SLOVENSKI STANDARD
SIST EN 27779:1999

01-november-1999

Akustika - Merjenje zračnega hrupa računalnika in pisarniške opreme (ISO 7779:1988)

Acoustics - Measurement of airborne noise emitted by computer and business equipment (ISO 7779:1988)

Akustik - Geräuschmessung an Maschinen - Luftschallemission, Hüllflächen- und Hallraumverfahren-Geräte der Büro- und Informationstechnik (ISO 7779:1988)

Acoustique - Mesurage du bruit aérien émis par les équipements informatiques et de bureau (ISO 7779:1988)

Ta slovenski standard je istoveten z: **EN 27779:1991**

ICS:

17.140.20	Emisija hrupa naprav in opreme	Noise emitted by machines and equipment
35.020	Informacijska tehnika in tehnologija na splošno	Information technology (IT) in general

SIST EN 27779:1999 **en**

EUROPEAN STANDARD

NORME EUROPEENNE

EUROPÄISCHE NORM

EN 27779:1991

October 1991

UDC 534.6:534.835.46:651.2:681.3

Descriptors : Acoustics, acoustic tests, acoustic measurements, airborne sound, engine noise, office machines, data processing equipment, sound pressure, sound power

English version

Acoustics - Measurement of airborne noise emitted by computer and business equipment (Identical to ISO 7779:1988)

Acoustique - Mesurage du bruit aérien émis par les équipements informatiques et de bureau (Identique à l'ISO 7779:1988)

Akustik - Geräuschmessung an Maschinen - Luftschallemission, Hüllflächen- und Hallraumverfahren Geräte der Büro- und Informationstechnik (Identisch mit ISO 7779:1988)

This European Standard was approved by CEN on 1991-10-07 and is identical to the ISO standard as referred to.
CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

This European Standard has been taken over by CEN/TC 211 "Acoustics" from the work of the International Organization for Standardization (ISO).

This document has been submitted to the formal vote and has been approved.

Natonal Standards identical to this European Standard shall be published at the latest by 92-04-09 and conflicting national standards shall be withdrawn at the latest 92-04-09.

In accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard : Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

Endorsement notice

The text of the International Standard ISO 7779:1988 has been approved by CEN as a European Standard without any modification.

INTERNATIONAL STANDARD

ISO
7779

First edition
1988-06-15

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

Acoustics — Measurement of airborne noise emitted by computer and business equipment

Acoustique — Mesurage du bruit aérien émis par les équipements informatiques et de bureau

Reference number
ISO 7779 : 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.

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 7779 was prepared by Technical Committee ISO/TC 43, *Acoustics*.

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 — Measurement of airborne noise emitted by computer and business equipment

0 Introduction

This International Standard specifies methods for the measurement of airborne noise emitted by computer and business equipment. Hitherto, a wide variety of methods has been applied by individual manufacturers and users to satisfy particular equipment or application needs. These diverse practices have, in many cases, made comparison of noise emission difficult. This International Standard simplifies such comparisons and is the basis for declaration of the noise emission level of computer and business equipment.

In order to ensure accuracy, validity and acceptability, this International Standard is based on the basic International Standards for determining the sound power level (ISO 3741, ISO 3742, ISO 3744 and ISO 3745) and the sound pressure level at the operator position(s) (ISO 6081). Furthermore, implementation is simplified by conformance to these International Standards.

In many cases, free-field conditions over a reflecting plane are obtained by semi-anechoic rooms. These rooms may be particularly useful during product design to locate and to improve individual contributing noise sources. Reverberation rooms may be more economical for production control and for obtaining sound power levels for declaration purposes.

The method for measuring the sound pressure level at the operator or bystander positions (see ISO 6081) is specified in a separate clause, as this level is not considered to be primary declaration information. The measurements can, however, be carried out at the same time as those for sound power determination in a free field over a reflecting plane.

For comparison of similar equipment it is essential that the installation conditions and mode of operation be the same. In annex C these parameters are standardized for many categories of equipment. It is intended to extend annex C to other categories in a future revision.

1 Scope and field of application

1.1 Scope

This International Standard specifies procedures for measuring and reporting the noise emitted by computer and business equipment. It is based on the measurement procedures specified in ISO 3740, ISO 3741, ISO 3742, ISO 3744 and ISO 3745. The basic emission quantity is the A-weighted sound power level which may be used for comparing equipment of the same type, but from different manufacturers, or for comparing different equipment.

