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AMERICAN NATIONAL STANDARD

Guidelines for the Preparation of Standard Procedures to Determine the Noise Emission from Sources

ABSTRACT

This standard contains guidelines for the preparation of procedures (standards, test codes, recommended practices, etc.) for determination of noise emission from sources. Included are the general questions that need to be considered during development of a measurement procedure. Guidelines on the following subjects are included: prefatory material, measurement conditions, measurement operations, data reduction, preparation of a test report, and guidelines for the selection of a descriptor for noise emission.

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AMERICAN NATIONAL STANDARDS ON ACOUSTICS

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

These standards are developed as a public service to provide standards useful to the public, industry, and consumers, and to Federal, State, and local governments.

This standard was approved by the American National Standards Institute as ANSI S12.1-1983 on 15 February 1983.

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FOREWORD

[This Foreword is not a part of American National Standard Guidelines for the Preparation of Standard Procedures to Determine the Noise Emission from Sources, S12.1-1983 (ASA Catalog No. 49-1983).]

This standard is based on a document generated as a result of the Workshop on Development of Standards for Environmental Sound held in Deerfield Beach, Florida, in December 1977. The Workshop was organized and managed by the Acoustical Society of America under the auspices of the Ad Hoc ANSI Standards Planning Panel on Noise Abatement and Control. The Workshop was sponsored by the U.S. Environmental Protection Agency in cooperation with the National Bureau of Standards.

Because this standard was considered to be needed by various organizations that prepare procedures for the measurement of noise emission from sources, working group, S1-74, was formed in 1978 under the jurisdiction of American National Standards Committee S1 on Acoustics with the charge to prepare an ANSI Standard from the document generated at the Deerfield Beach Workshop. The proposed standard was approved by Standards Committee S1 to be published as S1.39-1980 and circulated for a period of comment and criticism.

Responsibility to complete the standard was transferred in the fall of 1981 to the American National Standards Committee S12 on Noise. Working Group S12-5 (the former S1-74) assisted the committee in final editing of this standard.

American National Standards Committee S12 under whose jurisdiction this standard was developed, had the following scope:

Standards, specifications, and terminology, in the fields 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 draft standard was submitted to Standards Committee S12 for approval, the membership was as follows:

K. M. Eldred, *Chairman*

W. Melnick, *Vice-Chairman*

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U.S. Department of the Navy, Bureau of Medicine & Surgery • J. W. Greene
U.S. Department of the Navy-Naval Sea Systems Command • L. Herstein, K. Hartman (*A/I*)

Individual members of the S12 Committee were:

Batchelder L.	Galloway, W. J.	Hillquist, R. K.	Maling, G. C., Jr.
Benson, R. W.	Goldstein, J.	Johnson, D.	Marsh, A. H.
Feldman, S.	Gross, E.E., Jr.	Lang, W. W.	Melnick, W.
Gales, R. S.	Guernsey, R.	Lybarger, S. F.	Weissler, P. G.

Working Group S12-5 on Guidelines for the Preparation of Procedures for the Determination of Noise Emission from Sources which assisted the committee in the completion of this standard had the following membership:

Kenneth K. Eldred, *Chairman*

Peter K. Baade	Robert S. Gales	Ralph K. Hillquist	Henry E. Thomas
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Suggestions for improvements of this standard will be welcomed. They should be sent to the Standards Secretariat, Acoustical Society of America, 335 East 45 Street, New York, NY 10017.

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American National Standard

Guidelines for the Preparation of Standard Procedures to Determine the Noise Emission from Sources

1 SCOPE AND PURPOSE

This standard contains guidelines for the preparation of procedures (standards, test codes, recommended practices, etc.) for determination of noise emission from sources. These guidelines are intended to provide the framework for the thought process to be followed in developing measurement procedures. They do not contain a catalog of existing procedures nor do they contain a collection of specific requirements. Rather, they outline the general questions and issues which need to be considered during the development of a measurement procedure.

The following sections of this standard provide a structure for items to be considered during the development of a procedure for the determination of noise emission from sources. Each such procedure is, of course, unique and thus not all of the items may be applicable.

