

ANSI/ASA S12.10-2010/Part 1
(Revision of ANSI/ASA S12.10-2002/ISO 7779-1999 (R2007))

AMERICAN NATIONAL STANDARD

**Acoustics - Measurement of Airborne
Noise Emitted by Information Technology and
Telecommunications Equipment -
Part 1: Determination of Sound Power Level and
Emission Sound Pressure Level**

Secretariat:

Acoustical Society of America

Approved October 6, 2010 by:

American National Standards Institute, Inc.

Abstract

This Standard specifies methods for the measurement of airborne noise emitted by information technology and telecommunications 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 Standard simplifies such comparisons and is the basis for the declaration of the noise emission levels of information technology and telecommunications equipment.

This Standard is technically identical to parts of ECMA-74.

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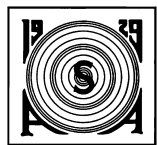
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Foreword

[This Foreword is for information only and is not a part of the American National Standard ANSI/ASA S12.10-2010/Part 1 American National Standard Acoustics – Measurement of airborne noise emitted by information technology and telecommunications equipment - Part 1: Determination of Sound Power Level and Emission Sound Pressure Level.]

This standard comprises a part of a group of definitions, standards, and specifications for use in noise. It was developed and approved by Accredited Standards Committee S12 Noise, under its approved operating procedures. Those procedures have been accredited by the American National Standards Institute (ANSI). The Scope of Accredited Standards Committee S12 is as follows:

Standards, specifications, and terminology in the field of acoustical noise pertaining to methods of measurement, evaluation, and control, including biological safety, tolerance, and comfort, and physical acoustics as related to environmental and occupational noise.

This standard revises and replaces ANSI/ASA S12.10-2002/ISO 7779:1999. This document adopts, with permission, parts of the 10th Edition of ECMA-74 (2008). ECMA-74 is also the underlying document for ISO 7779 and it is anticipated that the next edition of ISO 7779 will be essentially identical to the 10th Edition of ECMA-74 (2008).

Changes from ANSI/ASA S12.10-2002/ISO 7779:1999 include the following:

Changes were made to the main body of this Standard to be consistent with ECMA-74, which was revised to correspond with upcoming changes in the underlying standards: ANSI/ASA S12.51 / ISO 3741, ANSI/ASA S12.54 / ISO 3744, ANSI/ASA S12.55 / ISO 3745 and ISO 11201.

A revised Annex B includes a provision allowing the use of a 0.5 m radius hemispherical surface for measuring the sound power emitted by small noise sources such as disk drives. Annex B also allows the use of a cylindrical measurement surface and follows wording in ANSI/ASA S12.54 / ISO 3744.

Annex C was modified to reference the latest version of ECMA-74 for details of modes of operation and installation of specific product types, which is contained in Annex C of the 10th Edition of ECMA-74 (2008).

A revised Annex D includes prominence ratio in addition to tone-to-noise ratio, provides improved figures illustrating the tone-to-noise and prominence ratio calculations, and contains new criteria for prominent discrete tones. The new criteria are a result of a 3-year study by ECMA TC26 and ITI TC6. Changes were also made in part to better define the critical band edges, including changing from geometric critical bands to arithmetic critical bands for frequencies below 500 Hz. Also, curves were fitted to the band edges for the lower and upper critical bands when calculating prominence ratio, thus eliminating the need to use iteration for the calculations. Clarifications were added on frequency range of interest and elsewhere. Annex D was also revised to give clearer direction on determining the prominence of tones as well as introducing the concept of threshold of hearing when analyzing very low-noise equipment.

At the time this Standard was submitted to Accredited Standards Committee S12, Noise, for approval, the membership was as follows:

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Suggestions for improvements of this standard will be welcomed. They should be sent to Accredited Standards Committee S12, Noise, in care of the Standards Secretariat of the Acoustical Society of America, 35 Pinelawn Road, Suite 114E, Melville, New York 11747-3177. Telephone: 631-390-0215; FAX: 631-390-0217; E-mail: asastds@aip.org.

