

ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

STANDARD ECMA-109

**DECLARED NOISE EMISSION VALUES
OF COMPUTER AND BUSINESS
EQUIPMENT**

December 1985

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BRIEF HISTORY

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 immission requirements.

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

- Measuring noise emission values

Standard ECMA-74 specifies uniform methods of 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 gives 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, ECMA believes that 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 Standard specifies that both quantities shall be declared. In the preparation of this Standard divergences of opinion have been found between various national and international organizations as to the most useful way of presenting noise emission values. In order to dispel the misunderstanding between presentation of sound power levels in decibels re 1 pW and sound pressure levels in decibels re 20 uPa, this Standard expresses sound power level emission value in bels and sound pressure level emission values in decibels. This should alleviate the divergences of opinions mentioned.

As an option, methods for determination and presentation of subjective characteristics of noise emission are presented in Appendix B.

- Verification of declared noise emission level values

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

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1. SCOPE AND FIELD OF APPLICATION

This ECMA Standard applies to computer and business equipment.

This Standard specifies:

- the method of 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 Standard use the noise data measured according to ECMA-74 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} (which is a statistical maximum value and corresponds to L_C in ISO 7574) and the declared A-weighted sound pressure level L_{pAm} at the operator or bystander position(s) (which is a mean value).

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 immission levels, as described in ECMA TR/27.

Although the preferred quantity for calculating immission is the declared A-weighted sound power level, the declared A-weighted sound pressure level L_{pAm} may be used to estimate the immission level in the immediate vicinity of a single equipment.

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

2. REFERENCES

- ECMA-74 : Measurement of Airborne Noise Emitted by Computers and Business Equipment
- ECMA TR27: Method for the Prediction of Installation Noise Levels
- ISO 4871 : Acoustics - Noise Labelling of Machinery and Equipment
- ISO 7574 : Acoustics - Statistical Methods for Determining and Verifying Stated Noise Emission Values of Machinery and Equipment.

3. DEFINITIONS

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

General Definitions

3.1 Computer and Business Equipment

Equipment, and components thereof, used primarily in computer installations, offices or similar environments.

3.2 Batch (Lot) of Equipment

A number of units of the same family of computer or business equipment produced in quantity, manufactured to the same technical specifications and characterized by the same declared noise emission values.

NOTE 1:

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

3.3 Idle Mode

A condition specified in ECMA-74 in which the equipment, after any necessary warm-up period, is energized but is not operating.

3.4 Operating Mode

A condition in which the equipment is performing its intended function as specified in ECMA-74. If more than one operating condition is applicable, the condition which is typical for the majority of the applications shall be used.

Acoustical Definitions

3.5 A-weighted Sound Power Level L_{WA} in Decibels

The sound power level of equipment, determined according to ECMA-74, with A-weighting. The reference sound power is 1 pW.

3.6 A-weighted Sound Pressure Level L_{pA} in Decibels

The sound pressure level of equipment with A-weighting, determined according to ECMA-74 Section IV at the operator position, or at the bystander position(s) if no operator position is specified. The reference sound pressure is 20 uPa.

3.7 Declared Noise Emission Values

The value of the A-weighted sound power level L_{WAd} or that of the A-weighted sound pressure level L_{pAm} declared for all equipment in a batch or for a single equipment.

3.8 Declared A-weighted Sound Power Level L_{WAd} in bels

The upper limit of either the measured value of L_{WA} divided by 10 for a single equipment or for a specified large proportion of the measured values of L_{WA} divided by 10 for a batch of equipment when new. The verification procedures of 6 of this Standard ensures that there is a probability of 95% that more than 93,5% of the equipment in a batch will have an A-weighted sound power level lower than the declared noise emission value L_{WAd} . This value corresponds to L_C in ISO 7574. L_{WAd} shall be rounded to 0,1 B.

3.9 Declared A-weighted Sound Pressure Level L_{pAm} in decibels

The measured value of L_{pA} for a single equipment or the arithmetic mean of the measured values of L_{pA} for a batch of equipment when new. The measurement position for L_{pA} is the operator position defined in ECMA-74 or bystander positions if no operator position is specified.

Statistical Definitions

3.10 Standard Deviation of Repeatability σ_R

The standard deviation of noise emission values obtained under repeatability conditions, that is, the repeated application of the same noise emission measurement method (ECMA-74) on the same equipment within a short interval of time under the same conditions (same laboratory, same operator, same apparatus).

3.11 Standard Deviation of Reproducibility σ_R

The standard deviation of noise emission values obtained under reproducibility conditions, that is, the repeated application of the same noise emission measurement method (ECMA-74) 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.

