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# Tyres — Coast-by methods for measurement of tyre-to-road sound emission

*Pneumatiques — Méthodes en roue libre pour le mesurage de l'émission acoustique issue du contact pneumatique/chaussée*



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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.



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



This second edition cancels and replaces the first edition (ISO 13325:2003), which has been technically revised. The main changes compared to the previous edition are as follows:

— Test site description has been improved.

— Preparation and adjustment depending of the tyre type has been improved.

— Trailer method has been withdrawn.

— Clarification of the formula for the determination of test result has been added.

— Parameters and calculation method have been aligned with UN regulation 117.

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.

# Tyres — Coast-by methods for measurement of tyre-to-road sound emission

## 1 Scope

This document specifies methods for measuring tyre-to-road sound emissions from tyres fitted on a motor vehicle under coast-by conditions, i.e. when the vehicle is in free-rolling, non-powered operation. This is typically achieved by putting the transmission in the neutral or equivalent position and switching off the engine as well as all auxiliary systems not necessary for safe driving.

This document is applicable to passenger cars and commercial vehicles as defined in ISO 3833. It is not intended to be used to determine the sound contribution of tyres of vehicles running in powered condition nor for the determination of traffic sound nuisance at a given location.

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

ISO 10844, *Acoustics — Specification of test tracks for measuring noise emitted by road vehicles and their tyres*



IEC 60942, *Electroacoustics — Sound calibrators*

IEC 61672-1, *Electroacoustic — Sound level meters — Part 1: Specifications*

IEC 61672-3, *Electroacoustic — Sound level meters — Part 3: Periodic tests*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4223-1 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/

## 4 Symbols and abbreviated terms

### 4.1 LI

The load index (LI) is a numerical code associated with the maximum load a tyre can carry at the speed indicated by its speed symbol under the service conditions specified by the tyre manufacturer. In cases where the LI consists of two numbers, reference shall be made to the first number. For tyres where the load index is not available, reference shall be made to the maximum load marked on the tyre sidewall.

### 4.2 Classes of tyre

C1 Passenger car tyres.

C2 Commercial vehicle tyres with LI in single formation lower than or equal to 121 and speed category symbol higher than or equal to “N”.

C3 Commercial vehicle tyres with an LI in single formation lower than or equal to 121 and speed category symbol “M” and below, or such tyres with an LI in single formation 122 and higher.

## 5 General

This document is based on a test using a test motor vehicle in motion. Measurements shall relate to tyres in coast-by conditions.

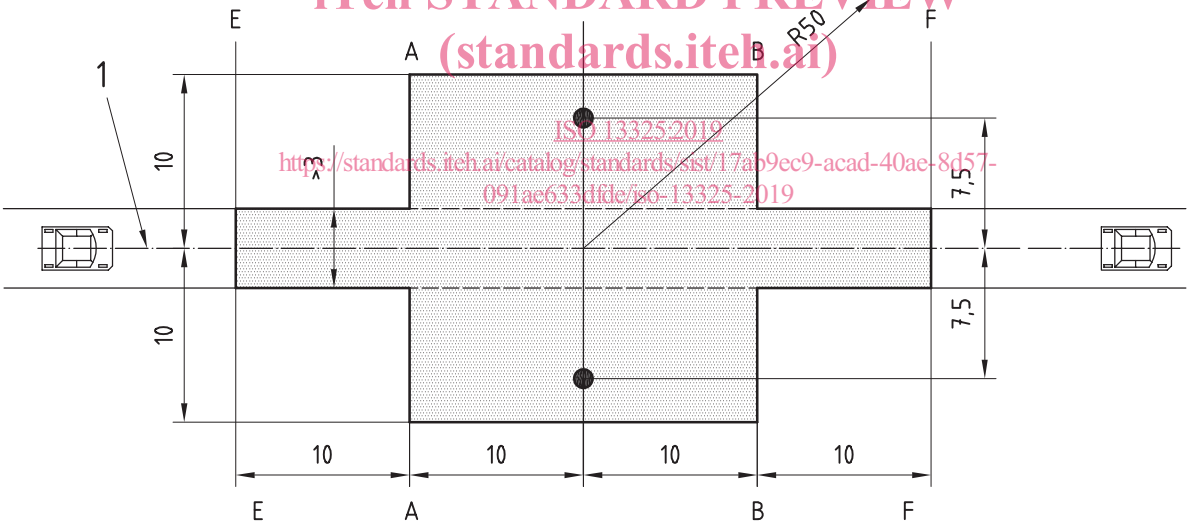
The results obtained give an objective measure of the sound emitted under the prescribed conditions of the test.