Introduction

ANSI/ASA S12.10-2010/Part 1 specifies methods for the measurement of airborne noise emitted by information technology and telecommunications 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 Standard simplifies such comparisons and is the basis for declaration of the noise emission level of information technology and telecommunications equipment.

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

In many cases free-field conditions over a reflecting plane are realized by hemi-anechoic rooms. These rooms may be particularly useful during product design to locate and to improve individual contributing noise sources. Reverberation test 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 are the same. In Annex C these parameters are standardized for many categories of equipment by referring to the latest edition of ECMA-74, which is the world-wide test code for the IT industry.

American National Standard

Measurement of Airborne Noise Emitted by Information Technology and Telecommunications Equipment - Part 1: Determination of Sound Power Level and Emission Sound Pressure Level

1 Scope

This American National Standard specifies procedures for measuring and reporting the noise emission of information technology and telecommunications equipment. This Standard is considered part of a noise test code for this type of equipment and is based on basic noise emission standards ANSI/ASA S12.51 / ISO 3741, ANSI/ASA S12.54 / ISO 3744, ANSI/ASA S12.55 / 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 determining the sound power levels are specified in this American National Standard in order to avoid undue restriction on existing facilities and experience. The first basic standard (ANSI/ASA S12.51 / ISO 3741) specifies comparison measurements in a reverberation test room; the other two (ANSI/ASA S12.54 / ISO 3744 and ANSI/ASA S12.55 / ISO 3745) specify measurements in an essentially free field over a reflecting plane. Any one of these three basic noise emission standards may be selected and shall then be used exclusively according to this 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 the basic noise emission standard ISO 11201. This sound pressure level is not a worker's immission rating level, but it may assist in identifying any potential problems that could cause annoyance, activity interference, or hearing damage to operators and bystanders.

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

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

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

The procedures may be applied 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 may serve noise emission declaration and comparison purposes (see ECMA-109). They are not to be considered as installation noise immission levels; however, they may be used for installation planning (see ECMA TR/27).

If sound power levels obtained are determined for a number of units of the same production series, they can be used to determine a statistical value for that production series (see ECMA-109).

2 Normative references

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

ANSI S12.5 / ISO 6926, *American National Standard Acoustics -- Requirements for the performance and calibration of reference sound sources used for the determination of sound power levels*

ANSI/ASA S12.51 / ISO 3741, *American National Standard Acoustics -- Determination of sound power levels of noise sources using sound pressure -- Precision methods for reverberation rooms*

ANSI S12.54 / ISO 3744, *American National Standard Acoustics -- Determination of sound power levels of noise sources using sound pressure -- Engineering method in an essentially free field over a reflecting plane*

ANSI S12.55 / ISO 3745, *American National Standard Acoustics -- Determination of sound power levels of noise sources using sound pressure -- Precision methods for anechoic and hemi-anechoic rooms*

ECMA-74, *Measurement of Airborne Noise Emitted by Information Technology and Telecommunication Equipment*

ECMA-108, *Measurement of High-frequency Noise Emitted by Information Technology and Telecommunication Equipment*

ECMA-109, *Declared Noise Emission Values of Information Technology and Telecommunication Equipment*

ECMA TR/27, *Method for the prediction of installation noise levels*

ISO 266, *Acoustics -- Preferred frequencies*

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 61672-1:2002, *Electroacoustics - Sound level meters - Part 1: Specifications*

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in ANSI/ASA S12.51 / ISO 3741 and ISO 11201 and the following apply:

3.1 General definitions

3.1.1

basic noise emission standard (B-type standard)

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

3.1.2

floor-standing equipment

functional unit which is intended to be installed on the floor

3.1.3

functional unit

unit of ITT equipment, either with or without its own end-use enclosure, that is tested or intended to be tested according to the procedures of this Standard

NOTE 1 A functional unit may comprise more than one unit of ITT equipment when such units are to be tested together according to the methods of this Standard. A functional unit may also comprise one or more units of ITT equipment coupled together with 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 units.

