

7th Edition of the ASACOS Editorial Guidelines
(Revision of ASACOS Editorial Guidelines 6-2003)

ASACOS Editorial Guidelines for Preparation of American National
Standards and ASA Technical Reports in

**ACOUSTICS, MECHANICAL VIBRATION AND
SHOCK, BIOACOUSTICS, ANIMAL BIOACOUSTICS
AND NOISE**

Approved January 28, 2020 by

Acoustical Society of America Committee on Standards (ASACOS)

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Introduction

This 7th edition of the “Editorial Guidelines for Preparation of American National Standards and Technical Reports in Acoustics, Mechanical Vibration and Shock, Bioacoustics, Animal Bioacoustics and Noise” is revised and updated to include the latest information regarding the preparation of draft documents. These Guidelines are to be used in conjunction with the ASA Standards Template and are intended for Working Groups preparing drafts of standards to be published by the Acoustical Society of America. Balloting, approval, publication, and revision of ASA/ANSI Standards are greatly facilitated by the use of the template and compliance with these Guidelines.

Changes in this revision of the *Editorial Guidelines* include:

- All standards carry the ANSI/ASA dual designation.
- Nationally Adopted International Standards (NAIS) remain in their original ISO or IEC format, with the exception of an ANSI/ASA cover page indicating the dual designation and date of the standard; the front matter, which identifies committee, working group and individual experts who participated; and US modifications (MOD), if any.
- Undated normative references are permitted.
- The bibliography replaces the Informative references clause.
- Names of participating Committee and Working Group members now appear with full first name rather than first initial.
- A uniform copyright notice as required by ANSI is now part of the template.
- A clause on representation of numbers and numerical values is added.
- Reference is made to IEEE 260.4-2019 for usage of abbreviations, units, and letter symbols.
- “log₁₀” is used for the common or Briggsian logarithm in equations, although “lg” will appear in Nationally Adopted International Standards originating in ISO or IEC.
- Polar plots and all frequency characteristics with a decibel or log magnitude vs. log frequency – with the exception of audiograms – shall comply with the aspect ratios given in IEC 60263.
- Figures are to be supplied along with the draft as enhanced meta files (*.emf).
- Scanned images are no longer allowed for figures.
- Procedures for describing measurement uncertainty in an informative annex for standards that require it, including the format for an example uncertainty budget table, are provided.
- Procedures for software that accompanies a standard are included, including an end-user license and software copyright notice.
- The ASA Standards template and instructions for its use are updated to work with the latest versions of Microsoft Word® and can be found on the ASA website at <https://acousticalsociety.org/acoustical-society-standards/>.

To help the Working Group ensure these Guidelines have been properly applied, a checklist appears in Annex A. Annex B contains a copy of the current ASACOS policies on definitions. Boilerplate text for an informative annex on Measurement Uncertainty appears in Annex C.

Suggestions for improvement of these *Guidelines* are welcome. Send suggestions to:

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ASACOS Editorial Guidelines for Preparation of American National Standards and Technical Reports in

Acoustics, Mechanical Vibration and Shock, Bioacoustics, Animal Bioacoustics and Noise

1 Scope for these guidelines

The purpose of the *ASACOS Editorial Guidelines* is to ensure uniformity in form and style in standards developed by the Accredited Standards Committees and published by the Acoustical Society of America.

These *Guidelines* apply to standards and technical reports prepared by any Working Group of a Standards Committee or Subcommittee for which the Acoustical Society of America provides the Secretariat. They are applicable to the preparation of new American National Standards originating in a Working Group, as well as to revisions of existing standards. To assist the Accredited Standards Committees, the intent is that all drafts prepared by Working Groups and submitted to a Standards Committee for ballot or approval or to ASACOS for information adhere to these *Guidelines*.

In order to expedite the process, IEC and ISO standards proposed for U.S. national adoption remain in their original ISO or IEC format, with the exception of an ANSI/ASA cover page indicating the dual designation and date of the standard, the front matter, which identifies committee, working group and individual experts who participated, and U.S. modifications (MOD), if any. In this case, these Guidelines apply only to those additions to these documents.

For any formatting or editorial requirements regarding form, style, and usage not covered in these Guidelines, the applicable clauses in the ISO/IEC Directives, Part 2 shall apply. In the case of a conflict between these Guidelines and the ISO/IEC Directives, Part 2, these Guidelines shall govern. Any ambiguities, issues, or questions should be brought to the attention of the ASA Standards Secretariat, Acoustical Society of America, 1305 Walt Whitman Road, Suite 300, Melville, NY 11747.

NOTE 1 These *Guidelines* and the associated ASA Template for preparation of acoustical standards require that drafts of acoustical standards or technical reports be prepared using Microsoft Word®, version 2016 or later.

NOTE 2 Wherever the word *standard(s)* is used, it also applies to technical report(s).

2 References for these guidelines

Although these Guidelines are not an American National Standard, normative references for this document are included below. These references 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.

ANSI Essential Requirements: Due process requirements for American National Standards. New York: American National Standards Institute

ANSI/ASA S1.1, American National Standard Acoustical Terminology

ANSI/ASA S2.1/ISO 2041 American National Standard Mechanical vibration, shock and condition monitoring — Vocabulary (a nationally adopted international standard)

ANSI/ASA S3.20, American National Standard Bioacoustical Terminology

ANSI/ASA S1.6 Preferred Frequencies and Filter Band Center Frequencies for Acoustical Measurements.

IEC 60263 Scales and sizes for plotting frequency characteristics and polar diagrams

IEEE 260.4, IEEE Standard Letter Symbols and Abbreviations for Quantities Used in Acoustics

ISO 497 Guide to the choice of series of preferred numbers and of series containing more rounded values of preferred numbers

ISO 690, Information and documentation — Guidelines for bibliographic references and citations to information resources

ISO/IEC Guide 98-3 Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM)

ISO/IEC Directives — Part 2: Rules for the structure and drafting of International Standards, Ed. 7.0, Geneva, Switzerland: International Organization for Standardization and International Electrotechnical Commission

NOTE "R" in the ANSI document number stands for reaffirmed.

3 Content of a standard

3.1 Normative and optional elements

A draft of a proposed standard shall contain the following elements, as applicable, in the noted order:

1. Title page with abstract (normative)
2. Copyright page (normative)
3. Table of Contents (normative)
4. Foreword (normative)
5. Introduction (optional)
6. Scope (normative)
7. Normative references to other standards and documents (normative, if any are required)
8. Terms and definitions (optional)
9. Requirements (main text) (normative)
10. Tables (as required)
11. Figures (as required)
12. Annexes (as required)
13. Tables for annexes (as required)
14. Figures for annexes (as required)
15. Bibliography (optional)

3.2 Title page with abstract

3.2.1 Format of the title page

The title page is the first page (un-numbered) of every draft of a proposed standard or technical report. Until the final designation is known, a temporary designation, such as BSR/ASA S3.XX-200X (shown in the upper right-hand corner of the title page), is used. The ASA Secretariat will provide this designation.

NOTE BSR – Board of Standards Review.

The fact that the proposed standard is a draft and is not approved as an ANSI standard is indicated by including a note to that effect above the words "American National Standards Institute, Inc." on the title page (see Figure 1) for all working drafts until the standard is balloted, approved, and published.

Each draft shall be dated in the upper right corner of the title page. The version number of each draft should also be indicated beneath the designation. See the default text and formatting in the ASA Standard template.

3.2.2 Title of the Standard

The title of the proposed standard includes the words "American National Standard" as an adjective modifying, and immediately preceding, a noun such as Method, Requirement, Terms and Definitions, Quantities, Levels, Procedures, Specifications, etc. The title should be concise, yet complete enough to cover, without ambiguity, the subject of the proposed standard. Titles of analogous standards should be identical, except for the distinguishing feature(s) of each standard. For standards in a series, either use separate titles or use Part numbers with Arabic numerals, followed by a colon and then the title for the Part, e.g., "Part 1: Basic Test Requirements". Contrary to other usage within the standard, the initial letter of each important word in the title is capitalized on the title page and wherever else the title is used in the text. (Titles of nationally adopted international standards and other adopted documents shall be given exactly as stated on the document.)

3.2.3 Abstract

Every proposed standard shall include a short abstract at the bottom of the title page. The abstract should begin with the most important purpose(s) or recommendation(s) of the standard and should be self-contained so that it may be understood without reading the standard. It should contain a summary of the contents of the standard. The relationship of the proposed standard to related standards or to previous versions of the standard (national or international) should be indicated. Write the text for the abstract with complete, connected sentences using active verbs and the third person. Abbreviations, symbols, references, and equations shall not be included in an abstract. The word count of an abstract shall not exceed 250 words.

The abstract shall not contain requirements.

3.3 Copyright notice

All standards shall carry the ASA copyright starting with the first draft of the standard (This appears in the footer of each page). For nationally adopted international standards, both the ASA copyright and the following copyright statement (given in the template) shall be included:

"These materials are subject to copyright claims of ISO [or IEC] and ASA. No part of this publication may be reproduced or redistributed in any form, including an electronic retrieval system, without the prior written permission of ASA. All requests pertaining to the [INSERT NAME OF DOCUMENT] Standard should be submitted to ASA."

3.4 Contents page(s)

Each draft of a proposed standard shall contain a Contents page(s). The Contents page(s) shall be numbered with lower-case Roman numerals, beginning with i. The Contents listing shall include as many of the following as are relevant:

- Clause number and full heading
- Subclause number and full heading, but only to the second level
- Annexes (informative or normative), including letter designation and full title
- Bibliography
- Indexes
- Tables
- Figures

The items to be listed in the Contents are those clauses and subclauses with first level and second level headings. Third-level, and lower, headings (for example, 6.1.1 or B.2.3.1) are not included.

Required elements for the contents, figures, and tables are generated automatically by the ASA Standards Template.

3.5 Foreword pages with Committee and Working Group membership lists

The proposed standard shall include a Foreword beginning on the next page after the contents page(s). Foreword pages shall be numbered sequentially with lower-case Roman numerals that follow the page numbers of the contents pages. The Foreword shall include as many of the following items as appropriate: (1) a brief history of the standard, (2) special remarks about use or application of the standard, and (3) if it is a revision of an American National Standard, an explanation of the principal differences between the current and the previous version. If the proposed standard is a national adoption of an International Standard, the principal technical differences, if any, that were needed to make the International Standard conform to national requirements should be explained. Do not include material in the Foreword that is appropriate for the scope. No normative material or requirements shall be included in the Foreword. The content of the Foreword shall be within the scope of the document and the scope of the Accredited Standards Committee.

