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**AMERICAN NATIONAL STANDARD
Reference Quantities for Acoustical Levels**

**ACCREDITED STANDARDS COMMITTEE S1,
ACOUSTICS**

ABSTRACT

This Standard provides certain reference quantities to be used for acoustical levels. Reference quantities are stated in the International System of Units (SI). The unit of most acoustical levels is the decibel. Acoustical levels are equal to ten (or twenty) times the common (base-10) logarithm of an appropriate nondimensional ratio of a variable quantity (in the numerator) to a reference quantity of the same kind (in the denominator). The multiplier ten is used when the numerator is a power or power-like quantity (such as the time-average of the square of a time-varying sound pressure or vibration acceleration) or an energy-like quantity (such as sound exposure). The multiplier twenty is used when the numerator is the root-mean-square of a field quantity or an instantaneous quantity, such as a peak or maximum sound pressure.

AMERICAN NATIONAL STANDARDS ON ACOUSTICS

The Acoustical Society of America provides the Secretariat for Accredited Standards Committees S1 on Acoustics, S2 on Mechanical Shock and Vibration, S3 on Bioacoustics, and S12 on Noise. These committees have wide representation from the technical community (manufacturers, consumers, and general-interest representatives). The standards are published by the Acoustical Society of America through the American Institute of Physics as American National Standards after approval by their respective Standards Committees and the American National Standards Institute.

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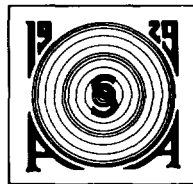
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FOREWORD

[This Foreword is for information only and is not a part of American National Standard Reference Quantities for Acoustical Levels, ANSI S1.8-1989 (ASA Catalog No. 84-1989).]

This Standard comprises a part of a group of definitions, standards, and specifications for use in acoustical work. This Standard was developed under the jurisdiction of Accredited Standards Committee S1 using the American National Standards Institute (ANSI) Standards Committee Procedures. The Acoustical Society of America holds the Secretariat for Accredited Standards Committee S1.

Accredited Standards Committee S1, Acoustics, had the following scope:

Standards, specifications, methods of measurement and test, and terminology, in the fields of physical acoustics, including architectural acoustics, electroacoustics, sonics and ultrasonics, and underwater sound, but excluding those aspects which pertain to biological safety, tolerance, and comfort.

This American National Standard is a revision of ANSI S1.8-1969 (R1974). Except as described below, the reference quantities in this Standard are consistent with those in ISO 1683.

This Standard provides a reference for sound exposure level; ISO 1683 does not mention sound exposure or sound exposure level. This Standard does not provide a reference for sound energy level or for sound energy density level. ISO 1683 gives one picojoule as the reference sound energy and one picojoule per cubic meter for the reference sound energy density.

In general, the magnitude of a standard reference quantity is one; its unit is a derived SI unit with an SI prefix to indicate the appropriate negative power-of-ten multiplier. Examples are a reference vibratory force of one micronewton ($1 \mu\text{N}$), or a reference power of one picowatt (1 pW).

A variety of engineering applications primarily related to structure-borne sound have traditionally used a reference vibration acceleration and reference vibration velocity of $10 \mu\text{m}/\text{s}^2$ and $10 \text{ nm}/\text{s}$ for all media, i.e., as in ANSI S1.8-1969 which was reaffirmed without technical change in 1974. In ISO 1683, those reference quantities are $1 \mu\text{m}/\text{s}^2$ and $1 \text{ nm}/\text{s}$, respectively. Appendix A recognizes and addresses the effect of the differences in reference vibration acceleration and reference vibration velocity on a numerical value of acceleration level or vibration level.

At the time this Standard was submitted to Accredited Standards Committee S1, Acoustics, for final approval, the membership was as follows:

D. L. Johnson, *Chairman*
J. B. Moreland, *Vice-Chairman*
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The *ad hoc* group, that assisted Accredited Standards Committee S1, Acoustics, in drafting this Standard consisted of:

T. F. W. Embleton	A. H. Marsh	R. W. Young
G. C. Maling, Jr.	L. W. Sepmeyer	

Suggestions for improvement in this Standard will be welcomed. They should be sent to the **Accredited Standards Committee S1 at the Standards Secretariat, in care of the Acoustical Society of America, 335 East 45th Street, New York, NY 10017-3483. Telephone (212) 661-9404.**

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American National Standard

Reference Quantities for Acoustical Levels

0 INTRODUCTION

0.1 Acoustical levels of various kinds are commonly used to describe acoustical measurements in gases, liquids, and solids. A reference quantity, preferably independent of the medium, is needed for each kind of level. The preferred unit for an acoustical level is the decibel.

0.2 Each particular kind of level should be based on the same reference quantity. However, for several kinds of acoustical levels, different reference quantities have been used from time to time. For clarity, the reference quantity should be indicated by some means.

0.3 The magnitude of a reference quantity determines whether the level of a particular variable quantity is positive or negative. For general measurements and many engineering applications, levels of a given kind should be consistently positive or consistently negative, rather than both positive and negative.

0.4 Reference quantities are specified with units from the International System (i.e., *Système International*, SI); see ISO 1000.

0.5 For any given kind of acoustical level, the reference quantity is unchanged and applies regardless of the unit of the variable quantity. An appropriate conversion of the measurement unit is therefore required if the variable quantity is not given in the desired SI unit, because the units of the numerator and denominator quantities have to be the same so that acoustical levels are always formed from nondimensional ratios. Alternatively, a non-SI measurement unit for the variable quantity may be retained and the SI unit of the reference quantity converted to the same unit as the variable quantity. See ASTM E 380-84 for suitable conversion factors.

0.6 In this Standard, letter symbols for variable and reference quantities and for acoustical levels are consistent with ANSI/ASME Y10.11-1984, ISO 31/7 with Amendment 1-1985, and IEC 27-3, except as specifically noted.

1 SCOPE

1.1 The scope of this Standard includes reference quantities for commonly used levels in acoustics, electroacoustics, and mechanical vibrations.

1.2 The use of levels to describe acoustical quantities is not made mandatory by this Standard. Reference quantities are provided for use when levels are employed.

2 PURPOSE

The purpose of the Standard is to encourage uniformity of practice by providing reference quantities of convenient magnitude for various kinds of acoustical levels.

3 APPLICATIONS

3.1 Variable quantities for which this Standard applies may vary in time or position, or both.

3.2 Reference quantities for acoustical levels not described in this Standard should be selected after consideration of the guidelines given in Section 0.

4 STANDARDS REFERRED TO IN THIS DOCUMENT

[The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of approval by the American National Standards Institute, Inc. (ANSI), the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Information on the recent editions is available from the ASA Standards Secretariat.]

4.1 American National Standards

(1) American National Standard Letter Symbols and Abbreviations for Quantities used in Acoustics, ANSI/ASME Y10.11-1984.

(2) American National Standard Preferred Frequencies, Frequency Levels, and Band Numbers for Acoustical Measurements, ANSI S1.6-1984.

(3) American National Standard Specification for Sound Level Meters, ANSI S1.4-1983 and Amendment S1.4A-1985.