## 6 Test site

The test surface, including voids, shall be dry and clean for all measurements. The test site, the test area and the test surface shall meet the requirements of ISO 10844. See Figure 1.



Dimensions in metres




**Key**

| | |
|---|---|
| 1 | centreline of travel |
| ● | microphones location |
| A–A, B–B, E–E and F–F | reference lines |

NOTE Travel of the vehicle (see Clause 9) is as appropriate.

**Figure 1 — Test area and surface**

The test area and surface shall be in accordance with ISO 10844, as shown in Figure 1. Additionally, there shall be no large acoustically reflective objects within the radius shown in Figure 1.

# 7 Instrumentation

## 7.1 Instrumentation for acoustical measurements

The sound pressure level meter or equivalent measuring system, including the windscreen recommended by the microphone manufacturer, shall meet the minimum requirements of a Class 1 instrument in accordance with IEC 61672-1 and/or IEC 61672-3. Alternatively, IEC 60651[1)] may be used.

The measurements shall be made using the frequency weighting, A, and the time weighting, F.

The calibration of the sound pressure level meter shall be checked and adjusted in accordance with the manufacturer's instructions or with a standard sound source (e.g. pistonphone) at the beginning of the measurements and rechecked and recorded at the end of them. The calibration device shall meet the requirements of Class 1 in accordance with IEC 60942.

If the sound pressure level meter indications obtained from these calibrations differ by more than 0,5 dB during a series of measurements, the test shall be considered invalid. Any deviation shall be recorded in the test report.

At intervals of not more than two years, the sound pressure level meter shall be verified with the requirements of IEC 61672-1 and/or IEC 61672-3. Alternatively, IEC 60651 may be used[5]. At intervals of not more than one year, the calibration device shall be verified with the requirements of IEC 60942.

Windscreens shall be used in accordance with the microphone manufacturer's recommendations.

When no general statement or conclusion can be made about conformance of the sound level meter model to the full specifications of IEC 61672-1, the apparatus used for measuring the sound pressure level shall be a sound level meter or equivalent measurement system meeting the compliance requirements of Class 1 instruments as described in IEC 61672-3.



NOTE The tests of IEC 61672-3 cover only a limited subset of the specifications in IEC 61672-1 for which the scope is large (temperature range, frequency requirements up to 20 kHz, etc.). It is economically not feasible to verify the whole IEC 61672-1 requirements on each item of a computerized data acquisition systems model.



Apparently, until today, no computerized data acquisition system available complies with the full specifications of IEC 61672-1. It is beyond the possibilities of the users of these systems to prove conformity of the instrumentation required by the test code.

## 7.2 Microphones

Two microphones shall be used in the test, one on each side of the vehicle. In the vicinity of the microphones, there shall be no obstacle that could influence the acoustical field and no person shall remain between the microphones and the sound source. Any observer or observers shall be positioned so as not to influence the sound reading, especially in the testing area.

The distance from the microphone positions to the centreline of travel on the test track shall be (7,5 ± 0,05) m. Each microphone shall be located (1,2 ± 0,02) m above the test area surface and shall be oriented as recommended by the manufacturer of the sound pressure level meter for field conditions for a test vehicle passing along the centreline of travel as shown in Figure 1.

## 7.3 Temperature measurement

### 7.3.1 General

For air as well as test surface temperature, the measuring instrument shall have an overall accuracy of at least ±1 °C. Meters utilizing the infrared technique shall not be used for air temperature measurements.

1) Withdrawn.

Continuous registration via an analog output may be employed. If such an option is not available, single values are to be measured.

Measurements of air as well as test surface temperatures are mandatory and shall be made in accordance with the instrument manufacturer's instructions.

Temperature measurements shall correspond reasonably over time with sound measurements. Alternatively, the average of the temperature at the beginning and the end of the set of tests may be used.