Examples of the items to be included in a Foreword are given in the ASA Standards Template. A bracketed notation shall be included, which reads as follows: “[This Foreword is for information only, and is not a part of the American National Standard XX.XX-YEAR, Title. In addition, it does not contain requirements necessary for conformance to the standard.]”.

After the list of the names of the members of the Working Group, a paragraph appears for soliciting comments on the standard (and the address to which the comments should be sent). The word "Foreword" should appear only on the first page.

The Foreword shall contain a statement that the standard was developed in accordance with ANSI's Accredited Standards Committee procedures under the Standards Secretariat of the Acoustical Society of America, followed by the current scope of the relevant Accredited Standards Committee [1].

After the scope of the Standards Committee, the Foreword shall list the names of the officers of the relevant Standards Committee. The names of the organizational members of the Standards Committee, and their representatives and alternate(s) if any, and the names of the Individual Experts of the Standards Committee shall also be included in the Foreword. Include in alphabetical order the names

of the members of the Working Group, if any, who assisted the Committee in preparing the proposed standard.

This text is common to all standards within a given Accredited Standards Committee and is provided in the ASA Standards Template.

The Committee and Working Group lists shall be complete with the correct names, properly spelled. Spell out proper first names and middle initial (if any). Do not include titles such as Mr., Dr., or Professor. Include Jr. or III (or other number) after the last name if the person uses it. The current list of Standards Committee officers, Individual Experts, and organizational members (and the names of their representatives and alternates) should be obtained from the ASA Standards Office. When the standard is published, the names of the officers and members of the Standards Committee will be applicable to the date when the proposed standard was submitted to the Standards Committee for the final ballot. This date does not refer to, nor is invalidated by, circulation of the document to the Committee for technical review following a ballot. The Working Group Chair is responsible for supplying the ASA Standards Secretariat with the names and contact information of the members of the Working Group.

3.6 Introduction page

A standard does not require an introduction. An introduction may be included if considered necessary by the Working Group to explain certain background details about the technical content of the document, or explanatory information useful for proper understanding of the use of the proposed standard.

The introduction shall be kept as short as feasible. If a more detailed description of the background for the standard is considered appropriate, it shall be placed in an informative annex.

Material in the introduction shall not duplicate similar information in the foreword. Also, the material in the introduction shall not include anything that properly belongs in the clauses describing the scope or the requirements of the standard.

The introduction page is numbered sequentially with lower-case Roman numerals that follow the page numbers of the foreword. The introduction itself is an unnumbered clause.

3.7 Text of the standard

3.7.1 Contents of the text

The text of a standard includes the applicable clauses listed in 3.1, as well as tables, figures, and the normative as well as the informative references that are cited in the text.

3.7.2 Title and page numbering

The text of the standard begins on page 1 (page numbering of the text uses Arabic numerals) with the title of the standard, namely, American National Standard <insert rest of title>.

3.8 Scope

The scope is a normative element of a standard and is always Clause 1. In the scope clause, explain what is and, if necessary, what is not covered by the proposed standard. The scope of a standard shall not exceed the approved scope of the Accredited Standards Committee. The scope shall not contain requirements. In standards that are subdivided into parts, the scope of each part shall describe only the subject of that part of the standard.

The statement of the scope of a standard shall cover as many of the following items as are applicable:

1. A general description of the subject of the standard, the aspects covered, and the fundamental assumptions on which the standard is based,
2. An indication of the uses of the data or devices developed in accordance with the standard,
3. An indication of the intended users of the standard,
4. A statement of the possible consequences of the use of the procedure, methods, or quantities addressed by the standard, and
5. A description of the applications, or field of applications, for the standard.

For example:

“The scope of this Standard covers a procedure for determining the sound of widgets when used in both low and high speed modes. The procedures herein are applicable for use by regulatory enforcement agencies to establish compliance with noise regulations. The primary concern of the sound measurement program is the risk of hearing damage. Special purpose widgets are not covered by this Standard.”

3.9 References

3.9.1 Normative references

Normative references are standards or other publications that are incorporated by reference in a standard, and are required for, and indispensable to, its use. The following paragraph shall be used to introduce the 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.”

Normative references, if required, shall appear in clause 2, immediately following the scope. Each normative reference listed in Clause 2 shall be referred to in the text of the standard.

Documents listed as normative references are those that are indispensable for application of the standard. Each listing of a normative reference in Clause 2 shall include the year of issue for the latest edition. If a requirement in the standard refers to a particular clause, subclause, paragraph, figure or table in a referenced standard, the listing in the text of the standard shall also include the year of issue.

American National Standards shall be listed in numerical order according to their designation numbers. That is, ANSI/ASA S1.11 before ANSI/ASA S3.20 and ANSI/ASA S3.9 before ANSI/ASA S3.10. After all ANSI references, list publications of the International Electrotechnical Commission (IEC) and International Standards Organization (ISO) in numerical order.

Undated references should be used if the intent is to incorporate any and all updates and changes to the referenced document for at least the duration of the standard cycle (i.e., until the published standard making the reference comes up for review). It is understood that the reference will include all amendments to and revisions of the referenced document.

The list of normative references shall not include any of the following:

1. Documents that are not publicly available;

2. Publications cited only in an informative manner – these may be listed in a bibliography;
3. Publications that have merely served as bibliographic or background material in the preparation of the document. Such publications may be listed in a bibliography.

Do not cite unpublished theses, private correspondence, personal communications, or internal reports by companies or other private institutions.

3.9.2 Informative references

Informative references shall be listed in a bibliography. See 3.23.

3.10 Terms and definitions

3.10.1 When to include a list of terms and definitions

Standards are not required to include a terms and definitions clause. However, a list of terms and definitions can be included if the standard contains:

1. Significant terms that are crucial to the interpretation and application of the standard or that may have a meaning more specialized or more restricted than the common dictionary meaning or the meaning in acoustical terminology standards;
2. Significant terms that are unique or applicable only to the standard or have meaning more specialized or more restricted than other technical meanings of the same term. If the term is unique to the standard, it shall be so restricted;
3. Qualitative terms or phrases that could be taken to denote or connote an absolute, unqualified, or unconditional property or capability, e.g., free-field, acoustically rigid, infinite impedance, etc. Such terms shall be defined in their intended absolute sense;
4. Qualitative phrases containing adjectives and nouns that denote or describe a quantitatively determinable property or capability, e.g., high voltage, low impedance, thin film, quiet surroundings, noisy environment, adequate isolation, etc. Such terms shall be defined so as to make clear their intended specialized quantitative meanings.

Definitions shall not be prepared for technical terms covering broad fields and having meanings that are well understood and not subject to dispute such as: force, mass, root-mean-square, integral, and other mathematical terms.

3.10.2 Definitions and Reference Terminology Standards

Well-written definitions are required to ensure that standards are properly understood and unambiguously interpreted, and to explain the meanings of technical terms for the benefit of the user of the standard. Whenever possible, each definition should stand on its own and clearly indicate or delimit its field of applicability.

Definitions found in the latest revisions of ANSI/ASA S1.1, ANSI/ASA S2.1/ISO 2041, ANSI/ASA S2.7, ANSI/ASA S3.20, and ANSI/ASA S3.32, (see 2.1), need not be listed in a terms and definitions clause. However, if terms from one or more of the aforementioned standards are deemed essential to the draft standard under preparation, the appropriate source standard for those terms shall appear in the list of Normative references. See 3.10.3.

A definition for a technical term that differs from a corresponding definition in one of the above Standards may be included if the existing definition is deemed by the Working Group to be incorrect or inadequate, provided written explanation for the new definition is included in the background information accompanying the letter ballot.

ASACOS policies on definitions are given in Annex B.

3.10.3 Format for terms and definitions

A list of terms and definitions shall be preceded by the following words: "For the purposes of this document, the following terms and definitions apply:"

In the case where terms defined in one or more other documents also apply, the following introductory wording shall be used, altered as necessary. "For the purposes of this document, the terms and definitions given in <insert the designation(s) of applicable standard(s)> and the following apply."

Terms and definitions may be listed in alphabetical order or in a technical sequence so that related terms are placed together. Each definition shall be numbered as a subclause of the terms and definitions clause of the standard, normally Clause 3, after the list of normative references in Clause 2.

A definition shall not take the form of, or contain, a requirement.

Examples of term usage and notes concerning entries, if needed, shall be given after the definition. One or more notes may follow a definition. Additional information that supplements the definition for a term should be given in a note.

Do not use a letter symbol as, or as part of, a term. Use full words to describe all terms. Letter symbols are for use in equations and, if required, as column headings in a table.

An equation is not a substitute for the full-word description of a term. An equation may be included in a note or an example after a definition. Letter symbols in an equation shall be explained and the preferred units of measure shall be given for physical quantities represented in the equation: see 3.17 for additional details.

The subclause number for the term and the term are set in boldface type. The definition starts with a lower-case letter except for capital letters that may be required by the normal written form of the definition.

The dictionary format for definitions, as described below, shall be used for the preparation of American National Standards. The name of the quantity being defined is given in lower-case (unless the word is a proper name for which an initial capital letter is used), in bold typeface, and followed by a period (full stop). Verbs such as "is" are omitted but understood. Leading articles such as "A", "An", and "The" are also omitted. The term being defined shall not be used in its definition. The first letter of the first word of the definition is capitalized. An example of the dictionary format appears below:

3.1 standard. Document describing (1) a specification, (2) a method for measurement, test, or evaluation, or (3) terminology.

NOTE 1 A "Draft Standard" contains material that is proposed for approval by the relevant Accredited Standards Committee.

NOTE 2 A standard may contain guidelines.

For terms that are physical quantities, give the SI (metric) units in full words in a note and introduce the unit for the quantity by the words “expressed in”, with the standard unit symbol enclosed within parentheses as shown in the following example.

NOTE Sound pressure is expressed in pascals (Pa).