The A-weighted sound power level is supplemented by the A-weighted sound pressure level measured at the operator position(s) or the bystander positions. This sound pressure level is not a measurement of total occupational noise exposure of workers (noise immission).

Two methods for determining the sound power levels are specified in this International Standard in order to avoid undue restriction on existing facilities and experience. The first method is based on reverberant room measurements (see ISO 3741 and ISO 3742); the second is based on measurements in an essentially free field over a reflecting plane (see ISO 3744 and ISO 3745). Either method may be used in accordance with this International Standard. They are comparable in accuracy and yield the same A-weighted sound power level within the tolerance range of the methods specified in this International Standard.

1.2 Field of application

This International Standard is suitable for type tests and provides methods for manufacturers and testing laboratories to obtain comparable results.

The method specified in clause 5 provides a comparison procedure for determining sound power levels in a reverberation room. The method specified in clause 6 provides a direct procedure for determining sound power levels using essentially free-field conditions over a reflecting plane. The method specified in clause 7 provides a procedure for measuring noise at the operator or bystander positions. The procedures in this International Standard may be applied to equipment which radiates broad-band noise, narrow-band noise, noise which contains discrete-frequency components or impulsive noise.

The methods specified in this International Standard allow the determination of noise emission levels for a unit tested individually.

The sound power levels and sound pressure levels are used for noise emission declaration and comparison purposes. They are not to be considered as installation noise levels; however they may be used for installation planning.

If sound power levels obtained are determined for several units of the same production series, the result can be used to determine a statistical value for that production series.

2 Conformance

Measurements are in conformance with this International Standard if they meet the following requirements:

a) The measurement procedure, the installation and the operating conditions specified by this International Standard are fully taken into account.

b) For the determination of sound power levels, the method specified in clause 5 or the method specified in clause 6 is used.

c) For the measurement of sound pressure level at the operator or bystander positions, the method specified in clause 7 is used.

3 References

ISO 266, *Acoustics — Preferred frequencies for measurements.*

ISO 3740, *Acoustics — Determination of sound power levels of noise sources — Guidelines for the use of basic standards and for the preparation of noise test codes.*

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

ISO 3742, *Acoustics — Determination of sound power levels of noise sources — Precision methods for discrete-frequency and narrow-band sources in reverberation rooms.*

ISO 3743, *Acoustics — Determination of sound power levels of noise sources — Engineering methods for special reverberation test rooms.*

ISO 3744, *Acoustics — Determination of sound power levels of noise sources — Engineering methods for free-field conditions over a reflecting plane.*

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

ISO 6081, *Acoustics — Noise emitted by machinery and equipment — Guidelines for the preparation of test codes of engineering grade requiring noise measurements at the operator's or bystander's position.*

ISO 6926, *Acoustics — Determination of sound power levels of noise sources — Characterization and calibration of reference sound sources.* [1)]

ISO 9295, *Acoustics — Measurement of high-frequency noise emitted by computer and business equipment.*

ISO 9296, *Acoustics — Declared noise emission values of computer and business equipment.*

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

IEC Publication 651, *Sound level meters.*

IEC Publication 804, *Integrating-averaging sound level meters.*

1) At present at the stage of draft.

4 Definitions

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

4.1 level of background noise: The sound pressure level at specified locations when the equipment being tested is neither operating nor idling.

4.2 bystander: An individual who is not the operator of the equipment, but whose position lies within the sound field produced by the equipment, either occasionally or continuously.

4.3 bystander position: A measurement position at a typical location occupied by a bystander.

4.4 computer and business equipment: Equipment and components thereof which are primarily used in offices or office-like environments and in computer installations.

4.5 floor-standing equipment: A functional unit that has its own stand and is intended to be installed on the floor.

4.6 frequency range of interest: This range normally extends from the 100 Hz one-third octave band to the 10 000 Hz one-third octave band. The 16 kHz octave band shall be included if a preliminary investigation indicates that it may affect the A-weighted sound pressure or sound power levels. The range and centre frequencies of the octave bands are specified in ISO 266.

NOTES

1 If the 16 kHz octave band is included in the measurements, the procedures of this International Standard may yield measurement uncertainties greater than those stated.

2 For equipment which emits sound only in the 16 kHz octave band, the procedures specified in ISO 9295 should be used.

4.7 functional unit: An entity of physical equipment, which has been allocated an identification number, capable of accomplishing a specified task. A functional unit may be supported by a frame or frames and may be self-enclosed or designed to be attached to another device.

