INTERNATIONAL STANDARD

ISO 7779

Third edition
2010-08-15

Acoustics — Measurement of airborne noise emitted by information technology and telecommunications equipment

Acoustique — Mesurage du bruit aérien émis par les équipements liés aux technologies de l'information et aux télécommunications

Reference number
ISO 7779:2010(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 7779 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

This third edition cancels and replaces the second edition (ISO 7779:1999), which has been technically revised. It also incorporates the amendment, ISO 7779:1999/Amd.1:2003.

Introduction

This International Standard specifies methods for the measurement of airborne noise emitted by information technology and telecommunications (ITT) equipment. Hitherto, a wide variety of methods have 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 the declaration of the noise emission levels of ITT equipment.

In order to ensure accuracy, validity and acceptability, this International Standard is based on the basic International Standards for determination of the sound power level and for determination of the emission sound pressure level at the operator position(s) and bystander position(s). Furthermore, implementation is simplified by conformity with these International Standards.

In many cases, free-field conditions over a reflecting plane are realised by hemi-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 noise emission declaration purposes.

The method for measuring the emission sound pressure level at the operator or bystander positions (based on ISO 11201) is specified in a separate clause, as this level is not considered to be primary noise emission declaration information. The measurements can, however, be carried out in conjunction with 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.

This International Standard is based on ECMA-74.

Acoustics — Measurement of airborne noise emitted by information technology and telecommunications equipment

1 Scope

This International Standard specifies procedures for measuring and reporting the noise emission of information technology and telecommunications equipment.

NOTE 1 This International Standard is considered part of a noise test code (see 3.1.2) for this type of equipment, and is based on basic noise emission standards (see 3.1.1) ISO 3741, ISO 3744, ISO 3745 and ISO 11201.

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.

Three basic noise emission standards for determination of the sound power levels are specified in this International Standard in order to avoid undue restriction on existing facilities and experience. ISO 3741 specifies comparison measurements in a reverberation test room; ISO 3744 and ISO 3745 specify measurements in an essentially free field over a reflecting plane. Any one of these three basic noise emission standards can be selected and used exclusively in accordance with this International Standard when determining sound power levels of a machine.

The A-weighted sound power level is supplemented by the A-weighted emission sound pressure level determined at the operator position(s) or the bystander positions, based on basic noise emission standard ISO 11201. This sound pressure level is not a worker's immission rating level, but it can assist in identifying any potential problems that could cause annoyance, activity interference, or hearing damage to operators and bystanders.

Methods for determination of whether the noise emission includes prominent discrete tones or is impulsive in character are specified in Annexes D and E, respectively.

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

The methods specified in this International Standard allow the determination of noise emission levels for a functional unit (see 3.1.4) tested individually.

The procedures apply to equipment which emits broad-band noise, narrow-band noise and noise which contains discrete-frequency components, or impulsive noise.

The sound power and emission sound pressure levels obtained can serve noise emission declaration and comparison purposes (see ISO 9296).

NOTE 2 The sound power and emission sound pressure levels obtained are not to be considered as installation noise immission levels; however, they can be used for installation planning (see ECMA TR/27[4]).

If sound power levels obtained are determined for a number of functional units of the same production series, they can be used to determine a statistical value for that production series (see ISO 9296).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 266, *Acoustics — Preferred frequencies*

ISO 3741, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for reverberation test rooms*

ISO 3744, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane*

ISO 3745, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for anechoic test rooms and hemi-anechoic test rooms*

ISO 6926, *Acoustics — Requirements for the performance and calibration of reference sound sources used for the determination of sound power levels*

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*

ISO 11201, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections*

ISO 11203, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level*

IEC 60942, *Electroacoustics — Sound calibrators*

IEC 61260, *Electroacoustics — Octave-band and fractional-octave-band filters*

IEC 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications*

ECMA-74, *Measurement of airborne noise emitted by information technology and telecommunications equipment*[1)]

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3744, ISO 11201, and the following apply.

3.1 General definitions

3.1.1
basic noise emission standard
B-type standard
standard which specifies the procedure for determining the noise emission of machinery and equipment in such a way as to obtain reliable, reproducible results with a specified degree of accuracy

[ISO 12001:1996[2], 3.1]

1) Available [viewed 2010-07-13] at: http://www.ecma-international.org/publications/files/ECMA-ST/ECMA-74.pdf

3.1.2
noise test code
C-type standard
standard that is applicable to a particular class, family or type of machinery or equipment, which specifies all the information necessary to carry out efficiently the determination, declaration and verification of the noise emission characteristics under standardized conditions

[ISO 12001:1996[2], 3.2]

NOTE This International Standard, together with ISO 9295 and ISO 9296, comprise the noise test code for ITT equipment.

