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Acoustics — Measurements of sound pressure level emitted by stationary road vehicles

Acoustique — Mesurages du niveau de pression acoustique émis par les véhicules routiers en stationnement

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web 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.

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 5130 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

This second edition cancels and replaces the first edition (ISO 5130:1982), which has been technically revised.

Introduction

This sound pressure level measurement procedure has been developed for use in the engineering evaluation of the sound pressure level performance of road vehicles in the vicinity of the exhaust systems. The method is intended to check vehicles in use and also to determine variations in the exhaust sound pressure level that can result from

— the wear, maladjustment or modification of particular components, when the defect does not appear by visual inspection;

— the partial or complete removal of devices reducing the emission of certain sound pressure levels.

It is possible to determine some of these variations by comparing the measurements with reference measurements made under similar conditions, for example during the type approval of the vehicle, using the same method. Other variations can be detected only when the engine is operated at a realistic load.

The document incorporates certain provisions of SAE J1492:1998-05, for measuring the sound pressure levels of exhaust systems of passenger cars and light trucks.

Acoustics — Measurements of sound pressure level emitted by stationary road vehicles

1 Scope

This International Standard specifies a test procedure, environment and instrumentation for measuring the exterior sound pressure levels from road vehicles under stationary conditions, providing a continuous measure of the sound pressure level over a range of engine speeds. This International Standard applies only to road vehicles of categories L, M and N equipped with internal combustion engines.

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.

It is within the scope of this International Standard to measure the stationary A-weighted sound pressure level during

— type approval measurements of vehicle;

— measurements at the manufacturing stage;

— measurements at official testing stations;

— measurements at roadside testing.

This International Standard specifies neither a method to check the exhaust sound pressure level when the engine is operated at realistic loads nor a method to check the exhaust sound pressure levels against a general noise limit for categories of road vehicles.

Technical background information is given in Annex A.

2 Normative references

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 5725 (all parts), *Accuracy (trueness and precision) of measurement methods and results*

IEC 60942, *Electroacoustics — Sound calibrators*

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

ISO Guide 98, *Guide to the expression of uncertainty in measurement (GUM)*

3 Terms and definitions

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

3.1
vehicle category L
motor vehicles with fewer than four wheels

NOTE United Nations Economic Commission for Europe (UN ECE) document TRANS/WP.29/78/Rev.1/Amend.4 (26 April 2005) extended the L category to four-wheeled vehicles as defined by L6 and L7 in ISO 362-1:—, 3.4.1.5 and 3.4.1.6.

3.2
vehicle category M
power-driven vehicles having at least four wheels and used for the carriage of passengers

3.3
vehicle category N
power-driven vehicles having at least four wheels and used for the carriage of goods

3.4
rated engine speed
S
engine speed at which the engine develops its rated maximum net power as stated by the manufacturer

NOTE 1 If the rated maximum net power is reached at several engine speeds, the *S* used in this International Standard is the highest engine speed at which the rated maximum net power is reached.

NOTE 2 ISO 80000-2 defines this term as "rated engine rotational frequency". The term "rated engine speed" was retained due to its common understanding by practitioners and use in government regulations.

4 Instrumentation

4.1 Instrumentation for acoustical measurement

4.1.1 General

The sound level meter or equivalent measuring system, including the windscreen recommended by the manufacturer, shall meet the requirements of class 1 instruments, in accordance with IEC 61672-1.

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

4.1.2 Calibration

At the beginning and at the end of every measurement session, the entire measuring system shall be checked by means of a sound calibrator that fulfils the requirements for sound calibrators of class 1 in accordance with IEC 60942. Without any further adjustment, the difference between the readings of two consecutive checks shall be less than or equal to 0,5 dB. If this value is exceeded, the results of the measurements obtained after the previous satisfactory check shall be discarded.

4.1.3 Compliance with requirements

Compliance of the instrumentation system with the requirements of IEC 61672-1 and compliance of the sound calibration device with the requirements of IEC 60942 shall be verified by the existence of a valid certificate of compliance. These certificates shall be deemed to be valid if verification of compliance with the respective standards was conducted within the previous 24 months for the instrumentation system and 12 months for the sound calibration device. All compliance testing shall be conducted by a laboratory that is authorized to perform calibrations traceable to the appropriate standards.

4.2 Instrumentation for engine-speed measurement

The rotational speed of the engine shall be measured with an instrument meeting the specification limits of at least ± 2 % or better at the engine speeds required for the measurements being performed.

5 Acoustical environment, meteorological conditions and background noise

5.1 Test site

A suitable test site shall be outdoors and consist of a level concrete, dense asphalt or similar hard material flat surface, free from snow, grass, loose soil, ashes or other sound-absorbing material. It shall be in an open space free from large reflecting surfaces, such as parked vehicles, buildings, billboards, trees, shrubbery, parallel walls, people, etc., within a 3 m radius from the microphone location and any point of the vehicle.

As an alternative to outdoor testing, a semi-anechoic chamber may be used. The semi-anechoic chamber shall fulfill the acoustical requirements given above**.** These requirements shall be met if the testing facility meets the 3 m distance criteria above and has a cut-off frequency below the lower of

— one-third-octave band below the lowest fundamental frequency of the engine during test;

— 100 Hz.

NOTE The noise performance of indoor testing facilities is specified in terms of the cut-off frequency (Hz). This is the frequency above which the room can be assumed to act as a semi-anechoic space.

5.2 Meteorological conditions

The tests shall not be carried out if the wind speed, including gusts, exceeds 5 m/s during the sound-measurement interval.

