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## Passenger car tyres — Method for measuring ice grip performance — Loaded new tyres

*Pneumatiques pour voitures particulières — Méthode de mesurage de  
l'adhérence sur glace — 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.

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](http://www.iso.org/directives)).

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This document was prepared by Technical Committee ISO/TC 31, *Tyres, rims and valves*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

The method for measuring ice grip performance described in this document is meant to reduce the variability of the performance measurement. The use of the proper reference tyres limits the variability of the testing method procedures.

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# Passenger car tyres — Method for measuring ice grip performance — Loaded new tyres

## 1 Scope

This document specifies the method for measuring the relative ice grip performance index of a candidate tyre compared with a reference tyre under loaded conditions for new tyres intended to be used for passenger cars on surfaces made of ice.

This document applies to all passenger car tyres, except for T-type temporary-spare tyres.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 4000-1, *Passenger car tyres and rims (metric series) — Part 1: Tyres*

ISO 4223-1, *Definitions of some terms used in the tyre industry — Part 1: Pneumatic tyres*

ASTM F2493, *Standard Specification for P225/60R16 97S Radial Standard Reference Test Tire*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4000-1 and ISO 4223-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

### 3.1

#### test tyre

candidate tyre (3.3), reference tyre (3.4) or control tyre (3.5)

### 3.2

#### test run

single pass of a loaded tyre over a given test surface

### 3.3

#### candidate tyre

##### T

test tyre (3.1) that is part of an evaluation programme

### 3.4

#### reference tyre

##### SRTT

##### R

special test tyre (3.1) that is used as a benchmark in an evaluation programme

Note 1 to entry: The reference tyre is defined in ASTM F2493.

Note 2 to entry: Reference tyres have carefully controlled design features to minimize variation and shall be stored in accordance with ASTM F2493.

Note 3 to entry: The reference tyre shall not be older than 30 months starting from the production week.

### 3.5 control tyre

C intermediate *test tyre* (3.1) that is used when the *candidate tyre* (3.3) and the *reference tyre* (3.4) cannot be directly compared on the same vehicle

Note 1 to entry: The control tyre shall pass the ice grip index threshold defined in 4.4.7.5.

### 3.6 braking test

series of a specified number of *test runs* (3.2) of the same *test tyre* (3.1) repeated within a short time frame

### 3.7 braking test cycle

series of *braking tests* (3.6) that consist of an initial braking test of the *reference tyre* (3.4) or the *control tyre* (3.5), of up to two braking tests of *candidate tyres* (3.3), control tyres or both, and a final braking test of the same reference tyre or control tyre

### 3.8 non-consecutive braking test cycle

*braking test cycles* (3.7) performed at least after minimum refreshing (or new preparation) of the ice surface, or on a different test lane, or on a different day

### 3.9 mean fully developed deceleration

$d_m$  average deceleration calculated on the basis of the measured distance recorded when decelerating a vehicle between two specified speeds

### 3.10 ice grip index

$G_I$  ratio between the *mean fully developed deceleration* (3.9) of a *test tyre* (3.1) and that of the *reference tyre* (3.4) or that of the *control tyre* (3.5)

### 3.11 reference load

$Q_{ref}$  theoretical load capacity of a tyre at the test inflation pressure

Note 1 to entry: It is expressed in kilograms.

Note 2 to entry: It may exceed the maximum load-carrying capacity of the test tyre as indicated by its load index

### 3.12 load-on-tyre rate

$R_{LoT}$  actual tyre load on test vehicle divided by *reference load* (3.11)

Note 1 to entry: It is expressed as a percentage of the reference load.

### 3.13 tyre set

set of four tyres



## 4 Test methods

### 4.1 Braking on ice method for passenger car tyres

#### 4.1.1 General

The ice performance is determined by a test method in which the mean fully developed deceleration of a candidate tyre in an ABS braking test on a flat surface made of ice is compared with that of a reference tyre.

For determination of the ice performance, braking tests of a candidate tyre shall be performed in three non-consecutive braking test cycles.

The relative performance shall be indicated by an ice grip index ( $G_I$ ).

#### 4.1.2 Test course

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

The test course surface shall be flat, smooth, polished ice and watered at least 1 h before testing. The water used to make the ice shall be clean and free of any solid inclusions. Before starting the test the braking line should be conditioned by conducting a braking test with tyres not involved in the test programme until the friction level stabilizes. When testing studless tyres, the exact same test line shall be used for all braking test repetitions. When testing studded tyres, the braking lines shall not overlap. The reference tyre shall be tested on its own braking line and the studded tyres next to it on their own individual braking lines. The line for the reference tyre shall be kept clean from ice and snow dust. The studded tyres shall be driven on new clean braking lines.

The surface grip level shall be controlled by measurements with the reference tyre. The average mean fully developed deceleration of the reference tyre shall be not less than 0,9 m/s<sup>2</sup> and not greater than 1,6 m/s<sup>2</sup> in each braking test.

The air temperature, measured about 1 m above the ground, shall be between -15 °C and +4 °C; the ice temperature, measured on the surface of the conditioned line, shall be between -15 °C and -5 °C. Both air and ice temperatures shall be reported for each tested tyre.

Tests cannot be conducted during snowfall or rainfall or any atmospheric precipitation. It is recommended that direct sunlight, large variations of sunlight or humidity, and wind are avoided.