4.8 idling mode: A condition in which the equipment being tested, after any necessary warm-up period, is energized but is not operating.

4.9 measurement surface: A hypothetical surface of area S enveloping the equipment being tested on which the measuring points are located.

4.10 operating mode: A condition in which the equipment being tested is performing its intended function(s).

4.11 operator: An individual who operates a piece of equipment from a position in the immediate vicinity of the equipment.

4.12 operator position: Measurement position at the assigned work-station of the operator.

4.13 rack-mounted equipment: One or more sub-assemblies installed in an end-use enclosure.

4.14 reference box: A hypothetical reference surface which is the smallest rectangular parallelepiped that just encloses the equipment being tested and terminates on the reflecting plane.

4.15 reference sound source: A device which is intended for use as a stable source of sound which has a known, calibrated broad-band sound power spectrum over the frequency range of interest and which conforms to ISO 6926.

4.16 sound power level, L_W, in decibels: Ten times the logarithm to the base 10 of the ratio of a given sound power to the reference sound power. The weighting network (A-weighting) or the width of the frequency band used shall be indicated. The reference sound power is 1 pW.

NOTE — For the purposes of this International Standard, the sound power is the time-average value of the sound power during the measurement duration.

4.17 sound pressure level, L_p, in decibels: Ten times the logarithm to the base 10 of the time-mean-square sound pressure to the square of the reference sound pressure. The weighting network (A-weighting) or the width of the frequency band used shall be indicated. The reference sound pressure is 20 μPa.

NOTE — For the purposes of this International Standard, the sound pressure is the square root of the time average of the squared sound pressure during the measurement duration.

4.18 standard test table: A rigid table having a top surface of at least 0,5 m^2 (length of the top plane > 700 mm). A suitable design for the standard test table is shown in annex A.

4.19 sub-assembly: A functional unit intended to be installed in another unit or assembled with other units in a single enclosure. The unit may or may not have its own enclosure and identification number.

4.20 surface-average sound pressure level, $\overline{L_{pf}}$, in decibels: Space/time-average sound pressure level averaged over a measurement surface, corrected for the environment.

4.21 table-top equipment: A functional unit that has a complete enclosure and is intended to be installed or used on a table, desk or separate stand.

4.22 time-average sound pressure level, L_{pT}, in decibels; equivalent continuous sound pressure level during time T, in decibels: Ten times the logarithm to the base 10 of the ratio of a time-mean-square value of instantaneous band-limited sound pressure, during a stated time interval, to the square of the standard reference sound pressure.

4.23 wall-mounted equipment: A functional unit which is normally mounted against or in a wall and does not have a stand of its own.

5 Method for determining sound power levels of equipment in reverberation rooms

5.1 General

The method specified in this clause provides a comparison procedure for determining the sound power levels produced by computer and business equipment using a reverberation room. It applies to equipment which radiates broad-band noise, narrow-band noise, or noise which contains discrete-frequency components or impulsive noise.

The measurements shall be carried out in a qualified reverberation room. The volume of the equipment being tested should preferably be not greater than 1 % of the volume of the reverberation room.

NOTE — Measurements on equipment which has a volume of less than 1 m^3 and emits broad-band noise may be carried out in a special reverberation test room (see ISO 3743).

5.2 Measurement uncertainty

Measurements carried out in accordance with this method yield standard deviations which are equal to, or less than, those given in table 1.

Table 1 — Uncertainty in determining sound power levels in a reverberation room

Octave-band centre frequency Hz	One-third octave-band centre frequency Hz	Standard deviation dB
125	100 to 160	3
250	200 to 315	2
500 to 4 000	400 to 5 000	1,5
8 000	6 300 to 10 000	3

NOTES

1 For most computer and business equipment, the A-weighted sound power level is determined by the sound power levels in the 250 to 4 000 Hz octave bands. The A-weighted sound power level is determined with a standard deviation of approximately 1,5 dB. A larger standard deviation may result when the sound power levels in other bands determine the A-weighted level.

2 The standard deviations given in table 1 reflect the cumulative effects of all causes of measurement uncertainty, including variations from laboratory to laboratory, but excluding variations in the sound power level from equipment to equipment or from test to test which may be caused, for example, by changes in the installation or operating conditions of the equipment. The reproducibility and repeatability of the test results for the same piece of equipment and the same measurement conditions may be considerably better (i.e. smaller standard deviations) than the uncertainties given in table 1 would indicate.