3.1.3
information technology and telecommunications equipment
ITT equipment
equipment for information processing, and components thereof, used in homes, offices, server installations, telecommunications installations or similar environments

3.1.4
functional unit
unit of information technology and telecommunications equipment, either with or without its own end-use enclosure, that is tested or intended to be tested in accordance with the procedures of this International Standard

NOTE 1 A functional unit can comprise more than one unit of ITT equipment when such units are to be tested together in accordance with the methods of this International Standard. A functional unit can also comprise one or more units of ITT equipment coupled to one or more units of non-ITT equipment, such as power modules, water pumps, or refrigeration units, when such equipment is necessary for the normal operation of the ITT equipment.

NOTE 2 Functional units of ITT equipment can take on a wide range of forms, including commercially available products, prototype units under development or sub-assemblies and components thereof.

3.1.5
work station
operator position
position in the vicinity of the equipment under test which is intended for the operator

NOTE 1 Adapted from ISO 11201:2010, 3.11.

NOTE 2 This term does not refer to a computer “workstation”, which denotes a high-performance, single-user computer.

3.1.6
operating mode
condition in which the equipment under test is performing its intended function(s)

3.1.7
idle mode
one or more steady-state conditions in which the equipment being tested is energized but is not operating

3.1.8
floor-standing equipment
functional unit which is intended to be installed on the floor

3.1.9
table-top equipment
functional unit which has a complete enclosure and which is intended to be installed or used on a table, desk or separate stand

3.1.10
wall-mounted equipment
functional unit which is normally mounted against or in a wall and which does not have a stand of its own

3.1.11
sub-assembly
functional unit, generally without its own end-use enclosure, intended to be installed in another unit of ITT equipment or assembled together with other sub-assemblies or units of ITT equipment into a single end-use enclosure

3.1.12
rack-mountable unit
functional unit that is designed to be installed in an end-use enclosure, in the form of a rack, frame, or cabinet, which can be fully enclosed, partially enclosed, or open frame

3.1.13
rack-enclosed system
functional unit in the form of a rack, frame, or cabinet containing one or more rack-mountable units

NOTE Rack-enclosed systems represent a wide variety of ITT equipment, depending on the particular configuration of the rack-mountable units in the rack or enclosure. These may be server systems, storage systems, I/O systems, networking systems or "integrated" systems of these or other types of rack-mountable units.

3.1.14
hand-held equipment
functional unit, generally small and lightweight, intended to be supported by the hand(s) during normal use

3.1.15
standard test table
rigid table having a top surface of at least 0,5 m^2 and length of the top plane not less than 700 mm

NOTE The design for the standard test table is shown in Annex A.

3.2 Acoustical definitions

3.2.1
emission
noise emission
airborne sound radiated by a well-defined noise source (e.g. the equipment under test)

NOTE Noise emission descriptors can be incorporated into a product declaration and/or product specification. The basic noise emission descriptors are the sound power level of the source itself and the emission sound pressure levels at an operator position or at bystander positions (if no operator position is defined) in the vicinity of the source.

3.2.2
sound pressure
p
difference between instantaneous total pressure and static pressure

NOTE 1 Sound pressure is expressed in pascals.

NOTE 2 The symbol p is often used without modification to represent a root mean square (r.m.s.) sound pressure.

[ISO 80000-8:2007[3], 9.2]

3.2.3
sound pressure level
L_p
ten times the logarithm to the base 10 of the ratio of the square of the sound pressure, p, to the square of a reference value, p0, expressed in decibels

$$L_p = 10 \lg \frac{p^2}{p_0^2} \text{ dB}$$

where the reference value, p_0, is 20 µPa

NOTE This definition is technically in accordance with ISO 80000-8:2007[3], 8.22.

[ISO/TR 25417:2007[22], 2.2]

3.2.4
time-averaged sound pressure level
L_{pT}
sound pressure level of a continuous steady sound that, within a measurement time interval, T, has the same mean-square sound pressure as a sound under consideration which varies with time

3.2.5
emission sound pressure level
L_p
sound pressure level measured at a specified position near a noise source, when the source is in operation under specified operating and mounting conditions on a reflecting plane surface, but excluding the effects of background noise

NOTE 1 The emission sound pressure level is expressed in decibels.

NOTE 2 Clause 8 specifies the method for determination of emission sound pressure level.