Although the dictionary format described above follows the practice long used in the preparation of acoustical standards in the U.S., international standards follow the ISO/IEC Directives, which require a different layout where the reference number for the term is given on the first line of type, followed by the term on a second line, and ending with the definition. There is no period after the term or at the end of the definition. The previous term and definition example with notes would appear according to the ISO/IEC Directives as shown:

3.1

standard

document describing (1) a specification, (2) a method for measurement, test, or evaluation, or (3) terminology

NOTE 1 to entry A standard may contain a terms and definitions clause.

NOTE 2 to entry A standard may contain guidelines.

An American National Standard that is prepared with the ultimate objective of being submitted for consideration as an International Standard should preferably prepare the list of terms and definitions in accordance with the requirements of the ISO/IEC Directives, Part 2 [2]. An International Standard that is being considered for adoption as an American National Standard will already have been prepared in accordance with the ISO/IEC Directives, Part 2.

3.11 Normative text, requirements, and specifications

The normative text of standards prepared by an Accredited Standards Committee generally describe a method, process, or device, including specifications or requirements. These requirements may appear in one or more clauses in any sequence that makes logical technical sense for the subject matter of the document. The text should follow the conventions specified in these Guidelines.

Requirements shall describe the following:

1. All characteristics relevant to the aspects of the products or processes covered by the standard, either explicitly or by reference;
2. The design-goal values of quantifiable characteristics and the tolerance limits allowed around the design goals;
3. For each requirement, either a reference to a test method for determining or verifying conformance to the requirements of the standard for a characteristic, or the test method itself.

Requirements shall be clearly distinguished from statements or recommendations.

Contractual, legal, or statutory requirements shall not be included in a standard prepared by an Accredited Standards Committee.

3.12 Clause and subclause numbering

3.12.1 For ease of reference, the subclauses are numbered using the ISO/IEC numbering system (see Clause 22 of the ISO/IEC Directives, Part 2). Although not required, it may be useful for cross-

referencing purposes to give each paragraph a sub-subclause, except when there is only one paragraph under a subclause.

3.12.2 Give only a single requirement in each subclause or paragraph.

3.12.3 A clause (or subclause) containing only a single paragraph shall not have that paragraph numbered as a subclause (or sub-subclause) because specific requirements may make direct reference to the main clause (or subclause) number.

3.12.4 Subclause numbers shall be shown in 10-point bold font style followed by a tab to 0.7 cm for numbers with 2 digits or by a tab to 1.5 cm for numbers with more than 2 digits, as required by the number of digits in the number for the preceding clause or subclause, and as illustrated in the preceding subclauses.

3.13 Citations in the text

Citations to both normative and bibliographical references shall be indicated in the text.

If the cited document is a normative reference, the designation (ANSI/ASA S#.#-YYYY or ISO or IEC #####:YYYY) shall be provided.

If the cited document is from the informative bibliography, the bibliographic number should be provided in the text and enclosed with brackets as [1].

3.14 Notes and examples

3.14.1 General

Notes and examples are used to clarify an element of a standard wherever appropriate, including a definition. Notes and examples are not normative parts of the standard. Any information necessary to conform to the requirements of the standard shall not be placed in a note.

3.14.2 Format for notes and examples

Notes and examples use the Note or Example styles found in the ASA Standards Template and are set in smaller 9-point type rather than the 10-point type used in the Normal style.

Notes and examples shall appear immediately after the paragraph to which they apply.

Notes and examples shall be preceded by the word NOTE or EXAMPLE, respectively, in capital letters. The first and subsequent lines of a note or example are set flush left.

The format for notes and examples varies depending upon their number:

Format for a single note:

NOTE A single note is not numbered. Apply the Note style to obtain the correct spacing and strike the tab key once after the word NOTE. Do not insert a blank space after the word NOTE or after the tab.

Format for two or more notes:

NOTE 1 The word "NOTE" precedes the numeral that is assigned to the NOTE with one blank space between the word NOTE and the numeral, followed by two strikes of the tab key with no blank spaces before or after the tabs.

NOTE 2 When there is more than one note, each note is numbered, with no dash or other punctuation separating the number and the text of the note, just two strikes of the tab key followed by the text of the note.

Format for a single example:

EXAMPLE

The text and/or equations in the example appear here.

Format for two or more examples:

EXAMPLE 1

The text and/or equations for the first example appear here.

EXAMPLE 2

The text and/or equations for the second example appear here.

3.15 Footnotes

Footnotes may be used to give additional information; however, their use shall be minimized. A footnote to the text of a standard shall not provide any requirements or any information that is needed to apply the requirements of the standard. Footnotes to the text of a standard are not normative parts of the standard, they are by definition only informative.

Each footnote to the text of a standard shall be sequentially numbered using superscript Arabic numerals followed by a single right parenthesis and inserted in the text. The footnote itself and its reference number shall appear at the bottom of the same page, separated from the text by a short thin horizontal line. The sequential numbering of the footnotes shall be continuous throughout the standard.

Footnotes and the separator lines should be generated using the footnote insertion feature in Microsoft Word®.

Figures and tables may contain footnotes that are independent of the footnotes to the text and may give requirements; see 3.18.4 and 3.19.3.

3.16 Representation of numbers and numerical values

3.16.1 General

In American National Standards, the decimal sign shall be a period (full stop). International Standards and Nationally Adopted International Standards may use the comma as the decimal sign.

Values of physical quantities are expressed as Arabic numerals followed by the unit symbol (see 3.17).

If the magnitude (absolute value) of a number less than 1 is written in decimal form, the decimal sign shall be preceded by a zero.

A space is used between groups of 3 digits to left of the decimal point.

NOTE This does not apply to binary and hexadecimal numbers, numbers designating years, or the numbering of standards.

Extremely large or small values shall use the appropriate prefix of the SI system to keep the mantissa values near unity. Scientific notation may also be used, However the number shall appear as the mantissa times 10 raised to the power, e.g., write “ 9.876×10^{-12} ”, not “9.876E-12”.

Any value or dimension that is mentioned for information only shall be clearly distinguishable from a requirement.

3.16.2 Implied precision and display of significant digits

Numerical values should not be expressed beyond their actual known precision. Use only the number of significant digits necessary or known for the lowest precision value. The implied precision of a given numerical value is 0.5 times the value of the least significant digit. units in the last position. A measured value of 4.321 implies that this value is correct to at least ± 0.0005 . Alternatively, it may be convenient to explicitly provide the numerical value of maximum error, e.g., 21.567 ± 0.015 , meaning that the true value lies somewhere in the interval [21.552, 23.582].

Numerical values requiring rounding shall be rounded in accordance with ISO 497.

3.16.3 Preferred number series

Logarithmic sequences of numbers shall use the preferred number series as specified in ANSI/ASA S1.16-2016.

3.16.4 Values, dimensions and tolerances

Values and dimensions shall be indicated as being minimum or maximum. Tolerances shall be specified in an unambiguous manner.

EXAMPLE 1

60 m × 20 m × 30 m (not 60 × 20 × 30 m)

EXAMPLE 2

10 mm ± 1 mm (not 10 ± 1 mm)

EXAMPLE 3

1 Pa to 3 Pa (not 1 to 3 Pa or 1 – 3 Pa)

EXAMPLE 4

18°C to 22 °C (not 18 to 22 °C or 18 – 22 °C)

Tolerances on values expressed in percent shall be expressed unambiguously. Write "from 5 % to 10 %" to express a range. Write "25 % ± 2 %" to express a center value with tolerance. The form "25 ± 2 %" shall not be used.

3.17 Abbreviations

Abbreviations and their usage shall conform to IEEE 260.4-2018.

Use of an abbreviation such as ADNL, CSEL, or PWL in a national or an international standard is deprecated because of the risk of misinterpretation. If a term is being used so frequently that an abbreviation is desirable, the abbreviated term shall be spelled out in full at its first appearance in text, followed by the abbreviation in parentheses. For example, “at 1 kHz the sound pressure level (SPL) was 87 decibels”; later, this same phrase may be written, “at 1 kHz the SPL was 87 dB.” Do not write, “the measured L_A shall not exceed 65 dB”; instead write, “the measured A-weighted sound level shall

not exceed 65 dB". Except for explanation in pertinent text, a letter symbol should not be used in place of full text or an abbreviation; use letter symbols in equations or, if necessary, because of inadequate space, as a column heading in a table.

3.18 Unit symbols

Units, unit symbols, and their usage shall conform to IEEE 260.4-2018.

In the text of the standard, the unit symbol for a quantity shall be used only when the unit is preceded by a numeral. When the unit is not preceded by a numeral, spell out the name of the unit. In text, even when a numerical value is given, it is desirable to spell out the name of the unit. Moreover, the name shall be spelled out when it first appears in the text, and more often if the text is lengthy.

Thus, in text write "...a sound pressure level of 73 dB"; or "...a sound pressure level of 73 decibels." Do not write "sound pressure level in dB"; the correct form is "sound pressure level in decibels."

Do not write "dB levels", "dB readings", or "dB SPL." Levels or readings are not of decibels; they are of sound pressure levels or levels of some other quantity. In the text, write out the word "decibel" for such applications and be sure that the word "decibel" follows, not precedes the description of the relevant acoustical quantity.

Always place a single blank space between a numerical value and its unit symbol, except for plane angles where the unit symbol for degrees, minutes, and seconds shall immediately follow the numerical value. For temperatures, place a blank space between the numerical value and the degree symbol followed by the letter symbol for the unit as 20 °C, not as 20° C.

Unit symbols shall be in Roman type.

Do not use unit symbols as part of the name of a quantity, or as a modifier of a noun, or as a modifier of an abbreviation. Unit symbols shall be used only when preceded by a number in the text of the standard, or in the caption of a table, or in the scale label of a figure.

Do not mix names for quantities with letter symbols. For example, for the unit of power spectral density, it is incorrect to write "power per Hz" or "power per hertz" or "power/hertz." Write "watt per hertz" or "W/Hz."

Standard unit symbols shall not be modified in an attempt to qualify or otherwise describe the quantity associated with that unit. Put the name for the modifier with the name for the quantity. Do not write "sound level in dBA", or "sound level of 90 dB(A)", or "sound level in A-weighted decibels." Write "A-weighted sound level in decibels" or "an A-weighted sound level of 90 dB." It is the acoustical quantity – not its unit (e.g., decibels) – that is weighted.

