INTERNATIONAL STANDARD

ISO 9296

First edition
1988-04-15

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
ORGANISATION INTERNATIONALE DE NORMALISATION
МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Acoustics — Declared noise emission values of computer and business equipment

Acoustique — Valeurs déclarées d'émission acoustique des matériels informatiques et de bureau

Reference number
ISO 9296 : 1988 (E)

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.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 9296 was prepared by the European Computer Manufacturers Association (as Standard ECMA-109) and was adopted, under a special "fast-track" procedure, by Technical Committee ISO/TC 43, *Acoustics*, in parallel with its approval by the ISO member bodies.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Printed in Switzerland

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Acoustics — Declared noise emission values of computer and business equipment

0 Introduction

Information on acoustic noise emission of computers and business equipment is needed by users, planners, manufacturers and authorities. This information is required for comparison of the noise emissions from different products and for installation acoustics planning and may be used for relating to workplace noise exposure requirements.

In order for equipment noise emission values to be useful, uniform methods are necessary for the following purposes:

— Measuring noise emission values

ISO 7779 specifies uniform methods for measuring noise emission from computers and business equipment when operating under specified conditions which are typical of actual use.

— Determining the noise emission value to be declared

ISO 4871 and its annex A give guidelines for the preparation of standards for deriving noise emission values for declaration purposes, and ISO 7574 gives statistical methods for such determination.

— Presentation of declared noise emission values

For the presentation of declared noise emission values, it is of prime importance to declare sound power levels, L_{WA}. It is recognized, however, that users still desire information on sound pressure levels, L_{pA}. Therefore, this International Standard specifies that both quantities shall be declared. In order to avoid any misunderstanding between presentation of sound power levels in decibels (reference: 1 pW) and sound pressure levels in decibels (reference: 20 µPa), this International Standard expresses sound power level emission values in bels and sound pressure level emission values in decibels.

Optional methods for determination and presentation of subjective characteristics of noise emission are presented in annex B.

— Verification of declared noise emission values

ISO 7574 gives methods for the verification of a declared noise emission value. In that International Standard the procedure is restricted to verifying declared sound power levels only.

1 Scope and field of application

This International Standard applies to computer and business equipment.

This International Standard specifies

— the method for determining the declared noise emission values;

— acoustical and product information to be given in technical documents supplied to users by the manufacturer;

— the method for verifying the declared noise emission values given by the manufacturers.

The uniform methods in this International Standard use the noise data obtained in accordance with ISO 7779 and the procedures specified in ISO 4871 and ISO 7574.

The basic declared noise emission values are the declared A-weighted sound power level, L_{WAd} (a statistical maximum value corresponding to L_c in ISO 7574), and the declared A-weighted sound pressure level, L_{pAm} (a mean value), at the operator or bystander positions.

The declared A-weighted sound power level, L_{WAd}, permits comparison of noise emissions between different products and permits predictions of installation or workplace noise exposure levels [1].

Although the most useful quantity for calculating exposure levels due to one or more sound sources is usually the declared A-weighted sound power level of the individual source(s), the declared A-weighted sound pressure level, L_{pAm}, may be used to estimate the exposure level in the immediate vicinity of an isolated piece of equipment.

To avoid confusion between sound power levels and sound pressure levels, the A-weighted sound power level is declared in bels and the A-weighted sound pressure level is declared in decibels.

2 References

ISO 4871, *Acoustics — Noise labelling of machinery and equipment.*

ISO 7574-1, *Acoustics — Statistical methods for determining and verifying stated noise emission values of machinery and equipment — Part 1: General considerations and definitions.*

ISO 7574-2, *Acoustics — Statistical methods for determining and verifying stated noise emission values of machinery and equipment — Part 2: Methods for stated values for individual machines.*

ISO 7574-4, *Acoustics — Statistical methods for determining and verifying stated noise emission values of machinery and equipment — Part 4: Methods for stated values for batches of machines.*

ISO 7779, *Acoustics — Measurement of airborne noise emitted by computer and business equipment.*

3 Definitions

For the purposes of this International Standard, the following definitions apply. They are grouped in three categories: general definitions, acoustical definitions and statistical definitions.

3.1 General definitions

3.1.1 computer and business equipment: Equipment, and components thereof, used primarily in computer installations, offices or similar environments.