3.12 Standard Deviation of Production σ_p

The standard deviation of the different means of noise emission values obtained on different equipment from batches of the same family, using the same noise emission measurement method (ECMA-74) under repeatability conditions (same laboratory, same operator, same apparatus).

3.13 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:

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

3.14 Reference Standard Deviation σ_M

The total standard deviation specified for the family of equipment under consideration which is considered typical for batches from this family. For computers and business equipment, the reference standard deviation for L_{WA} shall be 2,0 dB.

NOTE 2:

The use of a fixed σ_M for each family 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 shall estimate his risk of rejection on the basis of both standard deviations, σ_t and σ_M (see 4.3.1).

4. DETERMINATION OF THE DECLARED NOISE EMISSION VALUES

If more than one operating or idle condition is applicable, the condition which is typical for the majority of the applications shall be used. Values of L_{WAd} and L_{pAm} shall be determined for operating and idle conditions, where applicable.

4.1 Determination of the A-weighted Sound Power Level L_{WA}

The A-weighted sound power level L_{WA} , rounded to 0,1 dB, shall be determined in accordance with ECMA-74.

4.2 Measurement of the A-weighted Sound Pressure Level L_{pA} at the Operator (Bystander) Position

The A-weighted sound pressure level L_{pA} , rounded to 0,1 dB, at the operator position (or bystander position if no operator position is specified) shall be measured in accordance with ECMA-74, Section IV.

4.3 Determination of the Declared Noise Emission Values

The determination of L_{WAd} and L_{pAm} is the sole responsibility of the manufacturer.

4.3.1 Determination of declared A-weighted sound power level L_{WAd} for batches of equipment

To obtain the declared noise emission values L_{WAd} for batches of equipment the manufacturer shall take into account the following.

- i) The uncertainty of the measurement with respect to the precision of the measurement method (ECMA-74), considering reproducibility. The standard deviation of reproducibility σ_R for L_{WA} is estimated to be 1,5 dB.
- ii) The production variation, i.e. a sufficiently large sample size should be used to estimate the standard deviation of production σ_p . A small sample size will increase the manufacturer's risk.
- iii) 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 .
- iv) The procedures for verifying the declared noise emission values as given in 6 of this Standard, 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 $\sigma_M = 2,0$ dB.

NOTE 3:

The verification procedures of 6 of this Standard ensure that there is a probability of 95% that at least 93,5% of the equipment in a batch will have measured levels lower than the declared noise emission value.

The following procedure is recommended: Determine the L_{WA} for each individual equipment in the sample in accordance with ECMA-74 for a reasonably large sample size. Calculate the arithmetic mean measured value L_{WAm} and the total standard deviation s_t from the measured values L_{WA} of the individual equipment in a sample.

Determine the declared A-weighted sound power level L_{WAd} , rounded to 0,1 bel, from the values L_{WAm} and s_t , using the procedure of B.3 of ISO 7574/4.

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

NOTE 4:

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

NOTE 5:

The use of this equation results in a 5% risk of rejection.

4.3.2 Determination of the declared A-weighted sound power level value L_{WAd} for individual equipment

The declared A-weighted sound power level value for each equipment is determined from the measured A-weighted sound power level L_{WA} using the following relation:

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

The value of K in the above relation should be chosen to account for the random measurement errors occurring under reproducibility conditions. A value of K equal to 3,0 will cover most cases and is given for guidance. A deviation from the value of K = 3,0 might, therefore, be possible in specific cases.

Values of L_{WAd} for individual equipment are rounded to 0,1 B.

4.3.3 Determination of declared A-weighted sound pressure level L_{pAm}

For a batch of equipment the declared A-weighted sound pressure level L_{pAm} is the arithmetic mean of the measured A-weighted sound pressure levels L_{pA} at the operator position (or bystander position if no operator position is specified) from all the equipment measured in the batch.

For an individual equipment, the declared A-weighted sound pressure level L_{pAm} is the measured A-weighted sound pressure level L_{pA} at the operator position. If no operator position is specified, L_{pA} is determined by energy-averaging the measurements at the four bystander positions at the front, rear, right and left sides of the equipment as specified in ECMA-74.

The values of L_{pAm} shall be rounded to 1 dB.

