter above the ground, shall be between −2 °C and −15 °C; the snow temperature, measured at a depth of about one centimetre, shall be between −4 °C and −15 °C.

It is recommended to avoid direct sunlight, large variations of sunlight or humidity, as well as wind.

The snow compaction index measured according to ASTM F1805 by using a CTI penetrometer shall be between 75 and 85.

The candidate tyre should be tested in the same slope and snow compaction condition as the reference tyre to avoid any advantage or disadvantage for the candidate tyre.

4.1.3 Vehicle

The test shall be conducted with a standard production vehicle in good running order and equipped with ABS.

The vehicle used shall be such that the loads on each wheel are appropriate to the tyres being tested. Several different tyre set can be tested on the same vehicle.

4.1.4 Standard reference test tyre

The proper reference tyre to be used to evaluate passenger car tyre snow grip performance is ASTM E1136, SRTT P195/75R14.

4.1.5 Tyres preparation

Fit the test tyres on rims as per ISO 4000-1 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.

The tyres should be prepared prior to testing to remove spew, compound nodules or flashes resulting from the moulding process. The tyre surface in contact with snow shall be clean before performing a test.

Tyres shall be conditioned at the outdoor ambient temperature at least two hours before their mounting for tests. Tyre pressures shall then be adjusted to the values specified for the test.

In case a vehicle cannot accommodate both the reference and candidate tyres, a third tyre ("control" tyre) may be used as an intermediate. First, test the control tyre against the reference on a suitable vehicle, then test the candidate tyre against the control on the other vehicle.

4.1.6 Tyre load

The vehicle load shall be such that the resulting loads on the tyres are between 60 % and 90 % of the load corresponding to the tyre load index.

4.1.7 Tyre inflation pressure

The cold inflation pressure shall be 240 kPa.

4.1.8 Instrumentation

The vehicle shall be fitted with calibrated sensors suitable for measurements in winter conditions. There shall be a data acquisition system to store measurements.

The accuracy of measurement sensors and systems shall be such that the relative uncertainty of the measured or computed mean fully developed decelerations is less than 1 %.

4.1.9 Testing order and sequences

For every candidate tyre and the standard reference tyre, ABS-braking test runs shall be repeated a minimum of six times.

The zones where ABS-braking is fully applied shall not overlap.

When a new set of tyres is tested, the runs are performed after shifting aside the vehicle trajectory in order not to brake on the tracks of the previous tyre.

When it is no longer possible not to overlap full ABS-braking zones, the test course shall be re-groomed.

Order of testing:

— If only one candidate tyre has to be evaluated, the order of testing shall be as follows:

R1 - T - R2

where

R1 is the initial test of the SRTT;

R2 is the repeat test of the SRTT;

T is the test of the candidate tyre to be evaluated.

— A maximum of two candidate tyres (T1 and T2) may be tested before repeating the SRTT test, for example:

R1 - T1 - T2 - R2

Required sequence is as follows:

— six SRTT repetitions, then shift aside to test next tyre on fresh surface;

— six Candidate one repetitions, then shift aside;

— six Candidate two repetitions, then shift aside;

— six SRTT repetitions, then shift aside.

The comparative tests of SRTT and candidate tyres shall be repeated on two different days.

4.1.10 Test procedure

Drive the vehicle at a speed not lower than 28 km/h.

When the measuring zone has been reached, the vehicle gear is set into neutral, the brake pedal is depressed sharply by a constant force sufficient to cause operation of the ABS on all wheels of the vehicle and to result in stable deceleration of the vehicle and held down until the speed is lower than 8 km/h.

The mean fully developed deceleration between 25 km/h and 10 km/h shall be computed from distance, speed, or deceleration measurements.

The mean fully developed deceleration, mfdd, is given by Formula (1):

$$\text{mfdd} = \left| \frac{Sf^2 - Si^2}{2D} \right| \quad (1)$$

where

D is the distance covered between Si and Sf, in m;

Si is the initial speed, in m/s;

Sf is the final speed, in m/s.

4.1.11 Data evaluation and presentation of results

4.1.11.1 Coefficient of variation

For each tyre and each braking test, the mean and the standard deviation of the mfdd shall be computed and reported.

The coefficient of variation, CV, of a tyre braking test shall be computed as given in Formula (2):

$$\mathrm{CV}\left(\mathrm{tyre}\right) = \frac{\mathrm{Std.dev}\left(\mathrm{tyre}\right)}{\mathrm{Mean}\left(\mathrm{tyre}\right)} \tag{2}$$

4.1.11.2 SRTT weighted variance

Weighted averages (wa) of two successive tests of the SRTT shall be computed taking into account the number of candidate tyres in between.

If R1 is the mean mfdd in the first test of the reference tyre and R2 is the mean mfdd in the second test of the reference tyre, the following operations are performed, according to Table 1.

Table 1 — Calculation of weighted averages

If the number of sets of candidate tyres between two successive runs of the reference tyre is:		and the set of candidate tyres to be qualified is:	then "wa" is calculated by applying the following:
1	R1 -T1 – R2	T1	wa = 1/2 (R1 + R2)
2	R1 -T1 – T2 – R2	T1	wa = 2/3 R1 + 1/3 R2
		T2	wa = 1/3 R1 + 2/3 R2

"Ta" (a = 1, 2) is the average of the mean mfdd values for a test of a candidate tyre.

4.1.11.3 Snow Grip Index

The Snow Grip Index in percent of a candidate tyre shall be computed as given in Formula (3):

$$\mathrm{Snow\ Grip\ Index}\left(\mathrm{candidate}\right) = \frac{\mathrm{Mean}\left(\mathrm{candidate}\right)}{\mathrm{wa}\left(\mathrm{SRTT}\right)} \tag{3}$$

4.1.11.4 Statistical validation

The sets of repeats of measured or computed mfdd for each tyre should be examined for normality, drift, eventual outliers.

The consistency of the means and standard deviations of successive braking tests of SRTT should be examined.

The means of two successive SRTT braking tests shall not differ by more than 5 %.

The coefficient of variation of any braking test shall not be higher than 6 %.

If those conditions are not met, tests shall be performed again after re-grooming the test course.

The SRTT tyres shall be discarded if there is irregular wear or damage or when the performance appears to have been deteriorated.

4.1.12 Snow grip performance comparison between a candidate tyre and a reference tyre using a control tyre

4.1.12.1 General

In the case where the candidate tyres cannot be fitted to the same vehicle as the SRTT, for example, due to tyre size, inability to achieve required loading and so on, comparison shall be made using intermediate tyres, hereinafter referred to as "control tyres", and two different vehicles.