3.1.2 batch [lot] of equipment: A number of units of computer or business equipment intended to perform the same function produced in quantity, manufactured to the same technical specifications and characterized by the same declared noise emission values.

NOTE — The batch may be either an entire production series or a portion thereof.

3.1.3 idling mode: A condition specified in ISO 7779 in which the equipment, after any necessary warm-up period, is energized but is not operating.

3.1.4 operating mode: A condition in which the equipment is performing its intended function as specified in ISO 7779. If more than one operating condition is applicable, the condition which is typical for the majority of the applications shall be used.

3.2 Acoustical definitions

3.2.1 A-weighted sound power level, L_{WA}, in decibels: The sound power level of the equipment, determined in accordance with ISO 7779, with A-weighting. The reference sound power is 1 pW.

3.2.2 A-weighted sound pressure level, L_{pA}, in decibels: The sound pressure level of the equipment with A-weighting, determined in accordance with ISO 7779 at the operator position(s), or at the bystander positions if no operator position is specified. The reference sound pressure is 20 µPa.

3.2.3 measured value: The value of the A-weighted sound power level, L_{WA}, or the A-weighted sound pressure level, L_{pA}, determined from measurements on an individual machine in accordance with ISO 7779. Measured values shall not be rounded.

3.2.4 declared noise emission values: The value of the declared A-weighted sound power level, L_{WAd}, or that of the declared A-weighted sound pressure level, L_{pAm}, or both.

3.2.5 declared A-weighted sound power level [1], L_{WAd}, in bels: The value of the A-weighted sound power level, L_{WA}, divided by 10 declared for an individual machine or for all machines in a batch. The declared value indicates the limit below which the A-weighted sound power level, L_{WA}, divided by 10, of the individual machine and/or a specified large proportion of the A-weighted sound power levels, L_{WA}, divided by 10, of the batch of machines are stated to lie when the machines are new. The verification procedures in clause 6 are designed such that there is 95 % probability of acceptance if no more than 6,5 % of the equipment in a batch has A-weighted sound power levels greater than the declared noise emission value L_{WAd}. The value of L_{WAd} is rounded to the nearest tenth of a bel.

NOTE — L_{WAd} corresponds to L_c in ISO 7574.

3.2.6 declared A-weighted sound pressure level, L_{pAm}, in decibels: The value of the A-weighted sound pressure level, L_{pA}, declared for an individual machine or the arithmetic mean of the values of the A-weighted sound pressure level, L_{pA}, declared for a batch of machines, when new. The measurement position(s) for L_{pA} is (are) the operator position(s) defined in ISO 7779 or the bystander positions if no operator position is specified.

1) If the declared A-weighted sound power level, L_{WAd}, in bels (B), is to be used for the determination of installation noise levels, or for comparison with the declared A-weighted sound power levels in decibels (dB) for machines other than computer and business equipment, the value of L_{WAd} in bels is multiplied by ten to obtain its value in decibels, using the identity 1 B = 10 dB.

3.3 Statistical definitions

NOTE — In this International Standard, the symbol σ is used for a true standard deviation and the symbol s for an estimated standard deviation.

3.3.1 standard deviation of repeatability, σ_r : The standard deviation of measured values obtained under repeatability conditions, i.e. the repeated application of the same noise emission measurement method (ISO 7779) on the same equipment within a short interval of time under the same conditions (same laboratory, same operator, same apparatus).

3.3.2 standard deviation of reproducibility, σ_R : The standard deviation of measured values obtained under reproducibility conditions, i.e. the repeated application of the same noise emission measurement method (ISO 7779) on the same equipment at different times and under different conditions (different laboratory, different operator, different apparatus). The standard deviation of reproducibility, therefore, includes the standard deviation of repeatability.

3.3.3 standard deviation of production, σ_p : The standard deviation of measured values obtained on different equipment from batches of the same family, using the same noise emission measurement method (ISO 7779) under repeatability conditions (same laboratory, same operator, same apparatus).

3.3.4 total standard deviation, σ_t : The square root of the sum of the squares of the standard deviation of reproducibility and the standard deviation of production given by the following formula:

$$\sigma_t = \sqrt{\sigma_R^2 + \sigma_p^2}$$

3.3.5 reference standard deviation, σ_M : The total standard deviation specified for computer and business equipment which is considered typical for batches of this equipment. The reference standard deviation for L_{WA} shall be σ_M = 2,0 dB.