3.2.6
time-averaged emission sound pressure level
$L_{p\text{eq}T}$
emission sound pressure level of a continuous steady sound that, within a measurement time interval, T, has the same mean-square sound pressure as a sound under consideration which varies with time

$$L_{p\text{eq}T} = 10 \lg \left[\frac{\frac{1}{T}\int_0^T p^2(t)\,\text{d}t}{p_0^2} \right] \text{dB}$$

NOTE 1 The time-averaged emission sound pressure level is expressed in decibels.

NOTE 2 The emission sound pressure level is determined at the specified position(s) required by the noise test code (i.e. this International Standard, for specific families of ITT equipment).

NOTE 3 In general, the subscripts “eq” and “T” are omitted since time-averaged emission sound pressure levels are necessarily determined over a certain measurement time interval.

3.2.7
A-weighted impulse sound pressure level
$L_{p\text{AI}}$
A-weighted sound pressure level determined with a sound level meter set for the I time-weighting characteristic (impulse)

NOTE The A-weighted impulse sound pressure level is expressed in decibels.

3.2.8
C-weighted peak sound pressure level
$L_{p\mathrm{Cpeak}}$
highest instantaneous value of the C-weighted sound pressure level determined over an operational cycle

NOTE The C-weighted peak sound pressure level is expressed in decibels.

3.2.9
sound power
P
rate per time at which airborne sound energy is radiated by a source

NOTE 1 Sound power is expressed in watts.

NOTE 2 In this International Standard, it is the time-averaged value of the sound power during the measurement duration.

3.2.10
reference sound source
device which is intended for use as a stable source of sound, which has a known broad-band sound power spectrum calibrated in accordance with ISO 6926 over the frequency range of interest

3.2.11
frequency range of interest
one-third-octave bands with centre frequencies specified in ISO 266 from 100 Hz to 10 000 Hz inclusive

NOTE For equipment which emits discrete tone(s) in the 16 kHz octave band, the procedures specified in ISO 9295 are used; see Table 4.

4 Conformity requirements

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

a) the measurement procedures, the installation and the operating conditions specified in this International Standard are fully taken into account;

b) for the determination of sound power levels, one (and only one) of the methods specified in Clause 6 or 7 is used;

c) for determination of emission sound pressure level at the operator or bystander positions, the method specified in Clause 8 is used.

5 Installation and operating conditions

5.1 Equipment installation

5.1.1 General

The equipment shall be installed according to its intended use. Installation conditions for many different categories of ITT equipment are specified in Annex C; these shall be followed when noise emission declaration information is to be obtained. If the normal installation is unknown or if several possibilities exist, a representative condition shall be chosen and reported.

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 free from all objects which may interfere with the measurements.

NOTE If the equipment is mounted near one or more reflecting planes, the sound power radiated by the equipment can depend upon its position and orientation. It is possible that the determination of the radiated sound power is of interest either for one particular equipment position and orientation or from the average value for several positions and orientations.

5.1.2 Floor-standing equipment

5.1.2.1 Requirements for reverberation test rooms

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 test room.

5.1.2.2 Requirements for hemi-anechoic rooms

Floor-standing equipment shall be installed on the reflecting (hard) floor at a sufficient distance (more than 2 m, if possible) from the walls, unless otherwise specified in Annex C.

The equipment shall be installed in a way which allows access to all sides except the reflecting plane(s). The dimensions of the reflecting plane(s) shall extend beyond the test object by at least the measurement distance. The requirements for reflection are specified in the Note to 7.3.1. The plane(s) shall not contribute to the sound radiation due to their own vibrations.

5.1.2.3 Common requirements

If the equipment being tested consists of several frames bolted together in an installation or 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 emission levels of one are significantly influenced by the other, the equipment being tested shall, where practicable, include all units coupled together in this way.

Floor-standing equipment which is to be installed only in front of a wall shall be placed on a hard floor in front of a hard wall (see the Note to 7.3.1). 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.

5.1.3 Table-top equipment

5.1.3.1 Requirements for reverberation test rooms

Table-top equipment (see 3.1.9) 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 in accordance with 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).

5.1.3.2 Requirements for hemi-anechoic rooms

Table-top equipment (see 3.1.9) shall be placed on the floor, unless a table or stand is required for operation in accordance with 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). In any case, the measurement surface defined in 7.6 terminates on the floor.

5.1.4 Wall-mounted equipment

Wall-mounted equipment (see 3.1.10) shall be affixed to a wall of the reverberation test room at least 1,5 m from any other reflecting surface, unless otherwise specified. Alternatively, if operation permits, the equipment may be laid with its mounting surface on the floor at least 1,5 m (more than 2 m, if possible, in hemi-anechoic rooms) from any wall of the room.

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 and described in the test report.

