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Reciprocating internal combustion engines — Measurement of emitted airborne noise — Engineering method and survey method

*Moteurs alternatifs à combustion interne — Mesurage du bruit aérien
émis — Méthode d'expertise et méthode de contrôle*



Reference number
ISO 6798:1995(E)

Foreword

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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.

International Standard ISO 6798 was prepared by Technical Committee ISO/TC 70, *Internal combustion engines*, Subcommittee SC 5, *Special requirements*.

Annex A forms an integral part of this International Standard. Annex B is for information only.

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Introduction

Control of noise from machines or equipment requires effective exchange of acoustical information among the several parties concerned. These include the manufacturer, the party who fixes specifications, installer and user of the machine or equipment. This acoustical information is obtained from measurements. These measurements are useful only if they are carried out under specified conditions to obtain defined acoustical quantities using standardized instruments.

The sound power level data determined according to this International Standard is essentially independent of the environment in which the data are obtained. This is one of the reasons for using sound power level to characterize the sound emitted by various types of machine equipment.

This International Standard gives requirements for the measurement of the noise emission of reciprocating internal combustion engines. It has been prepared in accordance with ISO 3740 on the basis of ISO 3744 (engineering method) and ISO 3746 (survey method). Due to the special conditions concerning reciprocating internal combustion engines, it is necessary to define different noise sources and to use measurement surfaces differing from those specified in ISO 3744 and ISO 3746.

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1 Scope

1.1 This International Standard specifies methods for measuring the sound pressure levels on a measurement surface enveloping a source, and for calculating the sound power level produced by the source. It gives requirements for the test environment and instrumentation, as well as techniques for obtaining the surface sound pressure level from which the A-weighted sound power level of the source and octave or one-third octave band sound power levels are calculated. This method may be used to perform acceptance tests.

1.2 The aim of this International Standard is a grade 2 (engineering) result (see table 1). When the correction for background noise exceeds the limit of 1,3 dB but is less than 3 dB, and/or the correction for environment exceeds the limits of 2 dB but is less than 7 dB, then a grade 3 (survey) result is obtained (see table 2).

The same rectangular parallelepiped measurement surface and microphone positions are used for both engineering method (designated "ISO 6798 - Engineering") and the survey method (designated "ISO 6798 - Survey").

1.3 This test code applies to all reciprocating internal combustion engines falling within the field of application of ISO 3046-1 and for other applications, if no suitable International Standard exists.

1.4 The methods defined in this International Standard apply to the measurement of the noise emission of a reciprocating internal combustion engine under steady-state operating conditions.

In annex A special requirements for measuring noise levels emitted from exhaust outlets or combustion air inlets of reciprocating internal combustion engines are laid down.

1.5 Measurements made in accordance with this International Standard should result in standard deviations which are equal to or less than those given in table 3. The uncertainties in table 3 depend not only on the accuracies with which sound pressure levels and measurement surface areas are determined, but also on the "near-field error" which increases for smaller measurement distances and lower frequencies (i.e. those below 250 Hz). The near-field error always leads to sound power levels which are higher than the real sound power levels.

NOTES

1 If the methods specified in this International Standard are used to compare the sound power levels of similar machines that are omnidirectional and radiate broad-band noise, the uncertainty in this comparison tends to result in standard deviations which are less than those given in table 3, provided that the measurements be performed in the same environment with the same shape of measurement surface.

2 The standard deviations given in table 3 reflect the cumulative effects of all causes of measurement uncertainty, excluding variations in the sound power levels from test to test which may be caused; for example, by changes in the mounting or operating conditions of the source. The reproducibility and repeatability of the test result may be considerably better (i.e. smaller standard deviations) than the uncertainties given in table 3 would indicate.

