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AMERICAN NATIONAL STANDARD

For Rating Noise with Respect to Speech Interference

ANSI S12.65-2006

Accredited Standards Committee S12, Noise

Standards Secretariat
Acoustical Society of America
35 Pinelawn Road, Suite 114E
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For Rating Noise with Respect to Speech Interference

Secretariat

Acoustical Society of America

Approved 28 February 2006

American National Standards Institute, Inc.

Abstract

This standard defines a simple numerical method for rating the expected speech-interfering aspects of noise using acoustical measurements of the noise.

AMERICAN NATIONAL STANDARDS ON ACOUSTICS

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

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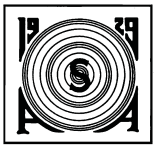

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Foreword

[*This Foreword is for information only, and is not a part of the American National Standard ANSI S12.65 - 2006 American National Standard For Rating Noise with Respect to Speech Interference*.

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

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

This standard is a revision and redesignation of ANSI S3.14-1977. In this revision the normative references have been updated, some new bibliographic references have been added as well as some introductory material about Speech Transmission Index (STI), Rapid Speech Transmission Index (RASTI), Articulation Index (AI), and Percent Loss of Consonants (%ALCONS), although these are not included in this standard. The definition of speech interference level has also been updated to be consistent with ANSI S1.1-1994.

This standard is not comparable to any existing ISO Standard

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

R.D. Hellweg, *Chair*

R.D. Godfrey, *Vice-Chair*
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Individual Experts of Accredited Standards Committee S12, Noise, were:

P.K. Baade
L.L. Beranek
E.H. Berger
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L.A. Wilber
G.E. Winzer
G.S.K. Wong

Working Group S12/WG43, Rating Noise with Respect to Speech Interference, which assisted Accredited Standards Committee S12, Noise, in the development of this standard, had the following membership.

M. Alexander, Chair
P.D. Schomer

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

Introduction

The intelligibility of speech in noise is dependent on many factors. These include:

(1) *Acoustic factors,* such as the level of the speech signal (at the listener's ear), the level of the interfering noise, the frequency spectrum of the speech signal, the frequency spectrum of the noise, the temporal pattern of the speech and noise, differences in the spatial relationship of the speech and noise sources, and reverberation effects.

(2) *Nonacoustic factors,* such as size of message set, *a priori* probability of occurrence of each message or unit of speech, the listener's motivation and familiarity with the speech material, the role of visual cues, and the talker's speech habits.

(3) *Random or quasirandom factors,* such as individual differences between talkers and listeners, day-to-day variations in a listener's ability or a talker's effectiveness, effects of randomization in the choice of test material, and random sampling errors.

NOTE The deleterious effect of noise on speech intelligibility may be greater for elderly listeners or listeners with sensory neural hearing impairments.

The method in which intelligibility is specified depends on the testing procedure. Subjective testing procedures that are commonly used yield sentence intelligibility [2, 8], monosyllabic word intelligibility or scores from a checklist of response words, such as the modified rhyme test [13] [see American National Standard S3.2-1989 (R1999)].

Ideally, given information on all of the above factors and the method for specifying intelligibility, it should be possible to predict accurately the intelligibility of speech in noise. There are, however, basic limitations to the accuracy of such predictions. First, the abovementioned random factors set an upper bound on precision. Second, not all the factors affecting intelligibility are fully understood. Experiments have shown, however, that reasonably accurate predictions of intelligibility can be made from acoustical measurements of the speech and the noise, given detailed information on the method of testing, speech material, skill and motivation of the listeners, and the proficiency of the talker [10, 18, 20, 27]. In addition, there are several measurements which provide estimates of speech intelligibility by characterizing the noise and reverberation in a room. These include, Speech Transmission Index (STI), Rapid Speech Transmission Index (RASTI), Articulation Index (AI), Speech Intelligibility Index (SII), Percent Loss of Consonants (%ALCONS) [7, 15, 23, 26, 29].

It is important to recognize the distinction between the physical measure called speech interference level and its application. The definition of speech interference level is exact; it is based on acoustical measurements of the noise and is specified with the same precision required of any physically measurable standard. The application of the index, e.g., as a predictor of speech interference, is less precise, owing to the limitations listed above. This is a difficulty common to all measures or standards attempting to predict perceptual effects. This does not mean that reasonably accurate predictions of subjective quantities cannot be made, but only that there is a substantial difference in the degree of precision that can be obtained. Experimental data on the relative precision of the speech interference level and other predictors of speech interference may be found in [4- 6, 16-22, 24, 25, 27, 28, 30-39].

Finally, it should be recognized that this standard is applicable to natural speech. Speech that is electronically transmitted, either in analog or digital form, or is electronically reinforced can be subject to distortion, both linear and nonlinear which can degrade its intelligibility beyond that which would be predicted by the speech interference level. Application of the SIL to predict intelligibility in these cases may be misleading.

American National Standard

For Rating Noise with Respect to Speech Interference

1 Scope

This standard defines a simple numerical method for rating the expected speech-interfering aspects of noise using acoustical measurements of the noise. The relevant acoustical characteristics of the noise are summarized in terms of a single-valued index known as the speech interference level. The application of the measure is intended for natural speech.

NOTE The speech interference level is related to the speech intelligibility index (ANSI S3.5-1997 (R2002) and to A-weighted sound level (ANSI S1.42-2001 (R 2006)).

2 Normative references

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

ANSI S1.1-1994 (R 2004), *American National Standard Acoustical Terminology*.

ANSI S1.4-1983 (R 2006) with Amd.S1.4A-1985 (R 2006), *American National Standard Specification for Sound Level Meters*.

ANSI S1.11-2004, *American National Standard Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters*.

ANSI S3.2-1989 (R1999), *American National Standard Method for Measuring the Intelligibility of Speech over Communication Systems.*

ANSI S3.5-1997 (R2002), *American National Standard Methods for the Calculation of the Speech Intelligibility Index*.

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in ANSI S1.1-1994 (R 2004) and the following apply:

3.1 speech interference level. One-fourth of the sum of the band sound pressure levels for octave-bands with normal midband frequencies of 500, 1000, 2000, and 4000 Hz. Unit, decibel; abbreviation, SIL; symbol L_{SI}.

NOTE 1 The limiting frequencies for the four octave bands cited above are 355-710, 710-1400, 1400-2800, and 2800-5600 Hz, respectively. In practice, these octave bands are realized with filters conforming to American National Standard S1.11-2004.

NOTE 2 In the previous edition (ANSI S3.14-1977) this symbol was L_{SIL}.