Indoor and outdoor facilities for ice tracks are acceptable as long as the above requirements are met.

### 4.2 Vehicle

The test shall be conducted with a commercial passenger car equipped with an ABS system in mechanical condition according to car manufacturer recommendations. Permitted modifications are as follows: 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. Increasing the load on the tyres by adding weight to the vehicle is permitted. Rim adapters or “spacers” for mounting wheels on the vehicle shall not exceed 60 mm.

### 4.3 Standard reference test tyre

For the evaluation of the ice grip performance of passenger car tyres, the reference tyre SRTT P225/60R16 97S as defined in ASTM F2493 shall be used.

## 4.4 Tyre preparation

### 4.4.1 General

Fit each test tyre on an approved rim in accordance with ISO 4000-1 using conventional mounting methods. The rim width code shall not differ more than 0,5 from the measuring rim. If a commercialized rim is not available for the test vehicle, it will be acceptable to use a rim whose rim width code differs by 1,0 from the measuring rim width code. Ensure proper bead seating with the use of a suitable lubricant. Excessive use of lubricant should be avoided to prevent slipping of the tyre on the wheel rim.

The studless tyres should be broken in prior to testing (at least 100 km on dry roads or with an equivalent method) to ensure stable performance and to remove spew, compound nodules or flash resulting from the moulding process. Studded tyres should be broken in prior to testing (at least 100 km on roads or with an equivalent method) to ensure correct fit of the studs and stable performance. In all cases, tyre designed tread depth and designed tread block or rib integrity shall not change significantly with breaking in, which means the pace and severity of the breaking in run needs to be carefully controlled to avoid such changes. When testing studded tyres, the stud protrusion shall be measured before each braking test according to the procedure described in [4.4.2](#).

It is acceptable to recondition a test tyre before the braking test. The reconditioning may be performed to reach the stabilized performance level. It can be done, for example, by driving 5 km to 10 km on rough road surfaces or equivalent.

The tyre surface in contact with ice shall be cleaned before performing the test, removing snow and dirt.

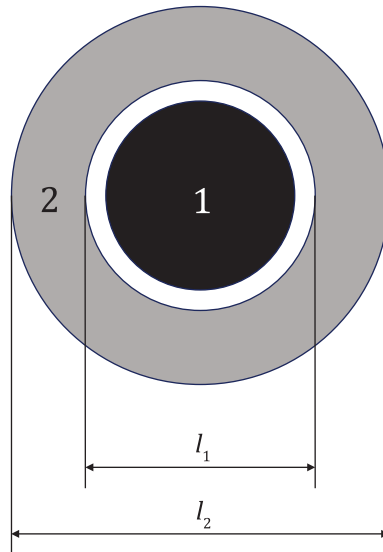
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Tyre and wheel assemblies shall be conditioned at the ambient temperature (outdoor or indoor, depending on the test facility) at least two hours before they are fitted on the vehicle for tests. Tyre pressures shall then be adjusted to the values specified for the test.

If a vehicle cannot accommodate both the reference and candidate tyres, a third (control) tyre may be used as an intermediate. First, test the control tyre versus the reference on a suitable vehicle, then test the candidate tyre versus the control tyre on the selected vehicle.

### 4.4.2 Stud protrusion measurement procedure

The stud protrusion measurement shall be done under the test inflation pressure conditions. [Figure 1](#) illustrates the stud protrusion device. It shall be equipped with a support plate (2) of 20 mm diameter and 12 mm diameter hole for the measurement head (1). The measurement head shall be pressed perpendicular to the tread surface with a force of 15 N to 20 N to trigger the measurement. The stud protrusion shall be measured from every test tyre, from 20 consecutive studs over the whole width of the tread and in circumferential direction, and at the same stud positions each time. Define in the test report whether tested with or without studs, and accordingly the stud type, name or main dimensions.



**Key**

- 1 measurement head
- 2 support plate
- $l_1$  12 mm
- $l_2$  20 mm

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**Figure 1 — Stud protrusion device sketch**  
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**4.4.3 Tyre load and inflation pressure** ISO/FDIS 19447

Tyre load and inflation pressure shall be adjusted according to [Table 1](#) (depending on a direct comparison of the candidate and reference tyres on the same vehicle, or an indirect comparison by using a control tyre and another vehicle).

**Table 1 — Tyre load and inflation pressure**

	Reference tyre	Control tyre	Candidate tyre
<b>Direct comparison</b>	Inflation pressure: $230 \text{ kPa} \leq p_{\text{test}} \leq 260 \text{ kPa}$  Load-on-tyre rate: $65 \% \leq R_{\text{LoT}}(\text{R}) \leq 75 \%$		Inflation pressure: $190 \text{ kPa} \leq p_{\text{test}} \leq 270 \text{ kPa}$  Load-on-tyre rate: $R_{\text{LoT}}(\text{R}) - 15 \% \leq R_{\text{LoT}}(\text{T}) \leq R_{\text{LoT}}(\text{R}) + 15 \%$
Load-on-tyre rate $R_{\text{LoT}}$ is given by:  $R_{\text{LoT}} = 100 \% \times \frac{Q_{\text{tyre}}}{Q_{\text{ref}}}$ where $Q_{\text{tyre}}$ is the actual tyre load on the test vehicle; $Q_{\text{ref}}$ is the reference load at the test inflation pressure as determined according to <a href="#">Formula (1)</a> .			