NOTE — The use of a fixed value for σ_M enables the application of a statistical method to deal with small sample sizes. If the total standard deviation, σ_t, is different from the reference standard deviation, σ_M, the manufacturer should estimate his risk of rejection on the basis of both standard deviations σ_t and σ_M (see 4.4.1).

4 Determination of the declared noise emission values

4.1 General

Declared noise emission values, L_{WAd} and L_{pAm}, shall be determined for the idling mode and the operating mode. If the machine has more than one operating or idling mode, the modes which are typical of the majority of the applications shall be used.

4.2 Determination of the A-weighted sound power level, L_{WA}

The A-weighted sound power level, L_{WA}, shall be determined in accordance with ISO 7779.

NOTE — Measured values should not be rounded. The precision of measured values should be consistent with the calculations to be performed in accordance with this International Standard.

4.3 Measurement of the A-weighted sound pressure level, L_{pA}, at the operator (bystander) position(s)

The A-weighted sound pressure level, L_{pA}, at the operator position(s) shall be measured in accordance with ISO 7779. If no operator position is specified, L_{pA} shall be determined by energy-averaging the measured values at the four bystander positions at the front, rear, right and left sides of the equipment in accordance with ISO 7779.

4.4 Determination of the declared noise emission values

NOTE — The determination of the declared noise emission values is the sole responsibility of the producer.

4.4.1 Determination of the declared A-weighted sound power level, L_{WAd}, for batches of machines

To obtain the declared A-weighted sound power level, L_{WAd}, for batches of machines, the producer shall take into account the following:

a) The uncertainty of the measurement with respect to the accuracy of the measurement method (ISO 7779), considering reproducibility. The standard deviation of reproducibility, σ_R, for L_{WA} is estimated to be 1,5 dB.

b) The production variation, i.e. measurements on many machines from one batch carried out in accordance with ISO 7779 in one laboratory under conditions as identical as possible (repeatability conditions). For each machine, the mean value from two measurements is determined. These values are used to estimate the standard deviation of production for the batch.

c) The total standard deviation, σ_t, for values of L_{WA} as a combination of the standard deviation of reproducibility, σ_R, and the standard deviation of production, σ_p.

d) The procedures for verifying the declared noise emission values as given in clause 6, which are consistent with ISO 7574-4: the single sampling inspection procedure with a sample size, n, equal to 3 and a reference standard deviation σ_M = 2,0 dB.

If a reasonably large sample is available, the following procedure shall be used. Determine the value, L_{WAi}, of the A-weighted sound power level for each individual machine in the sample in accordance with ISO 7779. Calculate the arithmetic mean, L_{WAm} of the L_{WAi} values using the following formula:

$$L_{WAm} = \frac{1}{n} \sum_{i=1}^{n} L_{WAi}$$

where n is the number of machines in the sample.

Calculate the standard deviation of production, s_p, from the measured L_{WAi} values in the sample:

$$s_p = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(L_{WAi} - L_{WAm})^2}$$

Calculate the total standard deviation, s_t, from the standard deviation of production, s_p, and the standard deviation of reproducibility, s_R (estimated to be 1,5 dB) using the following formula:

$$s_t = \sqrt{s_R^2 + s_p^2}$$
$$= \sqrt{1{,}5^2 + s_p^2}$$

NOTES

1 The values of L_{WAm} and s_t are estimates of the true mean value, μ, and the true total standard deviation, σ_t, of the batch.

2 If a reasonably large sample is not available, the value of s_t may be estimated from previous experience.

Determine the declared A-weighted sound power level, L_{WAd}, rounded to the nearest tenth of a bel, from the values of L_{WAm} and s_t using the following formula:

$$L_{WAd} = \frac{1}{10}[L_{WAm} + 1{,}5\,s_t + 0{,}564(2{,}0 - s_t)]$$

NOTE — This equation is based on ISO 7574-4 and results in a 5 % risk of rejection.

