International Standard

ISO 16254

Acoustics — Measurement of sound emitted by road vehicles of category M and N at standstill and low speed operation — Engineering method

Acoustique — Mesurage du bruit émis par les véhicules routiers de catégories M et N à l'arrêt et en fonctionnement à basse vitesse — Méthode d'expertise

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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 document 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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This document was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise,* in collaboration with ISO/TC 22, *Road vehicles*.

This second edition cancels and replaces the first edition (ISO 16254:2016), which has been technically revised.

The main changes are as follows:

— addition of multiple microphones at each measurement location;

— revised signal processing to improve correlation to human perception;

— further development of tonal loudness as an alternate method to identify frequencies and to assure frequencies so identified are audible to pedestrians.

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.

Introduction

The advent of road transport vehicles that rely, in whole or in part, on alternative drive trains (e.g. electromotive propulsion) is serving to reduce both air and noise pollution and their adverse impacts on citizens throughout the world. However, the environmental benefits achieved to date by these "hybrid or pure electric" road vehicles have resulted in the unintended consequence of removing a source of audible signal that is used by various groups of pedestrians (e.g. in particular, blind and low vision persons) to detect the approach, presence and/or departure of road vehicles.

Therefore, this document has been developed to provide a method to measure the sound emission of road vehicles at standstill and low speed operation, as well as to quantify the characteristics of any external sound-generation system installed for the purpose of conveying acoustic information about the approach, presence and/or departure of the vehicle to nearby pedestrians.

This document incorporates additional sensor locations and provisions to reduce the measurement variation of reported results and to introduce a metric for determining the frequency of tonal components that does not rely on prior knowledge of the sound signal. Tonal loudness calculates the audibility of the given signals considering how the sounds are perceived by people, providing an optional metric to assess detection and to identify frequency content.

This document was developed in cooperation with the Society of Automotive Engineers (SAE) Vehicle Sound for Pedestrians Subcommittee and the SAE Advanced Driver Assistance Committee.

Acoustics — Measurement of sound emitted by road vehicles of category M and N at standstill and low speed operation — Engineering method

1 Scope

This document is derived from ISO 362-1[2] and specifies an engineering method for measuring the sound emitted by M and N category road vehicles at standstill and low speed operating conditions. The specifications reproduce the level of sound which is generated by the principal vehicle sound sources consistent with stationary and low speed vehicle operating conditions relevant for pedestrian safety. The method is designed to meet the requirements of simplicity as far as they are consistent with reproducibility of results under the operating conditions of the vehicle.

The test method requires an acoustic environment which is only obtained in an extensive open space. Such conditions usually exist during the following:

— measurements of vehicles for regulatory certification;

— measurements at the manufacturing stage;

— measurements at official testing stations.

The results obtained by this method give an objective measure of the sound emitted under the specified conditions of test. It is necessary to consider the fact that the subjective appraisal of the annoyance, perceptibility, and/or detectability of different motor vehicles or classes of motor vehicles due to their sound emission are not simply related to the indications of a sound measurement system. As annoyance, perceptibility and/or detectability are strongly related to personal human perception, physiological human condition, culture, and environmental conditions, there are large variations and therefore these terms are not useful as parameters to describe a specific vehicle condition.

Spot checks of vehicles chosen at random rarely occur in an ideal acoustic environment. If measurements are carried out on the road in an acoustic environment which does not fulfil the requirements stated in this document, the results obtained might deviate appreciably from the results obtained using the specified conditions.

In addition, this document provides an engineering method to measure the performance of external sound generation systems intended for the purpose of providing acoustic information to pedestrians on a vehicle's operating condition. This information is reported as objective criteria related to the external sound generation system's sound pressure level, frequency content, and changes in sound pressure level and frequency content as a function of vehicle speed.

This document adds a metric related to the human perception of tonal loudness, the psychoacoustic tonality. The psychoacoustic tonality can be used to estimate audible frequency shifts of the sounds by identifying the most audible component in each auditory frequency band (critical band), as well as to determine if the band(s) so identified meet audibility criteria.

Annex A and Annex C contains background information relevant in the development of this document.

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 3745:2012, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for anechoic rooms and hemi-anechoic rooms*

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

ISO 26101-1, *Acoustics — Test methods for the qualification of the acoustic environment — Part 1: Qualification of free-field environments*

IEC 60942, *Electroacoustics — Sound calibrators*

IEC 61260-1, *Electroacoustics — Octave-band and fractional-octave-band filters — Part 1: Specifications*

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

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

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ECMA-418-2, *Psychoacoustic metrics for ITT equipment: models based on human perception*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
front reference plane
vertical plane tangent to the leading edge of the vehicle

3.2
rear reference plane
vertical plane tangent to the trailing edge of the vehicle

3.3
external sound generation system
system that provides an acoustic signal to the external environment of the vehicle for the purpose to provide information to pedestrians

3.4
component
external sound generation system (3.3) intended to emit sound information which can be tested separately from the vehicle

3.5
kerb mass
complete shipping mass of a vehicle fitted with all equipment necessary for normal operation plus the mass of the following elements for M1, N1 and M2 having a maximum authorized mass not exceeding 3 500 kg:

— lubricants, coolant (if needed), washer fluid;

— fuel (tank filled to at least 90 % of the capacity specified by the manufacturer);

— other equipment if included as basic parts for the vehicle, such as spare wheel(s), wheel chocks, fire extinguisher(s), spare parts and tool kit

Note 1 to entry: The definition of kerb mass can vary from country to country, but in this document, it refers to the definition contained in ISO 1176[4].