NOTE 2 The abbreviated form “functional unit” is used in this Standard to denote this term.

NOTE 3 Functional units of ITT equipment may take on a wide range of forms, including commercially available ITT products, prototype units under development, or sub-assemblies and components thereof.

3.1.4

hand-held equipment

functional unit, generally small and lightweight, intended to be supported in one's hand(s) during operation

3.1.5

idle mode

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

3.1.6

information technology and telecommunications (ITT) equipment

equipment for information processing used in homes, offices, server installations, telecommunications installations, or similar environments, covered under the scope of this Standard

NOTE Annex C, which specifies particular requirements for use with this Standard, may be useful in identifying many of the categories of ITT equipment.

3.1.7

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

NOTE This Standard (ANSI/ASA S12.10-2010/Part 1) together with ECMA-108 (ISO 9295) and ECMA-109 (ISO 9296) comprise the noise test code for Information Technology and Telecommunications Equipment. All three sets of noise test codes (ANSI, ISO and ECMA) are consistent with guidelines specified in ISO 12001.

3.1.8

operating mode

condition in which the equipment being tested is performing its intended function(s)

3.1.9

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.

3.1.10

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, either fully enclosed, partially enclosed, or open frame

3.1.11

standard test table

rigid table having a top surface of at least 0.5 m² and length of the top plane not less than 0.7 m

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

3.1.12

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

3.1.13

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

3.1.14

wall-mounted equipment

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

3.1.15

work station; operator position

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

NOTE 1 It does not refer to a computer “workstation,” which denotes a high-performance, single-user computer.

NOTE 2 See ISO 11201.

3.2 Acoustical definitions

3.2.1

A-weighted impulse sound pressure level, L_{pAI}

A-weighted sound pressure level determined with a sound level meter set for the time weighting I (impulse)

NOTE It is expressed in decibels.

3.2.2

C-weighted peak emission sound pressure level, L_{pCpeak}

highest instantaneous value of the C-weighted emission sound pressure level determined over an operational cycle

3.2.3

emission sound pressure level, L_p

sound pressure level at a specified position near a noise source, measured with a particular time weighting and a particular frequency weighting, when the source is in operation under specified operating and mounting conditions on a reflecting plane surface, excluding the effects of background noise

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

3.2.4

frequency range of interest

one-third-octave bands with center 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 ECMA-108 should be used; see Table 4.

3.2.5

reference sound source

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 ANSI S12.5 / ISO 6926

3.2.6

sound power, W

rate per unit time at which airborne sound energy is radiated by a source

NOTE 1 It is expressed in watts.

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

3.2.7

sound pressure, p

square root of the time mean-square sound pressure during the measurement duration

NOTE Sound pressure is expressed in pascals.

3.2.8

time-averaged emission sound pressure level, L_{peqT}

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

$$L_{p_{eqT}} = 10 \lg \frac{1}{T} \int_0^T \frac{p^2(t)}{p_0^2} dt \text{ dB}$$

NOTE 1 It 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 Standard, for this specific family of information technology and telecommunications equipment).

3.2.9

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

NOTE Time averaged sound pressure levels are expressed in decibels.

4 Conformance requirements

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

- a. The measurement procedures, the installation, and the operating conditions specified by this Standard are taken fully into account.
- b. For the determination of sound power levels, one (and only one) of the methods specified in 6 or 7 is used.
- c. For the determination of emission sound pressure level at the operator or bystander positions, the method specified in 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 information technology and telecommunications 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 may depend 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.

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 in 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 in 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 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 center of the top plane of the standard test table (see Annex A).

5.1.3.2 Requirements for hemi-anechoic rooms

Table-top equipment shall be placed on the floor 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 center 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 shall be mounted on 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 3.1.10) and rack-enclosed systems (see 3.1.9). Rack-mountable units shall either be tested outside of the rack or installed in a rack enclosure according to the requirements of Annex C. 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 Annex C 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 Standard (see Annex C for more information).