4.4.2 Determination of the declared A-weighted sound power level, L_{WAd}, for an individual machine

Determine the declared A-weighted sound power level for an individual machine from the measured A-weighted sound power level, L_{WA}, using the following relation:

$$L_{WAd} \geqslant \frac{1}{10}(L_{WA} + K)$$

The value of K in the relation above accounts for the random measurement errors occurring under reproducibility conditions. A value of K equal to 2,5 dB is appropriate for a 5 % risk of rejection for s_R = 1,5 dB.

The value of L_{WAd} for an individual machine is rounded to the nearest tenth of a bel.

4.4.3 Determination of the declared A-weighted sound pressure level, L_{pAm}, for batches of machines

Determine the declared A-weighted sound pressure level, L_{pAm}, for the batch of machines by calculating the arithmetic mean of the A-weighted sound pressure levels, L_{pA}, for the machines in the sample, measured at the operator position or bystander positions in accordance with 4.3.

The value of L_{pAm} is rounded to the nearest whole number of decibels.

4.4.4 Determination of the declared A-weighted sound pressure level, L_{pAm}, for an individual machine

The declared A-weighted sound pressure level, L_{pAm}, for an individual machine is equal to the value of the A-weighted sound pressure level, L_{pA}, measured at the operator position or bystander positions in accordance with 4.3.

The value of L_{pAm} is rounded to the nearest whole number of decibels.

5 Presenting declared noise emission values

The presentation of noise emission values for a product, determined in accordance with this International Standard, shall contain the following information:

a) the words "DECLARED NOISE EMISSIONS in accordance with ISO 9296" followed by the values of L_{WAd} and L_{pAm} as determined by the procedures in clause 4 for both operating and idling modes, where applicable, for batches of machines or individual machines, and indication of the identity 1 B = 10 dB;

b) identification of whether the value of L_{pAm} as defined in ISO 7779 refers to the operator position or bystander positions;

c) if the machine has more than one operating mode, sufficient information to identify unambiguously the mode used for the declaration;

d) identification of the product with sufficient detail to determine the applicability of the declared noise emission values. If such information is not given, the declared noise emission values apply to all variations of the listed product.

Declared noise emission values shall be given in technical documents or other literature supplied to the user (see annex A).

6 Verification of the declared noise emission values

6.1 General

The procedures for verifying the declared noise emission values are applicable only to declared A-weighted sound power levels, L_{WAd}, and are not applicable to declared A-weighted sound pressure levels, L_{pAm}.

The procedure for verifying the values of L_{WAd} of the batch is consistent with ISO 7574-4, using the single sampling inspection procedure with a sample size of n = 3 and with the reference standard deviation, σ_M, specified as 2,0 dB.

The procedure for verifying the L_{WAd} of an individual machine is consistent with ISO 7574-2.

Verification shall be checked with noise measurements and equipment operation in accordance with ISO 7779. Furthermore, the installation and operating conditions for verification shall be as specified in clause 4 and stated by the manufacturer as specified in clause 5.

6.2 Verification of the values of L_{WAd} for a batch of machines

The following procedure is designed for inspection under reproducibility conditions (see 3.3.2). It may be applied for inspection under repeatability conditions (see 3.3.1) if there is confidence that there is no significant systematic error of measurement connected with the relevant laboratory.

Take a random sample of three from the batch of new equipment under consideration.

The measured values are L_{WA1}, L_{WA2} and L_{WA3}, in decibels, and their mean value, $\bar{L}$, in decibels, is given by the following formula:

$$\bar{L} = \frac{1}{3}(L_{WA1} + L_{WA2} + L_{WA3})$$

The decision on the acceptability of the declared noise emission value, L_{WAd}, shall be made using the following rules:

a) if $\bar{L}/10 \leqslant (L_{WAd} - 0{,}11)$, the value of L_{WAd} is confirmed as verified for the batch;

b) if $\bar{L}/10 > (L_{WAd} - 0{,}11)$, the value of L_{WAd} is not confirmed as verified for the batch.

6.3 Verification of the values of L_{WAd} for an individual machine

The measured value is L_{WA} in decibels.

The decision on the acceptability of the declared noise emission value, L_{WAd}, for an individual machine shall be made using the following rules:

a) if $L_{WA}/10 \leqslant L_{WAd}$, the value of L_{WAd} is confirmed as verified for the individual machine;

b) if $L_{WA}/10 > L_{WAd}$, the value of L_{WAd} is not confirmed as verified for the individual machine.