3 If the method specified in this clause is used to compare the sound power levels of similar equipment that are omnidirectional and radiate broad-band noise, the uncertainty in this comparison yields a standard deviation which is less than that given in table 1, provided that the measurements are carried out in the same environment.

5.3 Test environment

5.3.1 General

Guidelines specified in ISO 3741 and ISO 3742 for the design of the reverberation room shall be used. Criteria for room absorption and the procedure for room qualifications given in these same International Standards shall be used.

5.3.2 Test room volume

The minimum test room volume shall be as stated in table 2. If frequencies above 3 000 Hz are included in the frequency range of interest, the volume of the test room shall not exceed 300 m^3. The ratio of the maximum dimension of the test room to its minimum dimension shall not exceed 3:1.

Table 2 — Minimum room volume as a function of the lowest frequency band of interest

Lowest frequency band of interest Hz	Minimum room volume m^3
125 (octave) or 100 (one-third octave)	200
125 (one-third octave)	150
160 (one-third octave)	100
250 (octave) or 200 (one-third octave) or higher	70

5.3.3 Level of background noise

The level of the background noise, including any noise due to motion of the microphone and/or rotating diffusers, shall be at least 6 dB, and preferably more than 10 dB, below the sound pressure level to be measured in each frequency band within the frequency range of interest.

5.3.4 Temperature and relative humidity

The air absorption in the reverberation room varies with temperature and humidity, particularly at frequencies above 1 000 Hz. The temperature θ, in degrees Celsius, and the relative humidity (r.h.), expressed as a percentage, shall be controlled during the sound pressure level measurements. The product

$$\text{r.h.} \times (\theta + 5)$$

shall not vary by more than $\pm$ 10 % during the measurements specified in 5.6, 5.7 and 5.8. For equipment the sound pressure level of which varies with temperature, the test temperature shall be 23 $\pm$ 2 °C.

The following conditions are recommended:

- barometric pressure: 86 to 106 kPa
- temperature: 15 to 30 °C
- relative humidity: 40 % to 70 %

5.4 Instrumentation

5.4.1 General

The instrumentation shall be designed to measure the space/time-average sound pressure level in octave and/or one-third octave bands; the space/time-average sound pressure level is the level of the squared sound pressure averaged over time and space. Alternatively, the space/time-average may be calculated in accordance with 5.9.

The instruments used may perform the required averaging in one of two different ways:

a) By integrating the square of the signal over a fixed time interval and dividing by the time interval. This integration may be performed by either digital or analogue means; digital integration is the preferred method (see IEC Publication 804).

b) By continuous averaging of the square of the signal using RC-smoothing with a time constant of at least 1 s ("slow" meter characteristic). Such continuous averaging provides only an approximation of the true average and it places restrictions on the settling time and observation time (see note to 5.7.2).

5.4.2 Microphone and its associated cable

The microphone used shall comply with the requirements regarding accuracy, stability and frequency response for a type 1 instrument specified either in IEC Publication 651 or in IEC Publication 804 and shall have been calibrated for its random incidence response.

The microphone and its associated cable shall be chosen so that their sensitivity does not change by more than 0,2 dB over the temperature range encountered during measurement. If the microphone is moved, care shall be exercised to avoid introducing acoustical or electrical noise (e.g. from gears, flexing cables or sliding contacts) that could interfere with the measurements.

5.4.3 Frequency response of the instrumentation system

The frequency response of the entire instrumentation system shall be flat over the frequency range of interest within the tolerances given either in IEC Publication 651 or, preferably, in IEC Publication 804, for type 1 instruments.

5.4.4 Reference sound source

The reference sound source shall meet the requirements specified in ISO 6926 over the frequency range of interest.

5.4.5 Filter characteristics

An octave-band or one-third octave-band filter set complying with the requirements specified in IEC Publication 225 shall be used. The centre frequencies of the bands shall correspond to those specified in ISO 266.

5.4.6 Calibration

During each series of measurements, an acoustical calibrator with an accuracy of $\pm$ 0,5 dB shall be applied to the microphone to check the calibration of the entire measuring system at one or more frequencies over the frequency range of interest. The calibrator shall be checked at least once a year to verify that its output has not changed. In addition, an acoustical and an electrical calibration of the instrumentation system over the entire frequency range shall be carried out at least every two years. The reference sound source shall be checked annually to verify that its output sound level has not changed.

