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Technical Specification

ISO/DTS 19425

Reciprocating internal combustion engines — Measurement method for air cleaners — Sound power level of combustion air inlet noise and insertion loss using sound pressure

Moteurs alternatifs à combustion interne — Méthode de mesure du bruit des purificateurs d'air — Niveau de puissance sonore du bruit d'entrée d'air de combustion et de perte d'insertion utilisant une pression sonore

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

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Contents

Page

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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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 70, *Air-borne noise*.

This second edition cancels and replaces the first edition (ISO 19425:2015), which has been technically revised.

The main changes are as follows:

— the terms and definitions have been revised and sources have been added (see Clause 3);

— the criterion for background noise has been changed (see 4.2);

— the application has been changed (see 5.3);

— the installation condition has been changed (see 6.2);

— the operation condition has been changed (see 6.3);

— the measurement radius has been changed (see 7.4).

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.

Reciprocating internal combustion engines — Measurement method for air cleaners — Sound power level of combustion air inlet noise and insertion loss using sound pressure

1 Scope

This document specifies the measurement method and requirements for combustion air inlet noise of air cleaners which are installed on reciprocating internal combustion engines, including laboratory measurement (engineering method and survey method) and site measurement (survey method).

This document applies to all air cleaners installed on reciprocating internal combustion engines (reciprocating internal combustion engine is referred to as engine hereafter, except for specific explanations) falling within the field of application of ISO 3046-1 and/or other air induction installation.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3046-1, *Reciprocating internal combustion engines — Performance — Part 1: Declarations of power, fuel and lubricating oil consumptions, and test methods — Additional requirements for engines for general use*

ISO 3046-3, *Reciprocating internal combustion engines — Performance — Part 3: Test measurements*

ISO 6926, *Acoustics — Requirements for the performance and calibration of reference sound sources used for the determination of sound power levels*

IEC 60942, *Electroacoustics — Sound calibrators*

IEC 61260, *Electroacoustics — Octave-band and fractional-octave-band filters*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in ISO 3046-1, ISO 3046-3, ISO 6926, IEC 60942, IEC 61260 and IEC 61672-1 and the following 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
sound pressure
p
difference between instantaneous pressure and static pressure

Note 1 to entry: It is expressed in pascals.

[SOURCE: ISO 80000-8:2007, 8-9.2]

3.2
sound pressure level
L_p
ten times the logarithm to the base 10 of the ratio of the square of the *sound pressure* (3.1), p, to the square of a reference value, p_0

$$L_p = 10\lg\frac{p^2}{p_0^2}$$

where the reference value, p_0, is 20 µPa

Note 1 to entry: If specific frequency and time weightings, as specified in IEC 61672-1, and/or specific frequency bands are applied, this is indicated by appropriate subscripts, e.g. L_{pA} denotes the A-weighted sound pressure level.

Note 2 to entry: It is expressed in decibels.

[SOURCE: ISO 3744:2010, 3.2]

3.3
time-averaged sound pressure level
$L_{p,T}$
ten times the logarithm to the base 10 of the ratio of the time average of the square of the *sound pressure* (3.1), p, during a stated time interval of duration, T (starting at t_1 and ending at t_2), to the square of a reference value, p_0

$$L_{p,T} = 10\lg\left[\frac{\frac{1}{T}\int_{t_1}^{t_2} p^2(t)\,dt}{p_0^2}\right]$$

where the reference value, p_0, is 20 µPa

Note 1 to entry: In general, the subscript "T" is omitted since time-averaged sound pressure levels are necessarily determined over a certain *measurement time interval* (3.5).

Note 2 to entry: Time-averaged sound pressure levels are often A-weighted, in which case they are denoted by $L_{pA,T}$, which is usually abbreviated to L_{pA}.

Note 3 to entry: It is expressed in decibels.

[SOURCE: ISO 3744:2010, 3.3]

3.4
surface time-averaged sound pressure level
$\overline{L_p}$
mean (energy average) of the *time-averaged sound pressure levels* (3.3) over all the microphone positions, or traverses, on the *measurement surface* (3.11), with the *background noise correction* (3.13), K_1, and the *environmental correction* (3.14), K_2, applied

Note 1 to entry: It is expressed in decibels.

[SOURCE: ISO 3744:2010, 3.18]

3.5
measurement time interval
T
portion or a multiple of an operational period or operational cycle of the noise source under test for which the *time-averaged sound pressure level* (3.3) is determined

Note 1 to entry: It is expressed in seconds.