5.1.6 Hand-held equipment

Hand-held equipment shall be supported $0.25\text{ m} \pm 0.03\text{ m}$ 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 sub-assembly support height shall be reduced to 0.125 m (+0.003 m, -0.005 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 3.1.12) shall be supported $0.25\text{ m} \pm 0.03\text{ m}$ 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 sub-assembly support height shall be reduced to 0.125 m (+0.003 m, -0.005 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 air inlet, 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. When there are multiple operating modes specified in Annex C, at a minimum, the most typical operating mode shall be tested and reported. 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 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.

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 for performing different functions, such as manually 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.

In the case of rack-mounted equipment in which the operation of several functional units is possible, the units intended to operate together shall be operated 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 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.

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 may be of interest. Such measurements may be made, but they are not part of the methods specified in this Standard.

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

6.1 General

The method specified in this clause provides a comparison procedure for determining the sound power levels produced by information technology and telecommunications equipment in a reverberation test room, according to the comparison method specified in ANSI/ASA S12.51 / 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 ANSI/ASA S12.51 / 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 Standard which are equal to or less than those given in Table 1.

Table 1 — Uncertainty in determining sound power levels in a reverberation test room according to Clause 6 of this Standard

Octave band center frequencies (Hz)	One-third-octave band center frequencies (Hz)	Standard deviation (dB)
125	100 to 160	3.0
250	200 to 315	2.0
500 to 4 000	400 to 5 000	1.5
8 000	6 300 to 10 000	3.0

NOTE 1 For most information technology and telecommunications equipment, the A-weighted sound power level is determined by the sound power levels in the 250 Hz 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 sound power level.

NOTE 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 indicate.

NOTE 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.

6.3 Test environment

6.3.1 General

Guidelines specified in ANSI/ASA S12.51 / ISO 3741 for the design of the reverberation test room, as applicable, shall be used. Criteria for room absorption and the procedure for room qualifications, specified in ANSI/ASA S12.51 / ISO 3741 shall be used.

ANSI/ASA S12.51 / ISO 3741 shall be followed with regard to the following:

- a. test room volume;
- b. level of background noise.

6.3.2 Meteorological conditions

The requirements of ANSI/ASA S12.51 / ISO 3741 shall be followed.

The following conditions are recommended:

- a. barometric pressure: 86 kPa to 106 kPa;
- b. temperature: within the range defined by the manufacturer for the equipment if a range is defined; if no range is so defined by the manufacturer, the recommended range is 15 °C to 30 °C;
- c. relative humidity: within the range defined by the manufacturer for the equipment if a range is defined; for processing of paper and card media only, if no range is so defined by the manufacturer, the recommended range is 40 % to 70 %.

For equipment whose noise emissions vary with ambient temperature in a prescribed manner (e.g., by varying the speeds of air-moving devices), the room temperature during the measurement shall be $23\text{ °C} \pm 2\text{ °C}$.

For equipment whose noise emissions vary with altitude in a prescribed manner (e.g., by varying the speeds of air-moving devices), the altitude of the test room shall either be less than or equal to 500 m or the equipment shall be tested under conditions simulating its operation at an altitude less than or equal to 500 m.

6.4 Instrumentation

6.4.1 General

The requirements of 6.4 as well as the instrumentation requirements of ANSI/ASA S12.51 / ISO 3741 shall be followed.

Digital integration is the preferred method of averaging.

6.4.2 The microphone and its associated cable

The instrument system, including the microphone and its associated cable, shall meet the requirements of ANSI/ASA S12.51 / ISO 3741. 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.

6.4.3 Frequency response of the instrumentation system

The requirements of ANSI/ASA S12.51 / ISO 3741 shall be followed.

6.4.4 Reference sound source

The reference sound source shall meet the requirements specified in ANSI S12.5 / ISO 6926 over the frequency range of interest.

6.4.5 Filter characteristics

The requirements of a class 1 instrument specified in IEC 61260 shall be followed.

