
**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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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.

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.

ISO 13325 was prepared by Technical Committee ISO/TC 31, *Tyres, rims and valves*.

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

1 Scope

This International Standard specifies methods for measuring tyre-to-road sound emissions from tyres fitted on a motor vehicle or towed trailer under coast-by conditions — i.e. when the vehicle or trailer is in free-rolling, non-powered operation, with transmission in the neutral position and the engine as well as all auxiliary systems not necessary for safe driving switched off. Whereas the results of the vehicle method could be higher than for the tyres alone, the trailer method can be expected to give a good indication of the sound emissions produced by the tyres alone.

This International Standard 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

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

ISO 10844, *Acoustics — Specification of test tracks for the purpose of measuring noise emitted by road vehicles*

IEC 60651:2001, *Sound pressure level meters*

IEC 60942:1997, *Electroacoustics — Sound calibrators*

3 Terms and definitions, symbols and abbreviated terms

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

3.1 Classes of tyre

- C1 Passenger car tyres
- C2 Commercial vehicle tyres with LI in single formation lower or equal to 121 and speed category symbol higher or equal to “N”.
- C3 Commercial vehicle tyres with a LI in single formation lower or equal to 121 and speed category symbol “M” and below, or such tyres with a LI in single formation 122 and higher.

3.2 LI (load index)

The 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 General

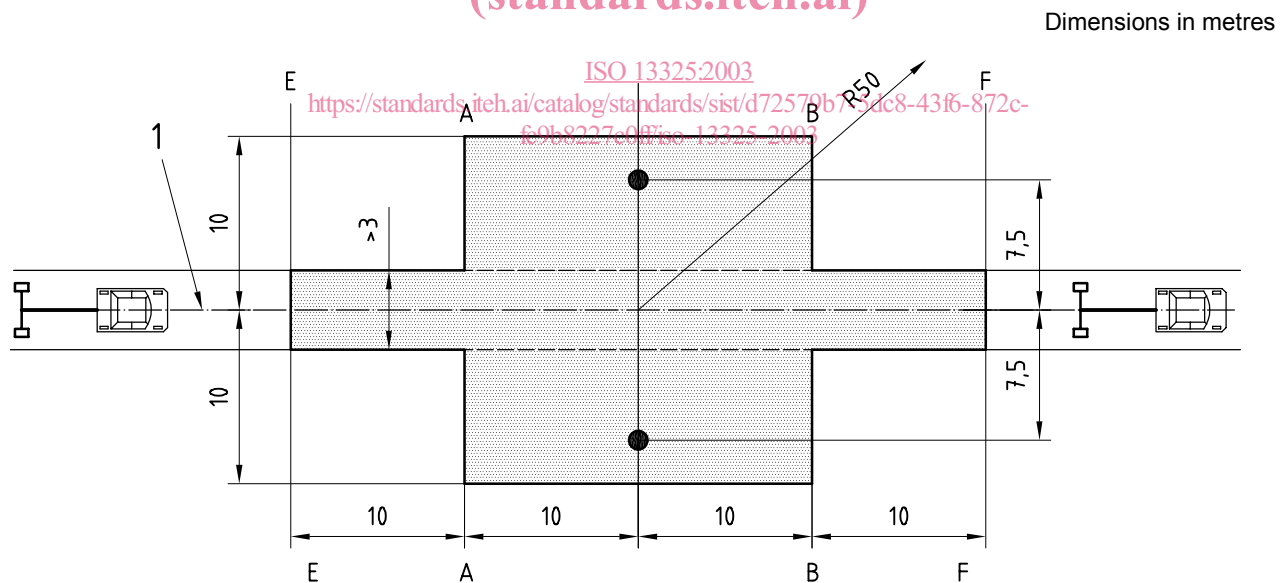
This International Standard is based on a test using a test motor vehicle (see Annex A) or towed trailer (see Annex B) in motion. Measurements shall relate to tyres in coast-by conditions.

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

5 Test site

The test site shall consist of a substantially flat and level area. Conditions of a free acoustical field between the sound source and the microphone shall be attained to within 1 dB. These conditions shall be deemed to be met if there are no large sound reflecting objects, such as fences, barriers, bridges or buildings, within 50 m of the centre of the test area.

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



Key

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

NOTE Travel of the vehicle (see Annex A) or trailer (see Annex B) is as appropriate.

Figure 1 — Test area and surface

6 Instrumentation

6.1 Instrumentation for acoustical measurements

The sound pressure level meter or equivalent measuring system shall at least meet the requirements of a Type 1 instrument in accordance with IEC 60651:2001.

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 60942:1997.

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 one year, the sound pressure level meter and the calibration device shall be verified with the requirements of IEC 60651 and IEC 60942.

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

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.

6.2 Microphones

Two microphones shall be used in the test, one on each side of the vehicle/trailer. 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.