[SOURCE: ISO 3744:2010, 3.5]

3.6
acoustic free field
sound field in a homogeneous, isotropic medium free of boundaries

Note 1 to entry: In practice, an acoustic free field is a field in which the influence of reflections at the boundaries or other disturbing objects are negligible over the frequency range of interest.

[SOURCE: ISO 3744:2010, 3.6]

3.7
reflecting plane
sound-reflecting planar surface on which the noise source under test is located

[SOURCE: ISO 3744:2010, 3.8]

3.8
acoustic free field over a reflecting plane
acoustic free field (3.6) in the half-space above an infinite *reflecting plane* (3.7) in the absence of any other obstacles

[SOURCE: ISO 3744:2010, 3.7]

3.9
frequency range of interest
frequency range of octave bands with nominal mid-band frequencies from 63 Hz to 8 000 Hz (including one-third octave bands with mid-band frequencies from 50 Hz to 10 000 Hz)

[SOURCE: ISO 3744:2010, 3.9]

3.10
measurement radius
r
radius of a spherical *measurement surface* (3.11)

Note 1 to entry: It is expressed in metres.

[SOURCE: ISO 3744:2010, 3.13]

3.11
measurement surface
hypothetical spherical surface of area, *S*, on which the microphone positions are located at which the *sound pressure levels* (3.2) are measured, enveloping the noise source under test

[SOURCE: ISO 3744:2010, 3.14]

3.12
background noise
noise from all sources other than the noise source under test

Note 1 to entry: Background noise includes contributions from airborne sound, noise from structure-borne vibration, and electrical noise in the instrumentation.

[SOURCE: ISO 3744:2010, 3.15]

3.13
background noise correction
K_1
correction applied to the mean (energy average) of the *time-averaged sound pressure levels* (3.3) over all the microphone positions on the *measurement surface* (3.11), to account for the influence of *background noise* (3.12)

Note 1 to entry: The background noise correction is frequency dependent; the correction in the case of a frequency band is denoted by K_{1f}, where *f* denotes the relevant mid-band frequency and that in the case of A-weighting is denoted by K_{1A}.

Note 2 to entry: It is expressed in decibels.

[SOURCE: ISO 3744:2010, 3.16]

3.14
environmental correction
K_2
correction applied to the mean (energy average) of the *time-averaged sound pressure levels* (3.3) over all the microphone positions on the *measurement surface* (3.11), to account for the influence of reflected sound

Note 1 to entry: The environmental correction is frequency dependent; the correction in the case of a frequency band is denoted by K_{2f}, where f denotes the relevant mid-band frequency, and that in the case of A-weighting is denoted by K_{2A}.

Note 2 to entry: It is expressed in decibels.

[SOURCE: ISO 3744:2010, 3.17]

3.15
sound power
W
through a surface, product of the *sound pressure* (3.1), p, and the component of the particle velocity, u_n, at a point on the surface in the direction normal to the surface, integrated over that surface

Note 1 to entry: The quantity relates to the rate per time at which airborne sound energy is radiated by a source.

Note 2 to entry: It is expressed in watts.

[SOURCE: ISO 3744:2010, 3.20]

3.16
sound power level
L_W
ten times the logarithm to the base 10 of the ratio of the *sound power* (3.15) of a source, W, to a reference value, W_0, expressed in decibels

$$L_W = 10 \lg \frac{W}{W_0}$$

where the reference value, W_0, is 1 pW

Note 1 to entry: If a specific frequency weighting, as specified in IEC 61672-1, and/or specific frequency bands are applied, this is indicated by appropriate subscripts, e.g. L_{WA} denotes the A-weighted sound power level.

Note 2 to entry: It is expressed in decibels.

[SOURCE: ISO 3744:2010, 3.21]

3.17
air cleaner
air filter
device which removes particles suspended in the fresh charge as it is drawn into the engine

Note 1 to entry: The air cleaner generally comprises the entire part from its air inlet but does not include the air induction manifold and pipe.

3.18
substitution pipe
rigid, non-absorbing circular pipe having the same length and the same cross section area of outlet as the tested *air cleaner* (3.17)

3.19
bent transition pipe
bent pipe used to change the airflow direction and to connect two pipes of the same cross section area

3.20
characteristic source dimension
d_0
characteristic dimension of source to determine the *measurement radius* (3.10)

3.21
insertion loss
D_I
difference between the *sound power level* (3.16) of combustion air inlet noise when the *substitution pipe* (3.18) is installed on the engine and when the *air cleaner* (3.17) is installed on the engine

$$D_I = L_{W(SP)} - L_{W(AC)}$$

where

$L_{W(SP)}$ is the sound power level of combustion air inlet noise when the substitution pipe is installed on the engine, in decibels;

$L_{W(AC)}$ is the sound power level of combustion air inlet noise when the air cleaner is installed on the engine, in decibels.