5. PRESENTING DECLARED NOISE EMISSION VALUES

5.1 Required Information

The presentation of noise emission values for a product, determined according to this Standard, shall contain the following information:

- the words "Declared Noise Emissions ECMA-... (L) or ECMA-... (I)" followed by L_{WAAd} and L_{pAm} as determined by the procedures in 4 of this Standard for both operating and idle modes, where applicable, for lots (batches) of equipment or individual equipment, respectively,
- identification of whether L_{pAm} refers to the operator position or bystander positions,
- if more than one operating mode according to ECMA-74 is possible, sufficient information to determine unambiguously the operating conditions,
- 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 may be given in technical documents or other literature supplied to the user (see Appendix 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_{WAAd} and are not applicable to declared A-weighted sound pressure levels L_{pAm} .

The procedure for verifying L_{WAAd} 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_{WAAd} of an equipment declared individually is consistent with ISO 7574/2.

Verification shall be checked with noise measurements and equipment operation in accordance with ECMA-74. Furthermore the installation and operating conditions for verification shall be as specified in 4 of this Standard and stated by the manufacturer as specified in 5 of this Standard.

6.2 Verification of L_{WAAd} for a batch of Equipment

The following procedure is designed for inspection under reproducibility conditions (see 3.11). It may be applied for inspection under repeatability conditions (see 3.10) 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 lot of new equipment under consideration.

The measured values are L_{WA1} , L_{WA2} and L_{WA3} in dB, rounded to 0,1 dB, and their mean value \bar{L} in dB is given by :

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

Decide on the acceptability of the declared noise emission value L_{WAAd} using the following rules:

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

6.3 Verification of L_{WAAd} for an individual equipment

The measured value is L_{WA} in dB rounded to 0,1 dB.

Decide on the acceptability of the declared noise emission value L_{WAAd} for an individual equipment using the following rules:

- if $L_{WA}/10 \leq L_{WAAd}$, L_{WAAd} is confirmed as verified for the individual machine,
- if $L_{WA}/10 > L_{WAAd}$, L_{WAAd} is not confirmed as verified for the individual machine.

APPENDIX A

Examples of Noise Emission Declarations

Example 1

Where declared noise emission values apply to all variations of a product and no operator position is specified.

Product: Computer, Model ABC
Declared Noise Emissions per ECMA- (L): Operating Idle
LWAd 7,1 B 7,0 B
LpAm (bystander positions) 57 dB 56 dB

Example 2

Where different declared noise emission values apply to variations of the product manufactured in different years and operator position is specified.

Product: Disk Drive Model DEF
Declared Noise Emissions per ECMA- (L): Operating Idle
Year of Manufacture: 1983-1985
LWAd 5,2 B 4,8 B
LpAm (operator position) 41 dB 37 dB
Year of Manufacture: 1981-1982
LWAd 5,5 B 5,1 B
LpAm (operator position) 44 dB 40 dB

Example 3

Where declared noise emission values apply to individual printer units, no operator position is specified and several printing speeds are available, of which 100 cps is the most frequently used.

Product: Printer Model XYZ, Serial Number: 123456
Declared Noise Emissions per ECMA- (I): Printing/100 cps Idle
LWAd 7,4 B 5,2 B
LpAm (bystander position) 62 dB 40 dB

APPENDIX B

Character of Noise

This Appendix specifies optional information which may be provided in addition to the declared noise emission values. Information on the character of the noise, that is, whether the noise is considered to be impulsive noise or whether it contains prominent discrete tones, may be of interest to the user of the equipment.

National and international organizations have been working on objective methods for rating these subjective characters of noise, however a final consensus on the procedure to be applied has not yet been reached. Furthermore statistical procedures have to be specified for determining a single description for the character of the noise of batches of equipment.

The latest developments will be taken into account by ECMA when revising Standard ECMA-74. Therefore this Appendix makes only reference to ECMA-74. The information determined according to this Appendix is considered to be optional.

B.1 Determination of the character of noise

For the specified operator or bystander position(s) it shall be determined whether the equipment emits impulsive noise and/or prominent discrete tones.

B.1.1 Impulsive noise

ECMA-74 shall be used to determine the impulsive parameter ΔL_I . If $\Delta L_I \geq 3$ dB, the noise is considered to be impulsive.

B.1.2 Prominent discrete tones

ECMA-74 shall be used to determine whether a prominent discrete tone is present.

B.2 Information on impulsive noise and prominent discrete tones

The declared noise emission values may be supplemented by one of the following statements, which describes the character of the noise as determined according to B.1:

- no impulsive noise, no prominent discrete tones,
- impulsive noise, no prominent discrete tones,
- prominent discrete tones, no impulsive noise,
- impulsive noise and prominent discrete tones.