2 GUIDELINE SUMMARY CHECKLIST

This section contains a checklist which is intended to insure that all the necessary elements are considered in development of a standard procedure for determination of noise emission. The key item for consideration is the purpose. All other items should be considered in relation to the purpose, consistent with ease of use and accuracy required to meet the purpose.

Prefatory Material

- (1) Purpose—source and noise descriptor, uses and users, consequences
- (2) Scope—source and operating mode(s)
- (3) Compatibility with other procedures and standards
- (4) Noise descriptor(s) to be used
- (5) Measurement precision and accuracy intended
- (6) Definitions unique to the document

Measurement Conditions

- (1) Instrumentation specifications, tolerance limits and calibration
- (2) Support equipment
- (3) Test environment required
- (4) Physical site
- (5) Ambient conditions—acoustical and atmospheric

Test Operations

- (1) Source configuration and installation
- (2) Source operating mode(s) during test
- (3) Repeatability of operations, results
- (4) Relative complexity of the procedure

Measurements and Data Reduction

- (1) Specification of preferred sound descriptor
- (2) Replications necessary
- (3) Variability, confidence criteria
- (4) Corrections to measured data

Test Report

- (1) Documentation of source type, installation and operations; site condition, configuration and environmental conditions; measurement equipment, etc.
- (2) Report of final sound data and any adjustments made

Supplemental Information

- (1) Rationale for test procedure requirements
- (2) Explanation of compromises made
- (3) Determination of measurement uncertainty
- (4) Supportive test data
- (5) Overall assessment of the measurement procedure.

3 PREFATORY MATERIAL IN A MEASUREMENT PROCEDURE

This section enumerates and discusses the items that should be considered for inclusion in the prefatory sections of a measurement procedure.

3.1 Purpose

After an introduction with appropriate background information, the first section of a procedure for the determination of noise emission from sources should contain a concise and complete statement of purpose. The purpose generally entails four main items:

- (1) a general description of the source,
- (2) an indication of the intended uses of the measured data,

- (3) an indication of the intended users of the procedure,
- (4) a statement of the possible consequences of the noise emission that the procedure is intended to address.

3.1.1 Statement of Purpose

A simple statement of the purpose of the document should identify a standard procedure for defining noise emission of a specific type of stationary or mobile source under specified operating conditions for certain uses by defined user groups and with respect to specific consequences of the sound emissions. (An example of a statement of purpose is as follows: The purpose of this standard is to describe a procedure for defining the noise emissions of widgets when used in the high-speed mode during the manufacture of gadgets. The procedure is intended for use by regulatory enforcement agencies and for production verification to establish compliance with noise regulations and specifications for widgets. The primary concern of the sound measurement program is the risk of hearing damage to widget operators and gadget production line workers. Special purpose widgets are not covered by this standard.

3.1.2 Uses

The statement of purpose should identify intended uses. Following is a partial list of uses:

- (1) Test procedures to be cited in purchase specifications and certification
- (2) Test procedures to be cited in regulations
- (3) Rating
- (4) Labeling
- (5) Quality assurance
- (6) Performance verification
- (7) Engineering information
- (8) Monitoring (by enforcement agencies and others)
- (9) Degradation assessment
- (10) Contracts between buyer and seller.

3.1.3 User Groups

The statement of purpose should identify expected users of the procedure. Typical users may include:

- (1) Public as represented by legislators or officials (federal, state, local)
- (2) Manufacturers
- (3) Operators
- (4) Owners or Contractors
- (5) Public interest groups
- (6) Consumers
- (7) Testing laboratories.

3.1.4 Consequences

Data developed through application of this procedure may be expected to be used for estimating potential effects of noise on people such as operators, passengers and others in the vicinity. Possible effects include, but are not limited to:

- (1) Task interference
- (2) Hearing loss
- (3) Communication interference
- (4) Annoyance (or aversiveness)
- (5) Sleep interference
- (6) Interference with the detection and recognition of signals
- (7) Detection.

More details on human response can be found in the Appendix.

3.2 Scope

The statement of the scope of a procedure should include a clear, concise description of the source, or class of sources. A description of operating cycles or modes of concern should also be included. When appropriate, the scope should state appropriate exclusions such as applications of the measured data to situations beyond the purpose of the procedure.