Note 1 to entry: It is expressed in decibels.

4 Test environment

4.1 General

For the engineering method, the test environments that are applicable for measurements in accordance with this document are the following:

a) a room or a flat outdoor area which is adequately isolated from background noise and which provides an acoustic free field over a reflecting plane;

b) a room or a flat outdoor area which is adequately isolated from background noise and in which an environmental correction can be applied to allow for a limited contribution from the reverberant field to the sound pressures on the measurement surface.

For the survey method, the test environment that is applicable for measurements in accordance with this document is a room or a flat outdoor area which is adequately isolated from background noise and which meets the qualification requirements given in 4.3.

Environmental conditions having an adverse effect on the microphones used for the measurements (e.g. wind, impingement of air discharge, high or low temperatures) shall be avoided. The instructions of the manufacturer of the measuring instrumentation regarding adverse environmental conditions shall be followed. Particular care should be exercised to ensure that the plane does not radiate any appreciable sound due to vibrations.

4.2 Criterion for background noise

For the engineering method, the time-averaged sound pressure level of the background noise measured and averaged over the microphone positions shall be at least 6 dB, and preferably more than 15 dB, below the corresponding uncorrected time-averaged sound pressure level of the noise source under test when measured in the presence of this background noise.

For frequency band measurements, it is possible that the criteria for background noise is not achievable in all frequency bands, even when the background noise levels in the test room are extremely low and well controlled.

For measurements in frequency bands, the following steps shall be followed to determine whether meeting the requirements of the background noise criteria.

a) The A-weighted sound power level is computed using the data from every frequency band within the frequency range of interest.

b) The computation of A-weighted sound power level is repeated but excluding those bands within the frequency range of interest for which ΔL_p < 6 dB (see 8.2.2).

c) If the difference between these two levels is less than 0,5 dB, the A-weighted sound power level determined from the data for all bands may be considered as conforming to the background noise criteria of this Technical Specification, or the measurement is not valid.

For survey method, the time-averaged sound pressure level of the background noise measured and averaged over the microphone positions, shall be at least 3 dB, and preferably more than 10 dB, below the corresponding uncorrected time-averaged sound pressure level of the noise source under test when measured in the presence of this background noise.

4.3 Criterion for acoustic adequacy of test environment

Annex A specifies procedures for determining the magnitude of the environmental correction, K_2.

For the engineering method, as long as it is practicable, the test environment shall be free from reflecting objects other than the reflecting plane(s). The reflecting plane(s) shall extend at least 0,5 m beyond the projection of the measurement surface on the plane(s). The sound absorption coefficient of the reflecting plane(s) shall be less than 0,1 over the frequency range of interest.

NOTE 1 Smooth concrete or smooth sealed asphalt surface(s) are generally satisfactory.

Measurements in accordance with the engineering method of this document are only valid where $K_{2A} \leq 4$ dB.

NOTE 2 The environmental correction, K_2, is assumed to be zero for measurements made in hemi-anechoic rooms which meet the requirements of ISO 3745.

The environmental correction, K_{2A}, shall first be determined without reference to frequency band data, using one of the procedures of Annex A. Where it is decided to make measurements in frequency bands, the relevant environmental correction K_2 shall be determined in each band over the frequency range of interest in accordance with A.4. L_{WA} of a noise source shall be calculated in accordance with Annex B.

Measurements in accordance with the survey method of this document are only valid where $K_{2A} \leq 7$ dB.

5 Instrumentation

5.1 General

The instrumentation system, including the microphones, cables and windscreen, if used, shall meet the requirements of IEC 61672-1, class 1 for results of accuracy grade 2 and class 2 for results of accuracy grade 3, and the filters shall meet the requirements of IEC 61260.

The sound level meter in acoustic measurement includes traditional handheld sound level meter and data acquisition and analysis equipment.

5.2 Calibration

Before and after each series of measurements, a sound calibrator meeting the requirements of IEC 60942, class 1 shall be applied to each microphone to verify the calibration of the entire measuring system at one or more frequencies within the frequency range of interest. Without any adjustment, the difference between the readings made before and after each series of measurements shall be less than or equal to 0,5 dB. If this value is exceeded, the results of the series of measurements shall be discarded.