3.19 Equations and letter symbols for quantities

Equations are useful and valuable means to convey unambiguous information in a standard. This subclause provides general guidance for the presentation and display of equations.

1. Letter symbols for quantities, and their usage, shall conform to IEEE 260.4-2018.
2. Create equations using the equation tool supplied with Microsoft Word®.
3. Center each equation between the left and right margins. Number each equation in Arabic numerals contained in parentheses and right flush at the right-hand margin.

4. It is not appropriate to include the derivation of an equation in a standard. Give only the relevant equation(s) in final form accompanied by a careful explanation of all letter symbols, subscripts and superscripts, constants, and the applicable SI units of measure for all terms. Give all units in the text or in an explanatory list, not as part of the equation. Make sure that all equations are dimensionally correct.
5. Numerical values shall follow the requirements in 3.16
6. Letter symbols, including those from the Greek alphabet, shall be used for variables that represent physical quantities and shall be set in italic font style. Symbols for vector quantities are set in roman bold font style. Text, mathematical functions, frequency weightings, and numbers are set in Normal (Cambria) font style.
7. Quantities in equations shall be represented by a single letter symbol, with appropriate subscripts as required. Multi-letter abbreviations shall not be used instead of symbols. Abbreviations may be used as subscripts (see IEEE 260.4-2018).
8. Mathematical functions, including trigonometric functions such as sin, cos, and tan, are set in Normal (Cambria) font.
9. Mathematical operators are set in Normal (Cambria) font style as: +, -, ±, <, >, and =. Use · or ×, not the letter “x” to represent multiplication, or enclose the elements within parentheses. Integral and summation signs are also set in Normal (Cambria) font style.
10. Use “log₁₀” not “lg” or “log” or for the base 10 (common or Briggsian) logarithm. Use “ln” for Napierian (base-e) logarithms, not log_e.

NOTE “lg” will appear in Nationally Adopted International Standards originating from ISO or IEC.

11. It is not necessary to include the unit symbol dB after the expression “10 log₁₀ (ratio)” in an equation. It should be clear from the accompanying text if expressions are operating on levels of a quantity (i.e., where all elements on the left and right-hand sides of the equation are expressed in decibels).
12. The square root of -1 is to be represented by j, not i.
13. Avoid the radical (square root) sign for exponents smaller than 1/2.
14. In a line of text, use fractional exponents to indicate exponentiation to a power less than one.
15. In a line of text, use the solidus (/ or forward slash) to indicate division, never the ÷ sign. For displayed equations that involve one or more complicated numerator and denominator terms, use built-up fractions to avoid ambiguity and spacing problems.
16. In many acoustical standards there is an exponential relationship among the variables. If the relationship is relatively simple, use the form e^{-ax} where the base e is in italic or slanted type, as is the variable x and coefficient a . When the relationship is more complicated, avoid built-up fractions and use instead the exp operator as: $\exp[(a \sin \theta + b \cos \phi) / c]$, where the operator “exp” is in regular font style to ensure that the exponent does not appear too small, e.g.. $e^{[(a \sin \theta + b \cos \phi) / c]}$.
17. For most applications where the terms in an equation require only a single line of type, judicious use of parentheses (), brackets [], and braces { }, will avoid ambiguity and also avoid the complication of a built-up fraction.

18. Use Normal 10-point type for equations that are a part of the text of a standard. For equations that are placed in a note, use the 9-point type. It may be necessary to scale Greek letters, subscripts, and superscripts, relative to the basic type size, so that equations are clearly readable. Similarly, subscripts and superscripts for Greek letters may need to be larger than those used for Roman letters.
19. Each equation in the main text of a standard, including those in notes, shall be numbered sequentially with an Arabic number starting with (1), independent of the numbering of clauses, tables, or figures. Identify equations in annexes with numbers preceded by the letter designating the annex with a period (full stop) separating the letter and the number, for example as (A.1). Set all equation designators flush with the right margin of the page. Subdivided equation designators, as (3a), (3b), (3c), shall not be used.
20. If the right-hand side of an equation contains so many terms that it is too long to fit comfortably within the margins of a page, the equation shall be broken and carried over to subsequent lines, aligned with the equals sign on appropriate mathematical operators. If it is necessary to show alternative forms of an equation, the various alternatives shall be on separate lines and shall each have separate equation designations. The equations are centered between the margins and the equation number is added by using a center tab at 8 cm and a right-flush tab at 16 cm, respectively. Additional examples below illustrate these rules.
21. The list of variables following an equation is indented 1.8 cm. Each variable description begins with the variable, followed by a tab and then the variable description. A variable description generally begins with "is...". There is no punctuation at the end of each variable description. The variable description lines are single spaced, with 12 point spacing after each description.
22. In the terms and definitions clause, there are two acceptable ways to write an equation in a note to a definition for the level of an acoustical quantity that has a complicated fraction as the argument of logarithm. One procedure is to show the complete expressions for the numerator and denominator in one equation with descriptions below the equation of all symbols and their SI units of measure. The other procedure is to provide separate definitions and letter symbols for the quantities in the numerator and denominator expressions and then use those letter symbols in the expression for the level of the quantity, also with all symbols and their units described. Examples below illustrate these two options.

EXAMPLE 1 The definition for A-weighted sound exposure level might be given as "ten times the logarithm to the base-10 of the ratio of the A-weighted sound exposure to the reference sound exposure." The mathematical expression for A-weighted sound exposure level might be given in a note to the definition as follows. Note that the *AE* subscript to the letter symbol for the quantity indicates that the sound exposure is determined with frequency weighting A and that the "A" is in roman type because the frequency weighting is not a physical quantity. Sound exposure *E* is a physical quantity and hence the "*E*" is shown in italic type. The "A" precedes the "*E*" because the frequency weighting is applied to the sound pressure signal before the operation of time integration.

NOTE 1 The mathematical expression for A-weighted sound exposure level is given by:

$$L_{AE} = 10 \log_{10} \left\{ \left[\int_{t_1}^{t_2} p_A^2(t) dt \right] / p_0^2 T_0 \right\} \quad (1)$$

where

L_{AE} is the A-weighted sound exposure level, expressed in decibels (dB)

E_A is the A-weighted sound exposure, expressed in pascal-squared seconds (Pa²s)

E_0 is the reference sound exposure of 400×10^{-12} Pa²s from the product of the square of the reference sound pressure and the reference time for sound exposure level

$p_A^2(t)$ is the square of the A-weighted instantaneous sound pressure, expressed in pascals squared, as a function of running time, t , during an integration period starting at time t_1 and ending at time t_2

p_0 is the reference sound pressure of 20 μPa

T_0 is the reference time for sound exposure level of 1 s

NOTE 2 A-weighted sound exposure level is related to a corresponding measurement of time-average A-weighted sound level by:

$$L_{AE} = L_{AT} + 10 \log_{10} \left(\frac{T}{T_0} \right) \quad (2)$$

where

L_{AT} is the time-average, A-weighted sound level, expressed in decibels (dB) relative to the reference sound pressure

T is the averaging time for the measurement of time-average sound level and also the integration time for the measurement of sound exposure level, that is $T = t_2 - t_1$, expressed in seconds

EXAMPLE 2 An alternative approach to the presentations of EXAMPLE 1 that may be preferred for some standards is to give separate definitions for the various terms before giving the definition for the level of the acoustical quantity. Thus, the list of terms and definitions would define the reference sound pressure after the definition for sound pressure, which would lead to definitions for sound pressure level and time-average sound level. Subsequently, the list would define sound exposure and then sound exposure level. By this approach, the notes that might follow the definitions for sound exposure and sound exposure level are as follows. In this case, sound exposure is assumed to be defined as a general frequency-weighted quantity while the note, as an example, assumes that A-weighting A has been employed.

NOTE 1 The mathematical expression for A-weighted sound exposure level is given by:

$$L_{AE} = 10 \log_{10} \left(\frac{E_A}{E_0} \right) \quad (1)$$

where

L_{AE} is A-weighted sound exposure level, expressed in decibels (dB)

E_A is A-weighted sound exposure, expressed in pascal-squared seconds (Pa^2s)

E_0 is the reference sound exposure of $400 \times 10^{-12} \text{Pa}^2\text{s}$ from the product of the square of the reference sound pressure and the reference time for sound exposure level

NOTE 2 A-weighted sound exposure level is related to a corresponding measurement of time-average A-weighted sound level by the following expression:

$$L_{AE} = L_{AT} + 10 \lg(T/T_0) \quad (2)$$

where

L_{AT} is the time-average A-weighted sound level, expressed in decibels (dB) relative to the reference sound pressure

T is the averaging time for the measurement of time-average sound level and also the integration time for the measurement of sound exposure level, expressed in seconds

In the second example, the lists below Equations (1) and (2) are minimal because the mathematical expressions for E_A and E_0 and L_{AT} and T would have, by this approach, been given in notes to the definitions for sound exposure, reference sound exposure, and time-average sound level and hence are not repeated here.

EXAMPLE 3 An example of the presentation of an equation with many terms on the right-hand side: consider the equation below, from Annex B of ANSI/ASA S1.26, for the calculation of the saturation vapor pressure in a sample of moist air as needed to calculate the molar concentration of water vapor from measurements of the static pressure of the air, air temperature, for a specified relative humidity.

NOTE The ratio of saturation vapor pressure to the reference static air pressure is a function of the temperature of the air and is given by the following:

$$p_{sat}/p_{ref} = 10 \quad (\text{B.2})$$

where

p_{sat} is the saturation vapor pressure, expressed in pascals

p_{ref} is the reference static air pressure of 101 325 Pa

V is an exponent given by the following empirical expression:

$$\begin{aligned} V = & 10.79586 [1 - (T_{01}/T)] - 5.02808 \log_{10}(T/T_{01}) \\ & + 1.50474 \times 10^{-4} \{1 - 10^{-8.29692[(T/T_{01})-1]}\} \\ & + 0.42873 \times 10^{-3} \{-1 + 10^{-4.76955[1-(T/T_{01})]}\} \\ & - 2.2195983 \end{aligned} \quad (\text{B.3})$$

where

T is the temperature of the sample of air, expressed in kelvins

T_{01} is the triple-point isotherm temperature of 273.16 K

Equation (B.3) is shown in 4 lines to emphasize the separate elements of the expression. With use of additional brackets and braces to avoid ambiguity, the equation could be reduced to 2 lines and still be displayed as centered between the margins.

