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

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The UK participation in its preparation was entrusted to Technical Committee MCE/14, RIC engines.

A list of organizations represented on this committee can be obtained on request to its secretary.

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ISBN 978 0 580 87181 8

ICS 27.020

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 December 2015.

Amendments issued since publication

Date	Text affected

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TECHNICAL SPECIFICATION

ISO/TS 19425

First edition
2015-12-15

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

Reference number
ISO/TS 19425:2015(E)

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Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
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Foreword

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The committee responsible for this document is ISO/TC 70, *Internal combustion engines*.

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Introduction

This Technical Specification specifies methods for measuring the sound power level of combustion air inlet noise and the insertion loss of air cleaners installed on reciprocating internal combustion engines.

Sound power level of combustion air inlet noise, insertion loss, and transmission loss are parameters to characterize the acoustic performance of air cleaners. Sound power levels of combustion air inlet noise and insertion loss are important parameters to characterize the acoustic matching performance of air cleaners and reciprocating internal combustion engines. Transmission loss is the difference in sound power level of combustion air inlet noise between the noise before and after transmitting through the air cleaner, which is the parameter to characterize the acoustic performance of the air cleaner itself and is irrelevant with the reciprocating internal combustion engine. The matching parameters of the sound power level of combustion air inlet noise and the insertion loss are used in this Technical Specification as the measurement parameters.

The enveloping surface method of this Technical Specification is applicable for engineering method (accuracy grade 2) and survey method (accuracy grade 3). Engineering method allows the determination of the A-weighted and frequency-band sound power level, survey method allows the determination of the A-weighted sound power level. The measurement result of sound power level is rounded to the nearest 0,1 dB.

In the combustion air inlet noise control of air cleaner, the relevant members (including manufacturer, installation, and the user) should make effective communication of acoustic information which is obtained by measurement. The measurement result is valid only in the specified measurement conditions by using the instrumentation as specified in this Technical Specification to obtain a clear acoustic value. Engineering method or survey method may be selected according to the purpose of noise measurement and measurement conditions.

The measurement surface defined based on the characteristics of noise source under test in this Technical Specification is spherical. To meet the requirements of the measurement uncertainty, this Technical Specification gives specification of the distance from the installation location of the noise source to the reflecting plane (ground).

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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 Technical Specification 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 Technical Specification applies to all air cleaners installed on reciprocating internal combustion engines (reciprocating internal combustion engine is referred to as engine except particular explanation in the following text) 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.

3.1
sound pressure
p
difference between instantaneous pressure and static pressure

Note 1 to entry: It is expressed in pascals.

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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.

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.

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.

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.

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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.

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

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

3.9
frequency range of interest
the 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)

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

Note 1 to entry: It is expressed in metres.

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

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.

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.

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}.

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