The distance from the microphone positions to the centreline of travel on the test track shall be $(7,5 \pm 0,05)$ m. Each microphone shall be located $(1,2 \pm 0,02)$ 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.

6.3 Temperature measurement

6.3.1 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.

The type of sensor shall be reported.

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. The results are the readings rounded to the nearest integer in degrees Celsius.

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, in both vehicle and trailer methods.

6.3.2 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 1,0 m to 1,5 m above the test surface level, to minimize the influence of the test surface thermal radiation at low airflows.

6.3.3 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 $\geq 0,1$ m is covered.

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

6.4 Wind measurement

The device shall be capable of measuring wind speed to within ± 1 m/s. Wind measurements shall be taken at microphone height, between Lines A–A and B–B and not more than 20 m from the centreline of travel (see Figure 1). The wind direction with reference to the driving direction shall be recorded.

6.5 Speed measurement

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

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7 Meteorological conditions and background sound

7.1 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 not be made if either the air or test surface temperatures are below 5 °C or the air temperature is above 40 °C.

7.2 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 that

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

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

ΔT is the difference between the reference surface temperature, 20 °C, and the surface temperature, t , at the time of the sound recording,

$$\Delta T = (20 - t) \text{ °C.}$$

7.3 Background sound pressure level

The background sound pressure level (including any wind noise) shall be at least 10 dB 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.

8 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.

The tyre/rim assembly shall be balanced. 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.

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

C1 and C2 test tyres shall be warmed-up immediately prior to testing in conditions equivalent to 10 min at 100 km/h of normal driving.

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Annex A (normative)

Vehicle method

A.1 General

A.1.1 Test vehicle

The test motor vehicle shall have two axles with two test tyres on each axle. It shall be loaded to obtain tyre loads in accordance with A.1.4.

A.1.2 Wheel base

The wheelbase between two axles fitted with test tyres shall be

- a) $\leq 3,5$ m for C1 tyres, and
- b) $\leq 5,0$ m for C2 and C3 tyres.

A.1.3 Other measures to minimize vehicle influence on measurements

In order to ensure that tyre sound is not significantly affected by the test vehicle design, the following requirements and recommendations are given.

a) Requirements

- 1) Spray suppression flaps or other extra devices to suppress spray shall not be fitted.
- 2) The addition or retention of elements in the immediate vicinity of the rims and tyres, which may screen the emitted sound, is not permitted.
- 3) Wheel alignment (toe-in, camber and caster) shall be checked on the unladen vehicle and found to be in full accordance with the vehicle manufacturer's recommendations.
- 4) Additional sound-absorbing material shall not be mounted in the wheel housings or on the underbody.
- 5) The windows and sliding roof of the vehicle shall be closed during testing.

b) Recommendations for avoiding parasitic sound

- 1) Components on the vehicle that could contribute to the background sound of the vehicle should be modified or removed. Any removals or modifications are to be recorded in the test report.
- 2) During testing it should be ascertained that brakes are not poorly released, causing brake noise.
- 3) Four-wheel-drive vehicles and trucks with reduction gears in the axles should not be used.
- 4) The good condition of suspensions should be such that they do not result in an abnormal reduction in ground clearance when the vehicle is loaded in accordance with the testing requirement. If available, body level regulation systems should be adjusted to give ground clearance during testing normal for the unladen condition.

- 5) Before testing, the vehicle should be washed clean of any mud, dirt or sound-absorbing material inadvertently added during the break-in period.

A.1.4 Tyre load

The vehicle method load conditions shall meet all the following conditions.

- a) The average load of all tyres shall be (75 ± 5) % of their LI.
- b) No tyre shall be loaded to less than 70 % or more than 90 % of its LI.

A.1.5 Tyre inflation pressure

Each tyre shall be inflated to a cold inflation pressure of $P_t + {}_0^{10}$ % :

$$P_t = P_r \left(\frac{Q_t}{Q_r} \right)^{1,25}$$

where

P_t is the test inflation pressure, in kilopascals;

P_r is the reference pressure, which,

— for a standard C1 tyre, equals 250 kPa, and

— for a reinforced C1 tyre, equals 290 kPa,

and for both of which the minimum test inflation pressure shall be $P_t = 150$ kPa, and

— for C2 and C3 tyres is the pressure marked on the tyre sidewall;

Q_r is the reference load, corresponding to the maximum mass associated with the LI of the tyre;

Q_t is the test load for the tyre.

A.1.6 Vehicle operating condition

The test vehicle shall approach Line A–A or Line B–B with the engine off and the transmission in neutral position, and with the vehicle centre following as closely as possible the “centreline of travel”, as shown in Figure 1.

A.1.7 Speed range

The test vehicle speed at the time when it is at a position perpendicular to the microphones, shall be in the range of

- a) 70 km/h to 90 km/h for C1 and C2 tyres, and
- b) 60 km/h to 80 km/h for C3 tyres.

For reference speeds, see A.2.2.