Note that the kelvin is the primary SI unit for temperature and hence the full-word text describing the temperature would read “the triple-point isotherm temperature of 273.16 kelvins.” Note also that no ° symbol appears before the unit symbol K as seen in the description of T_{01} above. Temperatures expressed in degrees Celsius shall use the ° symbol, e.g., “a reference temperature of 23 °C.”

3.20 Tables

3.20.1 Numbering of tables

Every table in the main text shall have an Arabic numeral and a caption and shall be cited at least once in the text. Tables shall be numbered sequentially in the order they are first mentioned throughout the standard. A table in an annex shall be identified by the combination of the capital letter for the annex designation, a period (full stop), and a sequence number for tables in that annex, e.g., Table B.3 for the third table in Annex B. The numbering of the tables is independent of the numbering of the clauses or figures. A single table in a standard is designated, for example, as Table 1 in the main text and Table A.1 in Annex A.

3.20.2 Table captions

Center the caption of a table horizontally above the table. Start with the word Table, followed by a space, an em-dash, another space, and then the caption, all in 10-point bold font. Capitalize only the first word of the caption, with the exception of proper nouns. Place a period at the end of the caption. In the caption, enumerate all elements of the table to provide the reader with a general idea of the subject with minimal reference to the standard. The format of a table is shown in the example below:

Table 1 — Poles and zeros (in Hz), and gain constant of the transfer function for the G-weighting network.

Zeros	<i>m</i>	<i>q_m</i>	<i>γ_m + jδ_m</i>
	1	4	0 + <i>j</i> 0
Poles			
Poles	<i>n</i>	<i>r_n</i>	<i>a_n + jβ_n</i>
	1	1	-0.707 + <i>j</i> 0.707
	2	1	-0.707 - <i>j</i> 0.707
	3	1	-19.27 + <i>j</i> 5.16
	4	1	-19.27 - <i>j</i> 5.16
	5	1	-14.11 + <i>j</i> 14.11
	6	1	-14.11 - <i>j</i> 14.11
	7	1	-5.16 + <i>j</i> 19.27
	8	1	-5.16 - <i>j</i> 19.27
<i>K</i>			
			2.48980026 x 10 ⁷

3.20.3 Table format

Tables should be prepared using the Table layout tool in Microsoft Word®. Each cell of a table shall have a border on all sides. All information relevant to the table shall be contained within its outer frame, including notes and footnotes (see 3.17.4).

Capitalize only the first word of a column heading. In a text entry for a cell in a table, capitalize only the first word. Follow the rules in 3.17 for unit symbols, and SI prefixes. Follow the rules in 3.19 for letter symbols.

If the same unit of measure applies to all columns of a table, put a statement about the unit above and outside the right hand corner of the table, spelled out in full words and using the 9-point regular font style, so that the units need not be repeated in each column heading, for example as “Levels in decibels.”

In column headings, where space permits, first write out the name for the quantity being tabulated using the bold font. On the next line or bottom line, provide the unit symbol of measure using Normal font. When only a narrow column width is available, do not use an abbreviation in a column heading if a letter symbol for the quantity is available.

Numerical values in tables shall follow the requirements in 3.16. To facilitate users copying and pasting numerical data from tables in a standard, negative numbers shall use the simple minus sign (Unicode 002D or ASCII 0045).

Do not use scientific notation in a column heading; such usage is ambiguous because one cannot tell whether the entries in the column have been, or should be, multiplied by the power of ten. Numbers in scientific notation shall not appear in tables. Instead of powers of ten, use the appropriate prefix of the SI unit (e.g., kilo “k” or micro “μ”) to make the entries near unity in magnitude.

Columns of related numbers should be aligned along the decimal point. Use a period, not a comma, for the decimal point. Do not use ditto marks to indicate repeated entries; repeat the entry in full each time. If there are no data for a particular entry in a column, use raised dots (••), not hyphens or a dash or a blank to represent the missing data. Do not combine decimal fractions and common fractions in the same field of a table.

If it is necessary to conserve space in a column, a hyphen or the word “to” may be used to indicate a range of numerical values.

Choose table alignment to center the table on a page without text wrapping.

3.20.4 Table notes and table footnotes

Place notes and footnotes within the frame of the table.

Indicate notes to a table by the sequence NOTE 1, NOTE 2, etc., with a new sequence for each table. A single note shall be preceded by the word NOTE.

Notes shall be contained in a single merged cell extending across all columns and either above the bottom frame line or above the cell that contains the footnotes, if any.

Indicate table footnotes by the sequence of superscript lower-case letters beginning with “a”. Start a new sequence for each table. Place the superscript footnote reference indicators on the table beginning at the upper left and extending across the table from left to right and downward row-by-row. Footnotes to tables are independent from footnotes to the text or a figure. Table footnotes shall be placed in the bottom cell of the table extending across all columns and below the cell that contains the notes, if any.

3.20.5 Continued tables

Every attempt should be made to confine tables to a single page or less. However, tables that are too large to fit on one page of the standard shall be captioned as a continued table. Column headings and any statement concerning units shall be repeated on all pages after the first page. The table caption is not repeated, but the words “Table # (continued)” are used in place of the table caption on each page of the continued table, except for the last page where the words “Table # (concluded)” shall be used.

NOTE For tables that continue over several pages, it is often useful to provide an abbreviated caption for the intermediate pages.

The distinguishing feature of the various pages of a continued table shall be described by an appropriate sub-caption preceded by lower-case letters in parentheses as (a), (b), and (c).

Plan all tables for a vertical (portrait) layout centered between the margins; avoid a horizontal (landscape) layout that would require the standard to be turned 90° in order to be read, or a large reduction from the original that would yield very small characters for the table entries. Foldout pages are not acceptable.

3.21 Figures

3.21.1 Use of figures

The requirements of the standard should be adequately given in the normative text, supplemented by tables as necessary. For some standards, however, figures (graphs and other illustrations) provide a measure of understanding not readily achieved otherwise. Each figure shall be referred to at least once in the text. Figures that require more than one page to be displayed are not allowed.

3.21.2 Format of figures and figure titles

Follow the general guidance of clause 28 of the ISO/IEC Directives, Part 2 when preparing a figure, with special attention to the labels and titles for the abscissa and ordinate axes. Polar plots and all frequency characteristics with a decibel or log magnitude vs. log frequency axes—with the exception of audiograms—shall comply with the aspect ratios given in IEC 60263: 10, 20, 25 or 50 dB per decade in frequency or 0.5, 1, 1.25, and 2.5 decades per decade in frequency.

The preferred appearance of x-y plots is a graph enclosed within 4 borders, two of which form the ordinate and abscissa axes, with appropriate interior tic marks on the four sides. Borders shall be black and grid lines shall be light gray. Grid lines may be omitted for x-y graphs with multiple curves. Explain the meanings of data symbols, line styles, and line weights in a figure legend. Callouts may be used in mechanical drawings, but are normally not used in graphs if the information can be provided in the legend, the title, or the figure caption.

Figures should be prepared as computer-generated drawings (including graphs, illustrations of mechanical elements, circuit diagrams, and flow charts) that are inserted into the draft of the document at a location immediately following, or as soon as practical, after the first mention of the figure.

All figures shall be saved separately as Enhanced Meta Files (*.emf). This vector graphics format enables the figure to be inserted into the document and resized with minimal deterioration or loss of resolution. emf files for all figures contained in a draft standard shall be delivered with the draft standard. The Working Group is responsible for retaining copies of the original drawing files for any subsequent revisions. These may be stored on the Working Group ftp site.

Graphs or charts may be prepared using a spreadsheet program, however, these should be saved as an Enhanced Meta File (*.emf) in order to keep the document file size reasonable.

Line drawings, flow charts, and similar illustrations may also be created using the drawing feature of Microsoft Word®, Microsoft Visio®, or equivalent. An emf file of these may be created by selecting the entire figure, right-clicking, and using Save As >> Enhanced Meta File (*.emf).

Photographs or scanned images shall not be used as a figure in a standard or technical report. Graphs or charts or other illustrations shall not be imported into the file of the draft standard as a link to another file where the figure was created.

Figures inserted into the draft standard shall fit and be centered within the margins. Care should be taken to preserve the aspect ratio when resizing figures. Figures should be appropriately cropped to eliminate unnecessary white space outside the borders.

The layout of a figure is shown in the following example:

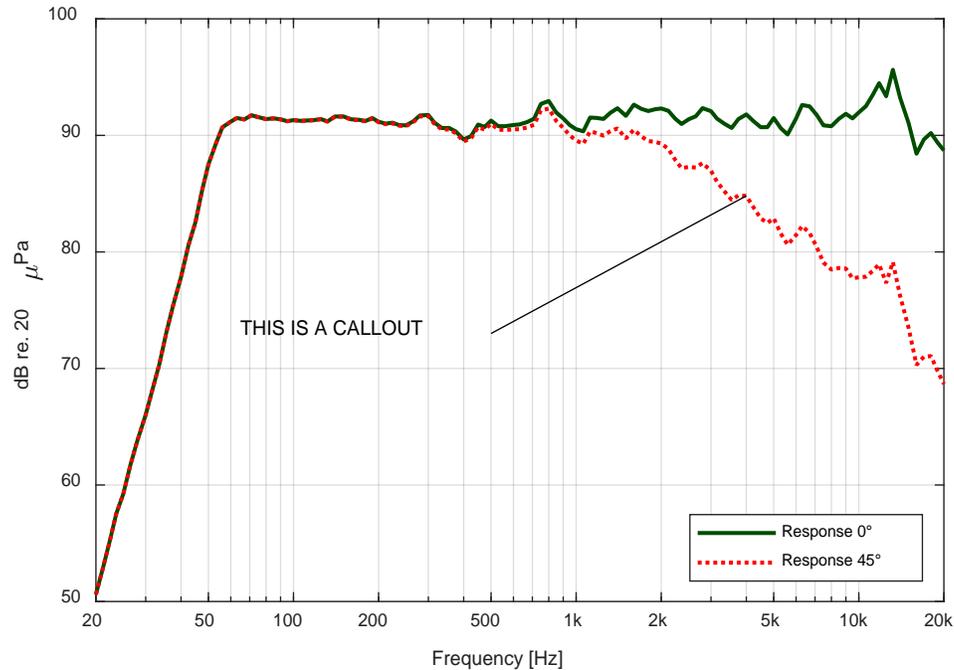


Figure 1 — Source response at 0° and 45°.