3.3 Compatibility

Preparation of a measurement procedure should consider existing, proposed, and draft documents dealing with similar sources and basic acoustical measurement procedures. Where applicable, primary consideration should be given to incorporating, or including as references, appropriate parts of national and international standards (see the Appendix). Typical standards may include:

- (1) Standards for procedure to measure similar acoustical quantities (e.g., sound level, sound pressure level, and sound power level)
- (2) Standards concerned with measurement of sound produced by similar type of sources
- (3) Standards related to application of the procedure.

3.4 Sound Descriptors

3.4.1 Definition

As stated in 3.1, the objective of any measurement procedure within the scope of this standard is to deter-

mine the noise emission of specific sources for a specified purpose. An exact and detailed description of noise emission requires measurement of many acoustical parameters such as amplitude, frequency spectrum, temporal characteristics, and directional properties. Since not all of the parameters may be relevant to the purpose at hand, those drafting the measurement procedure should choose the parameter, or a combination of parameters, appropriate to the purpose. The chosen quantity(s) is called the sound descriptor(s).

Various descriptors are available, suited for different purposes. Some descriptors may be determined from direct measurement; others are calculated from measurements of several parameters. All sound descriptors fall into one of the following two categories:

- (1) Descriptors which define the sound emission of the source in terms of the resulting sound pressure at a specified point in a specified acoustical environment.
- (2) Descriptors which define the sound emission of a source in terms of sound power, and thus are independent of the environment.

The specific descriptor(s) selected for a particular sound measurement procedure should be defined, and the rationale for selection identified.

3.4.2 Typical Applications of Sound Pressure and Sound Power Descriptors

Detailed guidelines for the selection of descriptors for noise emission of stationary and moving sources are given in the Appendix, respectively, together with a listing of selected sound measurement standards in Tables A1 and A2.

Sound pressure type descriptors are particularly applicable for moving sources. The point of evaluation should be specified both in terms of the distance from the source and in terms of the orientation with respect to the source (see Sec. A.3 of the Appendix).

Sound pressure type descriptors may also be applicable for stationary sources to describe the sound at an operator or other specified receiver position. The operator and/or other receiver position(s) relative to the source as well as the acoustical environment should be adequately specified. The position(s) should be typical for the particular type of source to be described.

Sound power descriptors of stationary source noise emission are particularly appropriate when the data are to be used in sound abatement and design calculations. Such calculations are typically based on the concept of sound power transmission from the source to

the receiver. The source descriptor must be compatible with the requirements of the calculation procedure to be used. If the transmission properties of the path(s) of interest are frequency-dependent (e.g., source and receiver separated by building structures, ducts, etc.), the source descriptor must provide suitable frequency information, usually in the form of frequency-band sound power spectra. If the transmission has little dependence on frequency (e.g., source and receiver both in the same room and not too far apart, or both located outdoors), the source descriptor may be expressed as A-weighted sound power level.

3.4.3 Descriptors for the Effects of Sound on People

The relationship between the physical parameters of the sound pressure at a person's ear and the response of that person depends on many factors. For sounds which are essentially steady and broadband in nature, the A-weighted sound pressure level (sound level) is an appropriate descriptor. For sounds that have a more complex temporal and spectral characteristic, more sophisticated descriptors have been developed. Additional discussion of the various descriptors and their use are found in Sec. A.4 of the Appendix.

3.5 Measurement Accuracy: Environment and Test Instruments

3.5.1 Background

The following methods have generally been used to measure noise emission from sources with decreasing degree of accuracy.

- (1) Precision test method (also called primary or basic test method)
- (2) Engineering test method (also called regulation or performance verification test method)
- (3) Survey test method (also often called in-use compliance or screening test method).

The three methods are characterized by the environment in which the test is performed and by the type of instrumentation used. In general, the test results become more accurate as the test environment becomes more controlled, as the accuracy requirements on the measuring instruments become more stringent, and as the training and skill of the test personnel are improved.

The required accuracy of the test results should be both appropriate to the purpose and cost-effective. As