5.5 Installation and operation of equipment — General requirements

5.5.1 Equipment installation

The equipment shall be installed according to its intended use. If the normal installation is unknown or if several possibilities exist, the same conditions for a group of similar machines shall be chosen and reported. Installation conditions for many different categories of equipment are specified in annex C; these shall be followed when labelling information is to be obtained.

a) Floor-standing equipment shall be located at least 1,5 m from any wall of the room and no major surfaces shall be parallel to a wall of the reverberation room.

If the equipment being tested consists of several frames bolted together in an installation and is too large for testing purposes, the frames may be measured separately. In such circumstances, additional covers may be required for the frames during the acoustical evaluation. These additional covers shall be acoustically comparable with the other covers on the equipment. If a unit is mechanically or acoustically coupled to another unit so that the noise levels of one are significantly influenced by the other, the equipment being tested shall, where practicable, include all units coupled together in this way.

b) Floor-standing equipment which is to be installed in front of a wall shall be placed on a hard floor in front of a hard wall (see note 2 in 6.3.1). The distance from the wall shall be in accordance with the manufacturer's instructions or as specified in annex C. If such information is not available, the distance shall be 0,1 m.

c) Table-top equipment shall be placed on the floor at least 1,5 m from any wall of the room unless a table or stand is required for operation according to annex C, e.g. printers which take paper from or stack paper on the floor. Such equipment shall be placed in the centre of the top plane of the standard test table (see annex A).

d) Wall-mounted equipment shall be mounted on a wall of the reverberation room at least 1,5 m from any other reflecting surface, unless otherwise specified. Alternatively, if operation permits, the equipment may be laid on its side and installed with its mounting surface attached to the floor at least 1,5 m from any wall of the room.

e) Rack-mounted equipment shall be placed in an enclosure which complies with the installation specifications for the equipment. The location of all units within the enclosure shall be described. The enclosure shall be tested as floor-standing or table-top equipment. Rack-mounted equipment which does not include, but requires the use of, air-moving equipment (i.e. cooling-fan assemblies) when in operation shall be tested with such equipment, as supplied or recommended by the manufacturer.

f) If the equipment is usually installed by being recessed into a wall or other structure, a representative structure shall be used for mounting during the measurements.

g) Hand-held equipment shall be supported 0,1 m above the reflecting plane by vibration-isolating elements. The supports shall not interfere with the propagation of airborne sound.

h) A sub-assembly shall be supported 0,25 m above the reflecting plane by vibration-isolating elements. The supports shall not interfere with the propagation of airborne sound.

NOTE — If the equipment is mounted near one or more reflecting planes, the sound power radiated by the equipment may depend strongly upon its position and orientation. It may be of interest to determine the radiated sound power either for one particular equipment position and orientation or from the average value for several positions and orientations.

Care shall be taken to ensure that any electrical conduits, piping, air ducts or other auxiliary equipment connected to the equipment being tested do not radiate significant amounts of sound energy into the test room. If practicable, all auxiliary equipment necessary for the operation of the equipment shall be located outside the test room and the test room shall be cleared of all objects which may interfere with the measurements.

5.5.2 Input voltage and frequency

The equipment shall be operated within 5 % of either

a) the rated voltage (if any is stated), or

b) the average voltage of a stated voltage range (i.e. operating at 120 V for a stated range from 110 to 130 V), at the rated power line frequency.

Phase-to-phase voltage variations shall not exceed 5 %.

5.5.3 Equipment operation

During the acoustical measurements the equipment shall be operated in a manner typical of normal use. Annex C specifies such conditions for many different categories of equipment.

The noise shall be measured with the equipment in both the idling and the operating modes. If several operating modes exist, e.g. reading and punching, the noise of each individual mode shall be determined and recorded. For equipment which, in normal functional operation, has several operating modes, the mode producing the highest A-weighted sound power level shall be determined, unless otherwise specified in annex C.

In the case of rack-mounted equipment in which the operation of several functional units is possible, the unit producing the highest A-weighted sound power level shall be operated together with those other units required for its operation. All other units shall be in the idling mode.

Some equipment does not operate continuously because of its mechanical design or its mode of operation under program control. Long periods may occur during which the equipment is idling. The operating mode measurements shall not include these idling periods. If it is not possible to operate the equipment continuously during the acoustical evaluation, the time interval during which measurements have to be made shall be described in the test plan, equipment specifications or other documentation.

Some equipment has operational cycles that are too short to allow reliable determination of the noise emissions. In such cases, a typical cycle shall be repeated several times.