Center the figure number and title below the figure beginning with the word “Figure”, followed by the figure number, followed by a space, then an em-dash, another space, and then the title of the figure, all in bold font. Place period at the end of the caption.

Figures shall be numbered sequentially in Arabic numerals, beginning with 1. Figures in annexes shall be numbered sequentially within each annex with the Arabic numeral separated from the annex letter by a period (full stop) as: Figure A.3. A single figure in a standard is designated, for example, as Figure 1 when located in the main text and Figure A.1 in Annex A.

All lettering on figures shall be in 10-point Normal font, including:

1. Axis titles and labels
2. Linear dimensions, angles, and other physical properties
3. Callouts, on drawings or to specific features on a graph
4. Legend text

Abbreviations, units, and letter symbols on figures shall follow the rules in 3.17 through 3.19.

3.21.3 Notes and footnotes to figures

Both notes and footnotes to figures shall be treated independently from notes integrated in the text. They shall be located above the title of the relevant figure. Notes shall precede figure footnotes (if any). A single note in a figure shall be preceded by the word “NOTE”, placed at the beginning of the first line of the text of the note. When several notes occur in the same figure, they shall be designated “NOTE 1”, “NOTE 2”, “NOTE 3”, etc. A separate numbering sequence shall be used for each figure.

Footnotes to figures shall be distinguished by superscript lower-case letters, beginning with “a”. The footnotes shall be referred to in the figure by inserting the same superscript lower-case letter along with an appropriate callout, as required.

Footnotes to figures shall be placed immediately above the title for the figure.

Footnotes to figures shall be sequentially identified in the figure by lower-case superscript letters beginning with “a”. The same lower-case letter shall appear as a callout in the figure. Footnote identifications shall begin again with “a” in subsequent figures.

3.22 Annexes

3.22.1 Placement and format

Annexes shall appear after the main text and in the order in which they are cited in the text.

The clauses, subclauses, tables, figures and mathematical formulae of an annex shall be numbered using the letter designating that annex followed by a period (full stop) then the numeral(s) for that clause or subclause. The numbering shall restart with each annex. A single annex shall be designated “Annex A.”

3.22.2 Elements of an annex title

Each annex, whether normative or informative, requires three elements in its title in three centered, single-spaced paragraphs:

1. The word “Annex” followed by the designation of the annex by an upper-case letter in alphabetical sequence starting with A and all in bold font;
2. Identification of whether the annex is normative or informative, with the identification enclosed within parentheses and in Normal font style;
3. Title of the annex, with the first letter of the first word capitalized and the remainder of the title in lower-case—proper nouns are also shown with initial capitals—all in bold font.

3.22.3 Normative annexes

A normative annex shall be referred to as such in the main body of the standard, by the second line of the title of the annex, by the listing of the annex in the Contents, and by the choice of the verb forms for the text of the annex.

3.22.4 Informative annexes

Informative annexes provide additional but non-essential information. They are provided only for clarification, illustration, and general information about the standard. For many standards it is appropriate and desirable to include additional related information for general use and guidance. Such information, however, cannot be a normative part of the standard and is appropriately included in an informative annex.

No material that is rightfully a normative part of a standard shall be placed in an informative annex. The material in an informative annex shall be within or closely related to the scope of the standard and not inconsistent with the standard itself. If the material is rightfully part of the standard, it shall be included as a normative annex and so identified as described in 3.22.3.

NOTE Although an informative annex is not a normative part of a standard, it is included in the overall approval process by the Standards Committee.

Examples of material appropriate for an informative annex include:

1. Remarks about significance and interpretation of the standard, for example, to amplify or explain a statement in the text of the standard;
2. Background for, and development of, equations used in calculations;
3. Charts, tables, graphs, or supplementary information needed for computations;
4. Data forms for recording of test results (such forms may also be given in a normative annex);
5. Comments on the rationale for development of the method or procedure in the standard;
6. Software accompanying a standard;
7. Information about software accompanying a standard and instructions for its use.

An informative annex may contain equations, tables, and figures but may not include normative information such as requirements. Such equations, tables, and figures shall have an identification that is unique to each annex.

3.23 Bibliography

A bibliography is an optional element in a standard. If a bibliography is considered necessary, it is placed after the last annex; a bibliography is not an annex but a separate and final element.

The bibliography contains informative references that may be included to provide information about the history or development of a standard. Informative references are those that are not required for application of the standard.

NOTE Earlier versions of these *Guidelines* provided for the inclusion of informative references in Clause 2. As part of the effort to harmonize these *Guidelines* with the *ISO/IEC Directives*, such references shall only be included in a bibliography.

Bibliographic entries shall be arranged in the sequence in which they are cited in the text. Each entry in the bibliography shall be cited in the body of the standard or an annex.

A bibliography may list publications that explain technical aspects of the standard. A standard, however, is not intended to be a technical treatise and shall not include an extensive reading list. A bibliography shall not contain references to source material not cited in the standard or to unpublished material.

All bibliographies shall include complete entries for any cited material. Written permission is required to reprint any material that is to be included verbatim in a standard. As far as possible, all entries shall be publicly available for the expected lifetime of the standard.

Each bibliographic entry shall be numbered using Arabic numerals in brackets, for example, as [1]. This number shall be shown with the citation in the text. Apply the bibliography style from the ASA template to achieve the desired numbering.

In general, each entry shall include as many of the following elements as possible: the name(s) of the author(s), complete title of the book or article exactly as published, name of the journal or magazine if

appropriate, edition, volume, publication data (place, publisher, date), page numbers, Universal Resource Locator (URL) for online Internet documents, and any other relevant data.

NOTE The date for citation of a reference may contain the month and year or only the year as appropriate.

A goal of these *Guidelines* is to ensure that a user of the standard can locate the sources cited in the bibliography. The examples in this subclause show the styles to be used for entries in a bibliography.

EXAMPLE 1 Book with a single author:

[1] Surname, initials or first name of author. *Title of Book*. City of Publication: Publisher, date.

EXAMPLE 2 Book with more than one author:

[2] Surname, initials or first name of primary author, first name and surname of second and other authors. *Title of Book*. City of Publication: Publisher, date.

EXAMPLE 3 Book or publication with no identified authors:

[3] *Title of publication*: City of Publication: Publisher, date.

EXAMPLE 4 Articles from Journals:

[4] Surname, initials or first name of primary author, first name and surname of second and other authors. "Title of article." *Name of Journal*, volume number, date: pages.

EXAMPLE 5 Online journals or publications:

[5] Surname, initials or first name of primary author, first name and surname of second and other authors. "Title of Article [online]." Publication date [cited date]. Available from the Internet at: <provide the complete URL>.

EXAMPLE 6 Citation of a URL:

[6] Available at <<http://www.abc.xyz/folder/filename.htm>>

EXAMPLE 7 A Standard:

[7] ISO 690 (all parts), *Documentation – Bibliographic references – Content, form and structure*

NOTE The listing in Example 7 of the undated reference to ISO 690 means that the latest version applies.

4 Special considerations

4.1 Essential patents

Although there is no objection in principle to developing an American National Standard that calls for the use of an essential patent, this practice shall be avoided whenever possible. If the Working Group considers it necessary for technical reasons to include an essential patent, the procedures given in 3.1 of the ANSI Essential Requirements [4] shall be followed.

4.2 References to commercial equipment

In a standard, references to commercial equipment or intellectual property shall be generic and shall not include trademarks or other proprietary designations. Where, on the date of approval of a standard, a sole source exists for essential equipment or materials, it is permissible to supply the name and address of the source in a note, provided the words “or the equivalent” are added to the citation. Trade names, if their use cannot be avoided, shall be identified, if appropriate, by the symbol ® to indicate a registered trademark.

4.3 Clarity

Great care is required to ensure that the text of subclauses is simply stated and clear-cut. The wording shall be such as to preclude the possibility of more than one interpretation. Avoid vague and indefinite terms.

4.4 Non-technical expressions

Use non-technical expressions wherever possible in the text to state requirements. If technical expressions must be used, all unusual terms shall be included in the list of terms and definitions.

4.5 Special word usage

4.5.1 “Shall” and “should”

The word “shall” (and “shall not”) is to be understood as denoting a normative requirement; the word “should” (and “should not”) as denoting a recommendation.

The following meanings shall apply to these words in American National Standards:

The verb “shall” is to be used wherever the criterion for conformance to the specific recommendation requires that there be no deviation. “Shall” is not to be used in any foreword, informative annex, or note. Do not use “may not” in place of “shall not” to express a prohibition.

The verb “should” is to be used wherever nonconformance to the specific recommendation is permissible. “Should” shall not be substituted for “shall” on the grounds that conformance to the requirements of the standard is considered voluntary.

NOTE The use of “should” or “shall” has no bearing on the voluntary nature of American National Standards. Inclusion of, or reference to, an American National Standard in a document, standard, or contract by a company, agency, or regulatory body is a voluntary act. When an American National Standard is so cited, the standard becomes a requirement within the limitations set forth by the document, standard, or contract.

4.5.2 “May” and “can”

The verb “may” (and “may not”) shall be used in statements to indicate a permissible (or non-permissible) action expressed by the standard and within the limits of the scope of a standard. Do not use “possible” or “impossible” as a substitute for “may” or “may not.”

The verb “can” shall be used to state a possibility or capability.

4.5.3 “Must” and “comply”

The verbs “must” and “comply” indicate mandatory legal requirements. Such usage is never appropriate for a standard. Use “shall” to express normative requirements. A product or a procedure may be

required by a standard to "conform to" the requirements of the standard, but not "comply with" or "meet" the requirements.

