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AMERICAN NATIONAL STANDARD

Methods for Measurement of Sound Emitted by Machinery and Equipment at Workstations and Other Specified Positions

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(Formerly ANSI S12.43-1997)

Accredited Standards Committee S12, Noise

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Methods for Measurement of Sound Emitted by Machinery and Equipment at Workstations and Other Specified Positions

Secretariat
Acoustical Society of America

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Abstract

This Standard provides three methods to measure sound pressure levels from all types of machinery and equipment at workstations and other specified positions. The first method applies to measurements in an essentially free field over a reflecting plane. These sound pressure levels are, in general, equal to or lower than those that would occur when the machine is operated in its normal surroundings as the effects of background noise or reflections from surfaces other than the mounting surface are excluded. The second method applies to measurements in normal operating environments where the effects of background noise and reflections from surfaces surrounding the machine are accounted for in the measurements. The third method is a survey method of measurement for sound sources operating in their normal environments when less-accurate measurements are acceptable.

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Foreword

[This foreword is for information only and is not an integral part of ANSI S12.43-1997 *American National Standard Methods for Measurement of Sound Emitted by Machinery and Equipment at Workstations and Other Specified Positions.*]

This American National Standard was developed as a national counterpart to four International Standards:

ISO 11200:1995 *Acoustics—Noise Emitted by Machinery and Equipment—Guidelines for the Use of Basic Standards for the Determination of Emission Sound Pressure Levels at a Workstation and at Other Specified Positions.*

ISO 11201:1995 *Acoustics—Noise Emitted by Machinery and Equipment—Measurement of Emission Sound Pressure Levels at a Workstation and at Other Specified Positions—Engineering Method in an Essentially Free Field over a Reflecting Plane.*

ISO 11204:1995 *Acoustics—Noise Emitted by Machinery and Equipment—Measurement of Emission Sound Pressure Levels at a Workstation and at Other Specified Positions—Method Requiring Environmental Corrections.*

ISO 11202:1995 *Acoustics—Noise Emitted by Machinery and Equipment—Measurement of Emission Sound Pressure Levels at a Workstation and at Other Specified Positions—Survey Method in Situ.*

This Standard was developed under the jurisdiction of Accredited Standards Committee S12, Noise, which has the following scope:

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.

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

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This Standard specifies three methods to measure sound pressure levels at workstations and other specified positions. The methods differ from each other in terms of the permissible test environments and expected accuracy of results. One annex provides guidance on the selection of which method is appropriate for a specific situation. Other annexes provide calculation procedures for making corrections to measured sound pressure levels for the presence of background sound levels and the acoustical properties of test environments.

The methods of this Standard are not applicable to machines whose sole purpose is to produce or reproduce sound, such as musical instruments, loudspeakers, or earphones, except where such machines are attached to other machines as annunciators.

This Standard is closely related to Draft ANSI S12.44-1997 *American National Standard Methods for Calculation of Sound Emitted by Machinery and Equipment at Workstations and Other Specified Positions from Sound Power Level*.

The ad hoc Working Group, which assisted Accredited Standards Committee S12, Noise, in the preparation of this standard, had the following membership:

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Suggestions for improvement will be welcomed. They should be made in writing to Accredited Standards Committee S12, Noise, in care of the Standards Secretariat, Acoustical Society of America, 120 Wall Street, 32nd floor, New York, New York, 10005-3993, U.S.A.

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American National Standard

Methods for Measurement of Sound Emitted by Machinery and Equipment at Workstations and Other Specified Positions

1 Scope

1.1 General

This Standard specifies three methods for measuring sound pressure levels from machinery and equipment, at a workstation and at other specified positions nearby. The three methods are differentiated primarily by the acoustical environment in which the measurements are made:

Method A: Measurements in an essentially free field over a reflecting plane.

Method B: Measurements in any environment that meets certain qualification requirements specified in this Standard.

Method C: Measurements, in a semi-reverberant field, for which the accuracy implied by the measurements under Methods A or B is not required.

A workstation is occupied by an operator of a machine or equipment. It may be located in an open space in the room where the sound source operates, or in a cab fixed to the source, or in an enclosure remote from the source. One or more specified positions may be in the vicinity of an unattended machine. As some of these positions may be occupied occasionally or regularly, they are sometimes referred to as bystander positions.

Emission sound pressure levels are measured with frequency weighting A and, if required, as C-weighted peak and in frequency bands.

Instructions are given for the installation and operation of the machine under test and for the

choice of microphone positions for the workstation and for other specified positions. The purpose of the measurements is to permit comparison of the performance of different units of a given family of machinery or equipment, under defined environmental conditions and standardized mounting and operating conditions. The data obtained are also used for the declaration and verification of sound pressure levels as specified in noise test codes.

1.1.1 Method A—engineering method

Method A in this Standard prescribes requirements on the test environment and instruments to permit measurements having an engineering grade of accuracy. Corrections are applied for background noise, but not for the acoustical environment.

1.1.2 Method B—method requiring environmental corrections

Method B in this Standard specifies the determination of a local environmental correction (the acceptable maximum value of which is prescribed) to be applied to the measured sound pressure levels to exclude the effects of reflections from reflecting surfaces other than the plane on which the machinery or equipment is placed. The accuracy of the measurements (engineering or survey) depends upon the value of the local environmental factor. The local environmental correction is based on the space average sound pressure level on a specified surface, the sound pressure level measured at a specified position, and either an environmental indicator or the equivalent sound absorption area of the test room.

1.1.3 Method C—survey method *in situ*

Method C of this Standard prescribes requirements on the test environment and instruments for measurements that result in the survey grade of accuracy. A method is given for determining a local environmental correction (subject to a prescribed limiting maximum value) to be applied to the measured sound pressure levels in order to exclude at least part of the effects of reflections from reflecting surfaces other than the plane on which the machinery or equipment is placed.