#### 7.3.2 Air temperature

Position the temperature sensor in an unobstructed location close to the microphone, such that it is exposed to the airflow and protected from direct solar radiation. The latter may be achieved by any shading screen or similar device. The sensor should be positioned 1,2 m ± 0,1 m above the test surface level, to minimize the influence of the test surface thermal radiation at low airflows.

#### 7.3.3 Test surface temperature

Position the temperature sensor in a location where the temperature is representative of the temperature in the wheel tracks, without interfering with the sound measurement.

If an instrument with a contact temperature sensor is used, apply heat-conductive paste between the surface and the sensor to ensure adequate thermal contact.

If a radiation thermometer (pyrometer) is used, the height should be chosen to ensure that a measuring spot with a diameter of ≥0,1 m is covered.



The test surface shall not be artificially cooled during or prior to testing.

### 7.4 Wind measurement



The device shall be capable of measuring wind speed to within ±1 m/s. Wind measurements shall be taken at microphone height. A suitable windscreen in accordance with 7.3 is recommended at any time and shall be used when the wind speed is above 2 m/s. The wind direction with reference to the driving direction shall be recorded.

### 7.5 Speed measurement

The speed measuring device shall be capable of measuring test motor vehicle speed to within a tolerance of ±1 km/h.

## 8 Meteorological conditions and background sound

### 8.1 Meteorological conditions

Measurements shall not be made in adverse weather conditions and shall not be affected by gusts of wind. Testing shall not be performed if the wind speed at the microphone height exceeds 5 m/s. Measurements shall be performed only if the air temperature is in the range from 5 °C to 40 °C and the road surface temperature in the range from 5 °C to 50 °C.

### 8.2 Temperature correction

Temperature correction shall be applied only for C1 and C2 tyres. Each measured sound pressure level, $L_m$, shall be corrected using the following formula:

$$L = L_m + K\Delta T$$

where

$L$ is the corrected sound pressure level;

$K$ is the coefficient which

— for C1 tyres is equal to −0,03 dB (A)/°C when the measured test surface temperature is >20 °C and −0,06 dB (A)/°C when the measured test surface temperature is less than 20 °C; and

— for C2 tyres, is equal to −0,02 dB (A)/°C;

$\Delta T$ is the difference between the reference surface temperature, 20 °C, and the surface temperature, $T_s$, at the time of the sound recording,

$\Delta T = (20 - T_s)$ °C.

If change in the measured test surface temperature does not exceed 5 °C within all measurements necessary for the determination of the sound level of one set of tyres, the temperature correction may be made only on the final reported tyre rolling sound level as indicated above, utilizing the arithmetic mean value of the measured temperatures. Otherwise, each measured sound level $L_m$ shall be corrected, utilizing the temperature at the time of the sound recording.

There is no temperature correction for C3 tyres.

### 8.3 Background sound pressure level



The background sound pressure level (including any wind noise) shall be at least 10 dB (A) less than the measured tyre-road sound emission.



A suitable windscreen may be fitted to the microphone provided that account is taken of its effect on the sensitivity and directional characteristics of the microphone.



## 9 Preparation and adjustments with respect to tyres

Test tyres shall be mounted on any rim approved by the tyre manufacturer. The rim width shall be recorded. Tyres with special fitment requirements, such as asymmetric or directional design, shall also be mounted in accordance with these requirements.

Before testing, tyres shall be conditioned (broken-in). Tyre break-in shall be equivalent to about 100 km of normal on-road operation. Tyres with special fitment requirements shall be broken-in in accordance with these requirements. The tyres fitted to the test vehicle shall rotate in the same direction as when they were broken-in.

Apart from the tread wear caused by the break-in procedure, the tyres shall have full tread depth.

Test tyres shall be warmed-up immediately prior to testing for at least 10 min in the range of the test speed, with only moderate lateral and longitudinal acceleration, in order to avoid any tyre surface tread wear effect.

In the case of tyres with a load capacity index in excess of 121 and without any dual fitting indication, two of these tyres of the same type and range shall be fitted to the rear axle of the test vehicle; the front axle shall be fitted with tyres of size suitable for the axle load and planed down to the minimum depth or equivalent quiet tyres in order to minimize the influence of tyre/road contact noise while maintaining a sufficient level of safety.