4.5.4 "And/or"

Avoid the term "and/or" wherever possible. Rewrite the statement to clarify the meaning; for example: "Headphones or headsets, or both", not "Headphones and/or headsets". "Nuts, or screws, or bolts, or a combination thereof"; not "nuts, screws, and/or bolts".

4.6 Metric and customary units

If a standard includes numerical values for dimensions and quantities, the values shall be given using International System (SI) units. Other appropriate units may be given in addition, where practicable. Where non-SI units are given to supplement the SI units, they shall be given in parentheses following the SI units.

EXAMPLE "Measurements shall be made at a distance of 100 m (328 ft) from the sound source."

In the SI system of units, prefixes to indicate powers of ten are given in multiples of 1000, for example as 1 km, 1 m, 1 mm, 1 μ m. Use metres or millimetres as appropriate, instead of centimetres.

NOTE The spelling of the SI unit of length is internationally standardized as "metre" and is preferred for acoustical standards.

4.7 Effective dates

American National Standards are published by the Acoustical Society of America and promulgated through ANSI for voluntary use. However, users, distributors, regulatory bodies, certification agencies, manufacturers, and others may apply American National Standards as normative requirements in commerce and industry. Such applications may require the establishment of effective dates for the provisions of the standard.

Effective dates shall not be part of a standard approved by ANSI. Such dates may be included in published American National Standards only when authorized by the standards developer and only if it is clearly shown that they are not part of the standard. Effective dates may appear on the cover of the publication, in the foreword, as notes, or in parentheses following a provision to which such a date applies. When an effective date appears in any portion of a published American National Standard (or in a proposed American National Standard), the following statement or its equivalent shall be included: "The effective date is established by the Standards developer and not by the American National Standards Institute."

4.8 Use of copyrighted material from other organizations

If a Working Group wishes to include any copyrighted material, including figures or tables, in a standard, the Working Group Chair shall obtain written permission from the copyright holder granting permission for ASA to publish such material. A copy of the written permission shall be submitted to the ASA Standards Secretariat prior to submitting the draft for ballot of the Accredited Standards Committee. If written permission is not obtained, the copyrighted material shall not be included.

4.9 Grammar, punctuation, and spelling

All ANSI/ASA standards shall be prepared in US English.

Use common American English spellings.

In a list of three or more items, use a comma before the final “or” or “and” as shown in the heading for this subclause.

Use hyphens to link a series of two or more nouns used as adjectives to modify another noun.

EXAMPLE “free-field sound-pressure level”

Capitalize the words Clause, Equation, Table, Annex, Figure, and Note when they are used to refer to a specific point of reference in the standard. As example, write “see Figure 2” not “see figure 2” or “see Fig. 2”; “see Clause 2” not “see clause 2”, and “see Equation (5)” or “see Eq. (5)”, not “see equation (5)”. Use lower-case for the initial letters on these words when not referring to a specific item. Refer to a subclause or paragraph by its numerical indicator only. Write “given in 4.9” or “described in 5.1.1.”, not “given in subclause 4.9” or “described in paragraph 5.1.1.”

5 Measurement Uncertainty

Standards describing measurements or test methods frequently include a measurement uncertainty reporting requirement. Such requirements shall appear in the normative body of the standard. Since it is advantageous that such information be correctly and consistently interpreted, any standard including a measurement uncertainty reporting requirement shall also include an informative annex providing general information about measurement uncertainty, including one example uncertainty budget. With the exception of the information in the example uncertainty budget table, the annex shall conform to the format and include the boilerplate text and figure found in Annex C. A bibliographic reference to the Part 3 of the GUM [9] shall also be included.

For more information about measurement uncertainty as it applies to standards, consult bibliography references [3] and [4].

6 Software to Accompany a Standard

6.1 General

In some cases, software may accompany a published standard. Reasons for including software with a standard may include: to simplify a process such a complex calculation; to reduce errors in a complex calculation; to show an example of a process described in the standard; and/or to show an example of the use of a method described in the standard in a practical application using realistic data as input.

Different formats of software are acceptable provided it can be delivered in a zip file, e.g., 64-bit (32-bit compatible) *.exe, MS Excel *.xlsx, Matlab *.m file, ASCII *.csv or *.txt file. Sample data may also be provided. Code such as Matlab, should be appropriately commented. Excel files should also include Cell Comments as needed.

Software accompanying ANSI/ASA standards is packaged in a zip file and sold or distributed with the PDF copy of the standard. Some resellers may also make the software available on CD accompanying a print copy of the standard.

6.1.1 Requirements for software accompanying a standard

Functionally, the accompanying software is the same as an informative annex, i.e., it is not a normative or essential part of the standard. The software is to be considered one possible embodiment of the standard, i.e., as an example of the implementation of the standard, but it shall not be essential for using

the standard. The normative text of the standard shall describe the process well enough for it to be used or implemented correctly without the software.

In the case of any discrepancy between the text, equations and tables published in the normative body of the standard and the accompanying software, the normative text in the standard shall apply. In the case of any such discrepancy, the working group shall review the issues and revise the standard and software at the earliest opportunity.

The software revision cycle is the same as the document revision cycle, i.e., the software will not be revised more frequently than the document. The software version distributed with the published standard shall be only the version that was reviewed and approved by the accredited standards committee.

The purpose and operation of the software shall be described in an accompanying informative annex of the standard. This same information may also appear in a README.TXT file or a HELP file within the program itself.

The completed software shall be included with the final draft of the standard document submitted to the ASA Standards Secretariat and go out with the draft for ballot. Any unauthorized revision of the software shall not be substituted for the original software unless and until it is balloted and approved as part of a revision of the standard.

The working group Chair shall be responsible for securing the necessary legal permission and/or open source license from the software developers for its free use within the standard (contact ASA for details).

6.1.2 Software copyright, license, and warranty notice

A work is “published” for copyright purposes when copies are sold, licensed, rented, lent, or otherwise distributed to the public. Unless otherwise noted in the standard and approved by ballot, ASA is the rights holder. Therefore, all software that accompanies a standard shall include a copyright notice. The copyright notice must include the copyright symbol, date and Acoustical Society of America, e.g.:

© 2019 Acoustical Society of America

Immediately following the copyright notice, the following license statement shall also be included:

“The purchaser of this standard has a nonexclusive, non-transferable, royalty-free license, without right to sublicense, to use the software. ASA does not warrant that any provided software is suitable for any particular purpose.”

For open code or spreadsheet templates, the copyright, license and warranty statement shall be prominently displayed in a comment line at the top of the program or worksheet and/or in the Help text. For compiled/executable code, the copyright notice shall be prominently displayed in any start up splash screen, in any drop down “About” or “About This Program” menu, and on any “Help” menu. This same notice shall also appear in the Informative Annex describing the accompanying software.

7 Technical reports

7.1 Technical report versus standard

ANSI and ASA Accredited Standards Committee Procedures recognize that situations can arise in which it is in the best interest of the public to issue a technical report on a subject instead of a standard with

normative requirements. This can occur for a developing subject for which a sufficient consensus does not yet exist to approve a document as a standard in a timely fashion, yet the information developed on the subject is of sufficient interest to deserve publication. In these situations, the Accredited Standards Committee may issue a technical report instead of a standard. *Guidelines for ANSI Accredited S Committee Working Groups* apply and shall be referred to during development. The ASA Standards Secretariat will then register the report with ANSI in accordance with procedures given in [5], or the ANSI procedures that may currently be in effect.

7.2 Editorial requirements for a technical report

The basic differences in editorial style between a technical report and a standard are related to the fact that the report shall not contain any normative text or requirements. Specifically:

1. “Shall”, or related verbs which imply specific requirements, are not used in a technical report.
2. All references in a technical report are “informative”, not “normative”. Hence all such references shall appear in a bibliography at the end of the report.
3. No annex to a technical report is “normative”, thus the indication required in the contents of a standard specifying whether an annex is “normative” or “informative” is omitted from the annex title and from the contents for every annex in a technical report.

7.3 Foreword to a technical report

The following disclaimer is required in the Foreword to a technical report that is published in lieu of a standard:

“Publication of this Technical Report that has been registered with ANSI has been approved by Accredited Standards Committee S1 Acoustics (or as appropriate). This document is registered as a Technical Report according to the *Procedures for the Registration of Technical Reports with ANSI*. This document is not an American National Standard and the material contained herein is not normative in nature. Comments on the content of this document should be sent to Accredited Standards Committee S1 Acoustics (or as appropriate), Standards Secretariat, Acoustical Society of America, 1305 Walt Whitman Road, Suite 300, Melville, NY 11747.”

The Foreword shall also contain a rationale to explain why the document is published as a technical report instead of a standard.

The Foreword may also contain changes since the last revision of the technical report and/or information about the history or evolution of the technical report.

7.4 General text of a technical report

The style of a technical report, other than the general restrictions stated in the previous clauses and the content of the foreword, shall follow the general structure of a standard as closely as possible. In this way, at some future time when it may be possible to convert the technical report into an actual standard, the extent of the revisions can be minimized.

7.5 Designator and running header for pages for a technical report

Instead of being designated, for example, as “American National Standard S1.XX-200X”, with the running header on each page being “ANSI/ASA S1.XX-200X”, a technical report shall be designated “ANSI/ASA Technical Report S1.XXTR–200X”, with the running header on each page being “ANSI/ASA

S1.XXTR-200X". (Obviously the appropriate S committee number will be used for technical reports issued under each committee's jurisdiction.)

8 National adoptions of international standards

If a Working Group wishes to recommend adoption of an ISO or IEC Standard as an American National Standard, the Chair should consult the ASA Standards Manager to discuss specific considerations. ANSI's requirements are spelled out in [2], with further information available in the Accredited Operating Procedures of the S Committees [6], a copy of which is available on the ASA standards website:

<https://acousticalsociety.org/introduction-to-asa-standards-program>

9 File Format

Draft standards shall be submitted as a Microsoft Word® file, version 2016 or later (*.docx). The document is converted to Portable Document Format (PDF) after final copy editing for balloting and final publication. The working group shall be responsible to check the PDF version of the document for any conversion errors. The secretariat shall be informed immediately so this can be addressed prior to ballot and publication.