This correction is based on the equivalent sound absorption area of the test room.

1.2 Types of noise and noise sources

The methods specified in this Standard are applicable to machines of all sizes, and to all types of sound. The methods apply to all types of machinery, both moving and stationary, for indoor or outdoor use.

1.3 Test environment

The type of acoustical test environment influences the accuracy of the determination of emission sound pressure levels. The test environment may be indoors or outdoors as long as it meets the requirements for the measurement method being used. For Method A an essentially free field over a reflecting plane is required. For either Method B or C the test environment may have one or more reflecting planes present, meeting the requirements specified in this Standard for the procedure.

1.4 Specified positions

Examples of appropriate positions where measurements may be made include the following:

- (a) a workstation in the vicinity of the machine under test; this is the case for many industrial machines and domestic appliances;
- (b) a workstation within a cab that is an integral part of the machine under test; this is the case for many trucks and earth-moving machines;
- (c) a workstation within a partial or total enclosure (or behind a screen) supplied by the manufacturer as an integral part of the machinery or equipment;
- (d) a workstation partially or totally enclosed by the machine under test; this situation may be encountered with some large industrial machines;
- (e) bystander positions occupied by individuals not responsible for the operation of the machine under test, but who may be in its immediate vicinity, either occasionally or continuously; and

- (f) other specified positions, not necessarily workstations or bystander positions.

The workstation may also lie on a specified path along which an operator moves (see 11.4).

1.5 Measurement uncertainty

Guidance is given in clause 4 regarding the determination of the standard deviation of reproducibility of measurements of sound pressure levels at workstations.

1.6 Guidelines for selecting a measurement method

Guidelines to assist in the selection of a measurement procedure appropriate for a particular situation are provided in annex A.

2 Normative references

The following Standards contain provisions which, through reference in this text, constitute provisions of the Standard. At the time of publication, the editions indicated are valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to apply the most recent editions of currently valid Standards.

ANSI S1.1-1994 *American National Standard Acoustical Terminology*.

ANSI S1.4-1983 (R 1994) *American National Standard Specification for Sound Level Meters*

ANSI S1.4A-1985 Amendment to ANSI S1.4-1983.

ANSI S1.11-1986 (R 1993) *American National Standard Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters*.

ANSI S1.40-1984 (R 1990) *American National Standard Specification for Acoustical Calibrators*.

ANSI S12.34-1988 (R 1993) *American National Standard Engineering Methods for the Determination of Sound Power Levels of Noise Sources for Essentially Free-field Conditions over a Reflecting Plane*.

ANSI S12.35-1990 American National Standard Precision Methods for the Determination of Sound Power Levels of Noise Sources in Anechoic and Hemi-Anechoic Rooms.

ANSI S12.36-1990 American National Standard Survey Methods for the Determination of Sound Power Levels of Noise Sources.

ANSI S12.44-1997 American National Standard Methods for Calculation of Sound Emitted by Machinery and Equipment at Workstations and Other Specified Positions from Sound Power Level.

IEC 651:1979, Sound Level Meters.

IEC 804:1985, Integrating Averaging Sound Level Meters.

3 Definitions

For the purposes of this Standard, the following definitions apply. More detailed definitions may be found in noise test codes for specific types of machinery and equipment and in ANSI S1.1-1994.

3.1 emission. Sound radiated by a well-defined sound source (e.g., the machine under test).

NOTE – Noise emission descriptors may be incorporated in a product label or product specification. The basic noise emission descriptors are the sound power level of the source itself and the sound pressure levels at the workstation or at other specified positions (if any) in the vicinity of the source.

3.2 emission sound pressure. Root-mean-square sound pressure, at a specified position near a sound source, under specified operating and mounting conditions, on a reflecting plane surface, excluding the effects of background noise as well as the effects of reflections from room surfaces other than the plane or planes permitted for the purpose of the test. Sound pressure may be measured with a specified frequency weighting; it may also be exponentially time-weighted. Unit, pascal (Pa); symbol, p .

3.3 emission sound pressure level. Ten times the logarithm to the base 10 of the ratio of the

square of the emission sound pressure to the square of the reference sound pressure of 20 μPa . Unit, decibel (dB); symbol, L_p .

3.4 time-average emission sound pressure level. Ten times the logarithm to the base 10 of the ratio of the mean-square emission sound pressure, during a stated time interval T , to the square of the standard reference sound pressure 20 μPa . Unit, decibel (dB); symbol, L_{pT} .

3.5 peak emission sound pressure level. Twenty times the logarithm to the base 10 of the ratio of the greatest absolute value of the instantaneous emission sound pressure, determined over an operational cycle, to the standard reference sound pressure 20 μPa . Unit, decibel (dB); symbol, L_{pk} .

NOTE – Peak emission sound pressure level should be measured with a standard frequency bandwidth, for example, the bandwidth provided by frequency weighting C.

3.6 emission sound exposure level. Ten times the logarithm to the base 10 of the ratio of the time-integrated squared emission sound pressure of an isolated single sound event to the product of the squared reference pressure of 20 μPa and reference duration of one second. Unit, decibel (dB); symbol; L_E .

3.7 free field over a reflecting plane. Sound field in a homogeneous, isotropic medium in the half space above an infinite, rigid plane surface on which the machine under test is located.

3.8 workstation. Position in the vicinity of the machine under test and intended for the operator.

3.9 operator. Individual whose workstation is in the vicinity of a machine and who performs a work task associated with that machine.

3.10 operator's position. Workstation of an operator.

3.11 specified position. Position defined in relation to a machine, including, but not limited to, an operator's position. The position can be a single fixed point, or a combination of points along a path or on a surface located at a specified distance from the machine.