5.3 Background noise

Readings on the measuring instruments produced by ambient noise and wind shall be at least 10 dB below the A-weighted sound pressure level to be measured. A suitable windscreen may be fitted to the microphone, provided that account is taken of its effect on the sensitivity of the sound level meter.

6 Test procedure

6.1 General comments

It is essential that persons technically trained and experienced in current sound measurement techniques select the test instrumentation and conduct the test.

It should be recognized that variations in measured sound pressure levels can occur due to variations in test sites, atmospheric conditions and test equipment; see Annex B.

Instrument manufacturers' specification for orientation of the microphone relative to the sound source and the location of the observer relative to the microphone shall be followed. The test may be performed with a hand-held sound level meter. However, the sound level meter or microphone should be mounted on a stand or fixture for stability; see Clause 9. When possible, a microphone extension cable should be used and measurement or recording devices should be located away from the microphone.

CAUTION — Caution should be exercised when measuring rear- and mid-engine vehicles because engine and cooling-fan noise can prevent accurate measurement of exhaust noise.

6.2 Positioning and preparation of the vehicle

The vehicle transmission shall be in neutral position and the clutch engaged, or in parking position for automatic transmission, and the parking brake applied for safety.

The vehicle air conditioner, if equipped, shall be turned off.

If the vehicle is fitted with fan(s) having an automatic actuating mechanism, this system shall not be interfered with during the sound pressure level measurements.

The engine hood or compartment cover shall be closed.

Before each series of measurements, the engine shall be brought to its normal operating temperature, as specified by the manufacturer.

In case of a two-wheeled motor-driven vehicle having no neutral gear position, measurements shall be carried out with the rear wheel raised off the ground so that the wheel can rotate freely.

If it is necessary to raise a two-wheeled vehicle off the ground to perform the test, the microphone measurement position shall be adjusted to achieve the specified distance from the reference point of the exhaust pipe; see Figure 1 for the location of the reference points.

6.3 Microphone position

The microphone shall be located at a distance of 0,5 m ± 0,01 m from the reference point of the exhaust pipe defined in Figure 1 and at an angle of 45° ± 5° to the vertical plane containing the flow axis of the pipe termination. The microphone shall be at the height of the reference point, but not less than 0,2 m from the ground surface. The reference axis of the microphone shall lie in a plane parallel to the ground surface and shall be directed towards the reference point on the exhaust outlet.

If two microphone positions are possible, the location farthest laterally from the vehicle longitudinal centreline shall be used.

If the flow axis of the exhaust outlet pipe is at 90° to the vehicle longitudinal centreline, the microphone shall be located at the point that is the furthest from the engine.

If a vehicle has two or more exhaust outlets spaced less than 0,3 m apart and connected to a single silencer, only one measurement shall be made. The microphone shall be located relative to the outlet the farthest from the vehicle's longitudinal centreline, or, when such outlet does not exist, to the outlet that is highest above the ground.

For vehicles having an exhaust provided with outlets spaced more than 0,3 m apart or more than one silencer, one measurement shall be made for each outlet as if it were the only one, and the highest sound pressure level shall be noted.

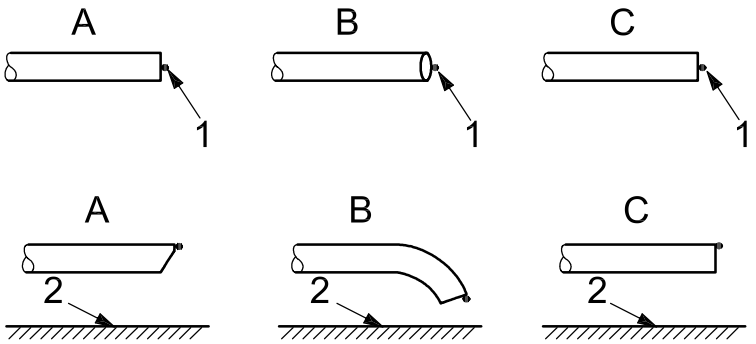
For vehicles with a vertical exhaust (e.g. commercial vehicles), the microphone shall be placed at the height of the exhaust outlet. Its axis shall be vertical and oriented upwards. It shall be placed at a distance of 0,5 m ± 0,01 m from the exhaust-pipe reference point as defined in Figure 1, but never less than 0,2 m from the side of the vehicle nearest to the exhaust.

For vehicles for which the reference point of the exhaust pipe is not accessible or located under the vehicle body, as shown in Figures 2 c) and 2 d), because of the presence of obstacles that form part of the vehicle (e.g. spare wheel, fuel tank, battery compartment), the microphone shall be located at least 0,2 m from the nearest obstacle, including the vehicle body, and its axis of maximum sensitivity shall face the exhaust outlet from the position least concealed by the above-mentioned obstacles.

When several positions are possible, as shown in Figure 2 d), the microphone position giving the lowest value of d_1 or d_2 shall be used.

Figures 2 a) to 2 e) show examples of the position of the microphone, depending on the location of the exhaust pipe.

For the purpose of roadside checking, the reference point may be moved to the outer surface of the vehicle body.



Key

1 reference point
2 road surface

A mitered pipe
B bent down pipe
C straight pipe
D vertical pipe

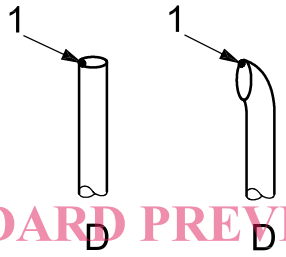


Figure 1 — Reference point