5.1.5 Rack-mounted equipment

Rack-mounted equipment includes both individual rack-mountable units (see 3.1.12) and rack-enclosed systems (see 3.1.13). Rack-mountable units shall either be tested outside of the rack or installed in a rack enclosure in accordance with the requirements of ECMA-74. Rack-enclosed systems shall be tested either as floor-standing equipment (see 5.1.2) or as table-top equipment (see 5.1.3) according to the type and size of system. The specific installation and operation requirements of ECMA-74 shall be followed.

For rack-enclosed systems that are available in more than one configuration of rack-mountable units, the particular configuration to be measured is usually governed by the purposes of the test and is thus not specified in this International Standard (see ECMA-74 for more information).

5.1.6 Hand-held equipment

Hand-held equipment (see 3.1.14) shall be supported 0,25 m ± 0,03 m above the reflecting plane by a vibration-isolating stand or fixture, or by appropriate vibration-isolating elements. If a hemispherical measurement surface is used with any radius less than 1 m (see B.1), the hand-held equipment support height shall be reduced to 0,125 m ± 0,015 m. The method of supporting the hand-held equipment shall not interfere with the propagation of airborne sound from the equipment or generate any additional sound radiation.

5.1.7 Sub-assemblies

A sub-assembly (see 3.1.11) shall be supported 0,25 m ± 0,03 m above the reflecting plane by a vibration-isolating stand or fixture, or by appropriate vibration-isolating elements. If a hemispherical measurement surface is used with a radius less than 1 m (see B.1), the sub-assembly support height shall be reduced to 0,125 m ± 0,015 m. The method of supporting the sub-assembly shall not interfere with the propagation of airborne sound from the sub-assembly or generate any additional sound radiation.

If the above-specified support height is not adequate to allow the manufacturer's recommended air flow at the sub-assembly's intake port, the height may be adjusted accordingly, but shall not exceed 0,5 m. The new height shall be documented in the test report.

5.2 Input voltage and frequency

The equipment shall be operated at its nominal rated voltage and the rated power line frequency.

Phase-to-phase voltage variations shall not exceed 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 categories of equipment and shall be followed. However, if the specified conditions are clearly contrary to the objective of providing uniform conditions closely corresponding to the intended use of the product, then an additional mode or modes closely related to the intended use shall be defined, tested and documented. Any subsequent declaration shall either:

— declare both values, indicating that one is based on Annex C, and indicating that the other is declared by the manufacturer to be typical use for the intended application; or

— declare only the latter, indicating that it is not based on Annex C, but is declared by the manufacturer to be typical use for the intended application.

When there are multiple operating modes specified in Annex C, at a minimum, the most typical operating mode shall be tested and reported.

The equipment shall be operated for a sufficient period of time before proceeding with the acoustical test to allow temperature and other pertinent conditions to stabilize.

The noise shall be measured with the equipment in both the idle and operating modes. If the equipment is designed to perform different functions, such as manual typing and automatic printing of stored information or for printing in different print qualities, unless otherwise specified in Annex C, the noise of each individual mode shall be determined and recorded. For equipment which, in normal functional operation, performs several operating modes, such as document insertion, reading, encoding, printing and document eject, and for which a typical operation cycle has not been defined in Annex C, such a typical cycle shall be defined for the measurements and described in the test report.

For rack-mounted equipment in which the operation of several functional units is possible, the units intended to operate together shall do so during the test; all other units shall be in idle mode. In the absence of operational specifications provided by Annex C or by the manufacturer, an operating mode that represents the most typical usage shall be tested. This mode shall be clearly described in the test report.

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 idle. The operating mode measurements shall not include these idle 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.

If the equipment being tested produces attention signals, such as tones or bells, such intermittent sound shall not be included in an operating mode. During the acoustical evaluation in the operating mode(s), such attention signals shall be inoperative or, if this is not possible, they shall be set to a minimum.

NOTE For certain applications, such signals as well as the maximum response of feedback signals of keyboards can be of interest. Such measurements can be made, but they are not part of the methods specified in this International Standard.

6 Method for determination of sound power levels of equipment in reverberation test rooms

6.1 General

The method specified in this clause provides a comparison procedure for determination of the sound power levels produced by ITT equipment in a reverberation test room, in accordance with the comparison method specified in ISO 3741. It applies to equipment which radiates broad-band noise, narrow-band noise, noise which contains discrete-frequency components or impulsive noise.

It is strongly recommended that the room be qualified for discrete-frequency components in accordance with the relevant procedure specified in ISO 3741. This avoids the need to determine the number of microphone positions and equipment locations each time equipment is measured.

6.2 Measurement uncertainty

Measurements carried out in accordance with this method yield standard deviations of reproducibility for the frequency range of interest of this International Standard which are equal to, or less than, those given in Table 1.