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Acoustics — Measurement of airborne noise emitted by construction equipment intended for outdoor use — Method for determining compliance with noise limits

Acoustique — Mesurage du bruit aérien émis par les machines et équipements de construction destinés à être utilisés à l'air libre — Méthode de vérification de la conformité en ce qui concerne les limites de bruit

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4872 was developed by Technical Committee ISO/TC 43, *Acoustics*, and was circulated to the member bodies in July 1976.

It has been approved by the member bodies of the following countries :

Austria	Hungary	Norway
Belgium	India	Poland
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France	Mexico	
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The member bodies of the following countries expressed disapproval of the document on technical grounds :

Czechoslovakia
Switzerland
United Kingdom

Acoustics — Measurement of airborne noise emitted by construction equipment intended for outdoor use — Method for determining compliance with noise limits

0 INTRODUCTION

This International Standard describes a method for measuring the noise emitted by construction equipment and machines intended for outdoor use. The method allows the determination of the acoustical characteristics of a sound source in terms of its A-weighted sound power level. The values obtained by this method are the fundamental quantities for characterizing the sound output. The results may be used for comparison with noise limits. In this case, the A-weighted sound power levels determined according to this International Standard are to be considered as guaranteed values which include all sources of measurement uncertainty.

The A-weighted sound power level of a device or machine is calculated from the measured values of the A-weighted sound pressure level at several microphone positions located on a hypothetical measurement surface which envelops the source. One of two alternative measurement surfaces may be selected :

- a hemispherical surface, or
- a rectangular parallelepipedal surface.

The method requires that the background noise be significantly lower than the noise produced by the source. Annex A gives procedures for qualifying the acoustic environment for the purpose of measurements made according to the requirements of this International Standard and for determining the magnitude of the environmental correction (if any).

Only the acoustical requirements for measurements in a free field over a reflecting plane are defined in this International Standard. The operating and mounting conditions of the device or machine are described in general terms. For specific types of machine, for example concrete

mixers, compressors, earth-moving machinery, etc., reference should be made to special test codes which give detailed information on operating and mounting conditions and the array of microphone positions to be selected from those given in this International Standard.

1 SCOPE AND FIELD OF APPLICATION

1.1 General

This International Standard describes a method for measuring the weighted sound pressure levels at prescribed microphone positions in the proximity of a device or machine for outdoor use, in order to determine compliance with noise limits. The A-weighted sound power level of the source is calculated from the measured values.

NOTES

1 When nine or more microphone positions are prescribed in the proximity of the source (as in clause 7), the A-weighted sound power levels determined in accordance with this International Standard tend to result in standard deviations less than approximately 2,0 dB, provided that the spectrum does not contain pronounced discrete frequencies; if it does, the magnitude of the uncertainties will be larger and no general rules for the magnitude of the uncertainties can be given. These standard deviations reflect the cumulative effects of all causes of measurement uncertainty, excluding variations in the sound power level from machine to machine or from test to test, which may be caused, for example, by changes in the mounting or operating conditions of the source.

2 For measurements made using a hemispherical measurement surface, the directivity index of the source may be calculated according to the description of annex B.

3 Measurement of A-weighted sound pressure levels at the operator's position(s) is not described in this International Standard.

4 The results of noise measurements made according to this International Standard are obtained under prescribed conditions and will not necessarily correspond to the noise experienced from the equipment when it is in operation on a construction site.

1.2 Field of application

1.2.1 Types of noise

This International Standard applies to sources which radiate broad-band noise, narrow-band noise, discrete tones and combinations thereof. Procedures given in this International Standard are primarily applicable to sources that radiate steady noise. These procedures may also be applied to sources that radiate non-steady noise, quasi-steady noise and impulsive noise, provided that certain precautions are taken (see 7.8).

1.2.2 Size of source

In principle, the method given in this International Standard does not restrict the size of the machine to be measured; for very large machines the procedure may, however, lead to microphone positions which are impracticable to use.

NOTE — In such cases the noise source may often be defined as being part of the complete machine. In some cases of excessively large plant, for example conveyer systems extending to hundreds of metres in length, it will be possible to identify separate pieces of noisy machinery which are part of the whole and to which the procedure of this International Standard may be applied individually.

2 REFERENCES

ISO/R 1996, *Acoustics — Assessment of noise with respect to community response*.

ISO 2204, *Acoustics — Guide to the measurement of airborne acoustical noise and evaluation of its effects on man*.

ISO 3741, *Acoustics — Determination of sound power levels of noise sources — Precision methods for broad-band sources in reverberation rooms*.

IEC Publication 179, *Precision sound level meters*.

IEC Publication 179A, (First supplement to IEC Publication 179), *Additional characteristic for the measurement of impulsive noise*.

3 DEFINITIONS

For the purposes of this International Standard, the following definitions apply :

3.1 sound pressure level, L_p : Twenty times the logarithm to the base 10 of the ratio of the sound pressure to the reference sound pressure, expressed in decibels. For the purposes of this International Standard, the A-weighting network shall always be used, yielding the A-weighted sound pressure level, L_{pA} . The reference sound pressure is 20 μ Pa.

3.2 surface sound pressure level, $\overline{L_{pA}}$: The mean sound pressure level A-weighted over the measurement surface as required in clause 8.

3.3 sound power level, L_W : Ten times the logarithm to the base 10 of the ratio of a given sound power to the reference sound power, expressed in decibels. For the purposes of this International Standard, A-weighting shall always be used, yielding the A-weighted sound power level, L_{WA} . The reference sound power is 1 pW ($= 10^{-12}$ W).

3.4 measurement surface : A hypothetical surface of area S which envelops the source and on which the microphone positions are located.

3.5 background noise : At the microphone positions on the measurement surface, the A-weighted sound pressure levels of the noise which is not generated by the source under test.

4 ACOUSTIC ENVIRONMENT

4.1 Criterion for adequacy of the test environment

Ideally, the test environment should be free from reflecting objects other than a reflecting plane so that the source radiates into a free field over a reflecting plane. Annex A describes a procedure for determining the magnitude of the environmental correction (if any) to account for departures of the test environment from the ideal condition.

4.2 Criterion for background noise

At the microphone positions, the A-weighted sound pressure level due to the background noise shall be at least 6 dB, and preferably more than 10 dB, below the A-weighted sound pressure level with the source operating.

4.3 Wind

The wind speed at the test site shall be less than 8 m/s. For wind speeds in excess of 1 m/s, a microphone windscreen shall be used and appropriate compensation for the effects of its use shall be allowed for in the calibration.

5 INSTRUMENTATION

5.1 General

The instrumentation shall be designed to permit the determination of the value of the A-weighted sound pressure level averaged over time on an energy basis. Tolerances of the several sections of the measuring chain shall not exceed the tolerances given in the relevant clauses of IEC Publications 179 and 179A.

NOTES

1 An example of an appropriate instrument for these measurements is a sound level meter that meets the requirements of IEC Publication 179 with a "slow" meter characteristic. For establishing the presence of impulsive noise, the "impulse" meter characteristic according to IEC Publication 179A shall be used in addition.

2 Another example of an appropriate instrumentation system is an integrator which effects an analogue or digital integration of the squared signal over a given time-interval.