Annex A (informative) Editorial checklist

Manuscript

When a draft of a proposed standard is ready to be balloted by a Standards Committee for the first time, it should be reviewed for conformance to these *Guidelines*. The following checklist is intended to assist in this review process.

When the draft is completed and the Working Group has reached consensus on the content, the Chair of the Working Group should review this checklist before submitting the draft standard to the Secretariat.

Checklist

- The draft has been created using the ASA Template.
- The draft is submitted in a Microsoft Word® document file (*.docx), in conformance with these *Guidelines*, including separate *.emf files for all figures.
- The wording of the title of the standard is the same everywhere it appears.
- A running header is provided to identify each text page of the standard after the page containing the scope.
- Styles provided in the template were used to create the headings for the clauses and subclauses and for the text of the paragraphs.
- Clauses and subclauses are numbered as required by these *Guidelines*.
- Page numbers are provided for every page and are in the prescribed position at the bottom of the page except for the title and copyright pages.
- Page order is as follows:
 - Title/abstract page
 - Copyright page
 - Contents
 - Foreword
 - Introduction
 - Text of standard
 - Annexes
 - Bibliography

Contents

- Title page in the format required by these *Guidelines* is included with an abstract and with the date for the current draft indicated in the upper right corner.
- Copyright page is included.

___ Content pages are complete; headings and page numbers for clauses and subclauses agree with those in the document, including annexes, table captions, figure titles, and page numbers agree with those in the document, including any tables and figures in annexes.

Foreword pages

___ Foreword pages are included.

___ Documentation has been included in the Foreword to describe any technical differences between the proposed American National Standard and a corresponding international document if the proposed standard ___ is, or ___ is not, comparable to any existing ISO or IEC standard.

___ The list of names of Working Group members is complete with full names and correct spellings.

NOTE The Chair of the Working Group is responsible for providing Standards Secretariat with the list of the full names of all Working Group members who participated in the draft standard, as well as designations such as "Jr." or "III".

Main text

___ Introduction (optional).

___ Scope, Clause 1, is included (normative).

___ Statement detailing whether the standard is a revision of an existing American National Standard or an identical or modified national adoption of an international standard is included in the ___ abstract, foreword, and ___ main body of the standard.

___ Normative references, Clause 2, are provided if required, including ___ References to American National Standards, and ___ International Standards. Ensure that the references are current, that the titles are quoted correctly, and that the reference numbers for the standards are complete with the year of issue.

___ Terms and definitions, Clause 3, if applicable, are included with proper format and content.

___ Numerical values cited in the standard have been checked for accuracy and agree, to the indicated precision, with values calculated, if possible, from corresponding equations in the standard or annexes.

___ Equations are numbered in serial order, have the proper format, and use letter symbols not abbreviations, to represent quantities, variables, and coefficients.

___ SI (metric) units are used for all physical quantities, with corresponding (customary) units, if necessary, shown within parentheses following the SI units.

___ Symbols for physical quantities and their units conform to the latest available American National Standard. Appropriate ___ italic letter symbols are used for measurable quantities; Roman letter symbols are used where required for non-measurable quantities.

___ Abbreviations and acronyms, if used at all, are explained in full words at least the first time they are used.

___ Tables have numbers and captions, each table is referred to in sequence in the text, each table is prepared in accordance with the requirements of these *Guidelines*.

___ Figures, have ___ proper dimensions, each figure was prepared as a computer-generated object that was inserted directly into the file for the draft standard; each figure follows the requirements for scales, _ scale labels, ___ callouts, ___ line weights, and ___ data symbols. Each figure has a separate ___ number ___ and ___ title; _ each figure is referred to in sequence in the text.

___ Figures, have been provided separately in an * .emf file format.

Annexes

___ Annexes are identified as ___ normative or ___ informative, _ each annex is referred to in the text in sequence; for each annex, ___ text, ___ figures, ___ tables, ___ equations, ___ and references conform to the requirements of these *Guidelines* regarding form and style.

Bibliography

___ References given in the bibliography are in the proper format, are complete, and the spelling has been checked. Each entry is numbered and sequentially cited in the text.

Special considerations

___ No material intended to be a normative part of the standard is included in a foreword, note, footnote, or informative annex.

___ Normative requirements are given by using the auxiliary verb "shall"; direct instructions are given by the imperative tense.

___ The verbs "must" and "comply" are not used to give any normative requirement.

___ Non-normative requirements are given by the auxiliary verbs "should", "may", or "can".

___ The term "and/or" has been avoided and replaced with a statement to clarify the meaning.

___ Commercial instruments or equipment are not mentioned in the standard by a trademark name or by a manufacturer's proprietary designation.

___ Written permission has been obtained from the publisher for use of any copyrighted material and the original copy of the permission letter has been submitted to the ASA Standards Secretariat.

___ If inclusion of patented items has been required, ANSI policies have been followed (see 4.1).

Annex B

(normative)

ASACOS policies on definitions

- 1) Definitions shall be consistent with corresponding definitions in the most current and relevant acoustical terminology standard(s).
- 2) Definitions in an approved acoustical terminology standard shall not be changed in any respect unless there is a demonstrated need. A change proposed to a definition in an existing American National Standard shall be supported by strong technical reasons for the change.
- 3) Where more than one definition for a term exists in various standards, the version most recently approved by the Accredited Standards Committee shall be used in subsequent standards.
- 4) The clause for terms and definitions in proposed standards shall not repeat definitions from acoustical terminology standards unless the Working Group considers it absolutely necessary. If such repetition of a definition is deemed to be necessary by the Working Group, the citation to the text from the original Standard shall be specific, such as: *See 11.46 in S1.1-1994* and that terminology standard shall be listed as a normative reference including the date.
- 5) If a term is used in several related standards in a series, give the definition only in the most general of the standards. The other standards shall then refer to the general standard without repeating the definition.
- 6) Avoid circular definitions in which one concept is defined by a second concept, and the second concept is defined by the first concept.
- 7) Equations may be included in a note to a definition to supplement, but never serve as a replacement for, the text of the definition.
- 8) In an acoustical terminology standard, do not include definitions that are specialized for use with only one standard, or are so general that they may be found in any general purpose dictionary or mathematics handbook.

Annex C (informative)

Tolerances and measurement uncertainty

(This annex is not part of <<insert name number and date of standard here>> but is included for information purposes only.)

Tolerances, in general, apply to the performance of a device under test as measured with perfectly accurate measurement equipment. To ensure that performance is within a specified tolerance when using real and imperfect measurement equipment, the inside acceptance interval on the measured value shall be less than the specified tolerance by the maximum permitted uncertainty for that measurement, e.g., for outgoing inspection. To confirm that performance is outside of the specified tolerance when using real and imperfect measurement equipment, the outside acceptance interval on the measured value shall be greater than the specified tolerance by the maximum permitted uncertainty for that measurement, e.g., for incoming QC/QA. Note the maximum permitted uncertainty is applied to each tolerance limit to obtain the acceptance interval (see Figure D.1).

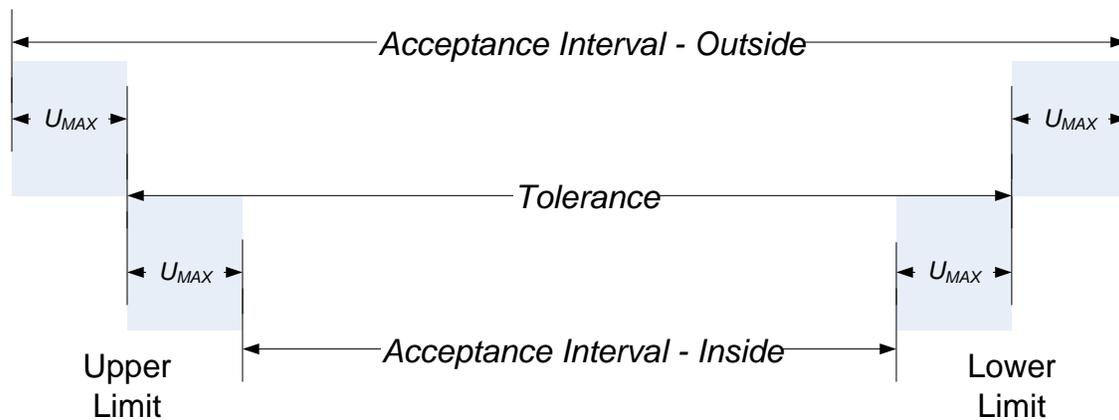


Figure D.1 – Relationship between tolerance limits, corresponding acceptance intervals and the maximum permitted uncertainty of measurement, U_{MAX}

Although calibration of the measurement system minimizes the effects of bias errors, random errors will still remain. The maximum permitted uncertainty due to these random errors is found by first determining the standard uncertainty for each source of measurement error. These sources may be computed or estimated, found from manufacturer's calibration data, or determined empirically from a statistically significant number of similar measurements. These standard uncertainties are generally given in decibels and therefore must be converted to linear units. These linear values, expressed as percentages, are then squared and summed. The square root of this sum is the total standard uncertainty. The total standard uncertainty times 2 then yields the expanded uncertainty with a coverage factor of $k = 2$ (equivalent to 2σ or a probability of approximately 95%). This value is the maximum permitted uncertainty, U_{MAX} , which is usually expressed in decibels. An example uncertainty budget is shown in Table D.1. The actual maximum permitted uncertainty is calculated for the specific measurement conditions. Note that the calculated uncertainty applies to the measurement itself, not to any uncertainty or variability in the device under test. Detailed information regarding measurement uncertainty can be found in ISO/IEC Guide 98-3 Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM).

Example Bibliography

- [1] *ANSI Procedures for the National Adoption of ISO and IEC Standards as American National Standards*. New York: American National Standards Institute, January 2018.
- [2] C. J. Struck, "Measurement Uncertainty and its Application to Standards in Acoustics", presented at the Acoustical Society of America 174th Meeting (INVITED) in New Orleans, LA (4-8 Dec. 2017), *Proc. Of Meetings on Acous.*, April 2018. <https://doi.org/10.1121/2.0000775>
- [3] *Procedures for the Registration of Technical Reports with ANSI*. New York: American National Standards Institute, January 2019.
- [4] *Accredited Standards Committee (ASC) Operating Procedures*, latest edition.