6.4.6 Calibration

During each series of measurements, a sound calibrator of class 1 as specified in IEC 60942 shall be applied to the microphone to verify the calibration of the entire measuring system at one or more frequencies over the frequency range of interest. The compliance of the calibrator shall be verified with the requirements of IEC 60942 once a year, and the compliance of the instrumentation system with the requirements of IEC 61672-1 at least every 2 years in a laboratory making calibrations traceable to appropriate standards.

The reference sound source shall be fully calibrated every 2 years according to ANSI S12.5 / ISO 6926.

The reference sound source shall be checked annually in accordance with the procedure in ANSI S12.5 / ISO 6926 to determine whether or not recalibration of the reference sound source is necessary prior to the 2-year calibration period. If changes in any one-third-octave-band sound pressure level exceed values for recalibration specified in ANSI S12.5 / ISO 6926, then the reference sound source shall be fully calibrated according to ANSI S12.5 / ISO 6926 before further use.

The date of the last verification of the compliance with the relevant ISO or IEC standards shall be recorded.

6.5 Installation and operation of equipment: General requirements

See Clause 5.

6.6 Microphone positions and source locations

6.6.1 General

The major cause of uncertainty in determining sound power level in a reverberation test room is the spatial irregularity of the sound field. The extent of this irregularity and, hence, the effort required to determine the average sound pressure level accurately is greater for discrete-frequency sound than for broad-band sound.

It is strongly recommended that the room be qualified for the measurement of discrete-frequency components in accordance with the relevant procedures of ANSI/ASA S12.51 / ISO 3741. This avoids

the need to determine the number of microphone positions and equipment locations each time equipment is measured.

If the room has not been qualified for the measurement of discrete-frequency components, the procedures specified in ANSI/ASA S12.51 / ISO 3741 shall be used to determine the minimum number of microphone positions and to evaluate the need for additional noise source locations prior to each measurement. The results of these procedures depend on the presence or absence of significant discrete-frequency components or narrow bands of noise in the sound emitted by the source. When these are present, the number of microphone positions and equipment locations may be large.

6.6.2 Number of microphone positions, reference sound source locations and equipment locations

The requirements of ANSI/ASA S12.51 / ISO 3741 shall be followed.

6.6.3 Microphone arrangement

The requirements of ANSI/ASA S12.51 / ISO 3741 shall be followed.

6.7 Measurement of sound pressure level

6.7.1 General

The requirements of ANSI/ASA S12.51 / ISO 3741 shall be followed, as applicable.

6.7.2 Measurement duration

The requirements below in addition to those of ANSI/ASA S12.51 / ISO 3741 shall be followed, as applicable.

For equipment which performs repetitive operation cycles (e.g., enveloping machines), the measurement duration shall include at least three operation cycles. For equipment which performs a sequence of varying operation cycles, the measurement duration shall include the total sequence. Annex C specifies additional requirements for many categories of equipment.

6.7.3 Corrections for background noise

The requirements of ANSI/ASA S12.51 / ISO 3741 shall be followed, as applicable.

NOTE When the background noise levels in the test room are extremely low and very controlled, the environment may satisfy the absolute and/or relative criteria for background noise in accordance with ANSI/ASA S12.51 / ISO 3741. Care should be taken to use the latest version of ANSI/ASA S12.51 / ISO 3741; the third edition (1999-08-01), and earlier, did not use the concept of absolute and relative criteria for background noise.

6.8 Measurement of the sound pressure level of the reference sound source

The requirements below in addition to those of ANSI/ASA S12.51 / ISO 3741 shall be followed.

For the purposes of determining the sound power level of the equipment by means of reverberation test rooms, this Standard uses exclusively the comparison method specified in ANSI/ASA S12.51 / ISO 3741. This method has the advantage that it is not necessary to measure the reverberation time of the test room. The comparison method requires the use of a reference sound source with characteristics and calibration in accordance with ANSI S12.5 / ISO 6926. The reference sound