Table 1 — International Standards used as a basis for determining the sound power level of a reciprocating internal combustion engine

International Standard	Classification of method ¹⁾	Test environment	Volume of source	Character of noise	Sound power levels obtainable	Optional information available
ISO 3744	Engineering (grade 2)	Outdoors or in large room	Greatest dimension less than 15 m	Any	A-weighted and in one-third octave or octave bands	Directivity information; sound pressure levels as a function of time; other weighted sound power levels
ISO 3746	Survey (grade 3)	No special test environment	No restrictions: limited only by available test environment	Any	A-weighted	Sound pressure levels as a function of time; other weighted sound power levels
1) See ISO 2204.						

Table 2 — Limits for correction

Values in decibels

Grade of accuracy	Background noise correction	Environment correction
Grade 2	$\leq 1,3$	≤ 2
Grade 3	$> 1,3$ but ≤ 3	> 2 but ≤ 7
Special case ¹⁾	> 3	> 7
1) For higher values of background noise and/or environmental corrections, the real sound power level cannot be determined with acceptable uncertainty, but the results can be useful to estimate an upper limit of the noise emission of the reciprocating internal combustion engine to be tested.		

Table 3 — Uncertainty in determining sound power levels, expressed as the largest value of the standard deviation

Values in decibels

Grade of accuracy	Octave band centre frequency					A-weighted
	31,5 Hz to 63 Hz ¹⁾	125 Hz	250 Hz to 500 Hz	1 000 Hz to 4 000 Hz	8 000 Hz	
Grade 2	5	3	2	1,5	2,5	2
Grade 3	For a source which produces sounds that contain prominent discrete tones.					5
	For a source which produces sounds that are uniformly distributed in frequency over the frequency range of interest.					4
1) If measurement is outdoors.						

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3046-1:1995, *Reciprocating internal combustion engines — Performance — Part 1: Standard reference conditions, declarations of power, fuel and lubricating oil consumptions, and test methods*.

ISO 3046-3:1989, *Reciprocating internal combustion engines — Performance — Part 3: Test measurements*.

ISO 3744:1994, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane*.

ISO 3745:1977, *Acoustics — Determination of sound power levels of noise sources — Precision methods for anechoic and semi-anechoic rooms*.

ISO 3746:1995, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane*.

IEC 225:1966, *Octave, half octave and third octave band filters intended for the analysis of sounds and vibrations*.

IEC 651:1979, *Sound level meters*.

IEC 804:1985, *Integrating-averaging sound level meters*.

3 Definitions

For the purposes of this International Standard the definitions of ISO 3744 and ISO 3746 apply with the following additions.

3.1 airborne noise: At the microphone positions on the measurement surface, the sound pressure levels

of the noise which is generated by the engine under test, including the following sources:

- surface of the engine;
- combustion air inlet;
- exhaust outlet;
- essential dependant auxiliaries (e.g. fuel pump, coolant pump, air charging equipment, heat exchanger, cooling systems).

NOTES

3 The following sources are excluded: gearbox (unless it forms an integral part of the engine); driven machinery or loading system.

4 Where the installation is such that combustion air inlet and/or exhaust outlet noise cannot be included, this International Standard requires this to be stated in the test report.

5 Where any of the essential dependent auxiliaries are located outside the measurement surface, this International Standard requires that the noise be measured either in accordance with a suitable application standard or the relevant general standard (ISO 3744 or ISO 3746).

3.2 background noise: At the microphone positions on the measurement surface, the sound pressure levels of the noise which is not generated by the engine under test.

4 Acoustic environment

4.1 Criteria for adequacy of the test environment

No reflecting objects that are not part of the source under test shall be located inside the measurement surface other than the reflecting plane (ground).

4.1.1 Engineering method

Test environments that are suitable for measurements according to the engineering method include a flat outdoor area or a room which meets the qualification requirements of annex A of ISO 3744:1994. If indoors, the test environment shall be adequately isolated from extraneous noise (see 4.2). Annex A of ISO 3744:1994 specifies a procedure for determining whether or not a test environment is adequate for measurements made according to the engineering method.