ASA/ANSI S3/SC1.6-2018

AMERICAN NATIONAL STANDARD

Procedure for Determining Audiograms in Toothed Whales through Evoked Potential Methods

Secretariat:

Acoustical Society of America

Approved on May 31, 2018

American National Standards Institute, Inc.

Abstract

This standard describes measurement procedures for obtaining audiograms in odontocete cetaceans (i.e., toothed whales) via evoked potential methods, specifically by generation of the auditory steady-state response (ASSR). Methods are specified for the use of sinusoidally amplitude-modulated (SAM) tones and trains of tone bursts. It further establishes standards for reporting data collection methods, analyses, and hearing thresholds.

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Accredited Standards Committee S3/SC 1, Animal Bioacoustics

Standards Secretariat
Acoustical Society of America
1305 Walt Whitman Road, Suite 300
Melville, NY 11747

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Acoustical Society of America
ASA Secretariat
Melville, New York 11747
Telephone: 1 (631) 390-0215
Fax: 1 631-923-2875
E-mail: asastds@acousticalsociety.org

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Foreword

[*This Foreword is for information only, and is not a part of the American National Standard* ANSI/ASA S3/SC1.6-2018 American National Standard Procedure for Determining Audiograms in Toothed Whales through Evoked Potential Methods*. As such, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the standard.*]

This standard comprises a part of a group of definitions, standards, and specifications for use in animal bioacoustics. It was developed and approved by Accredited Standards Committee S3/SC 1 Animal Bioacoustics, under its approved operating procedures. Those procedures have been accredited by the American National Standards Institute (ANSI). The Scope of Accredited Standards Committee S3/SC 1 is as follows:

> *Standards, specifications, methods of measurement and test, instrumentation, and terminology in the field of psychological and physiological acoustics, including aspects of general acoustics which pertain to biological safety, tolerance, and comfort of non-human animals, including both risk to individual animals and to the long-term viability of populations. Animals to be covered may potentially include commercially grown food animals; animals harvested for food in the wild; pets; laboratory animals; exotic species in zoos, oceanaria or aquariums; or free-ranging wild animals.*

This standard is not comparable to any existing ISO Standard.

At the time this Standard was submitted to Accredited Standards Committee S3/SC 1, Animal Bioacoustics, for approval the membership was as follows:

D.S. Houser, *Chair*
K. Fristrup, *Vice-Chair*

N. Stremmel, *Secretary*

Acoustical Society of America ..... A.M. Thode
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..... M.J. White (Alt.)

U.S. Navy Marine Mammal Program ..... J.J. Finneran
..... D.S. Houser (Alt.)

University of Cincinnati Animal Audiology Clinic/Bioacoustics Lab ..... P.M. Scheifele
..... D.K. Brown (Alt.)

Individual Experts of Accredited Standards Committee S3/SC 1, Animal Bioacoustics, were:

A.E. Bowles	J.J. Finneran	D. Ketten
D.K. Delaney	K. Fristrup	

Working Group S3/SC 1/WG 6, Evoked Potential Testing of Toothed Whale Hearing, which assisted Accredited Standards Committee S3/SC 1, Animal Bioacoustics, in the development of this standard, had the following membership.

D.S. Houser, Chair

R.F. Burkard	A. Kumar	A. Pacini
J.J. Finneran	K. Lucke	T.K. Rowles
R.L. Gentry	T.A. Mooney	P. Scheifele
R. Gisiner	J. Mulsow	A. Scholik-Schlomer
J. Kassewitz	P.E. Nachtigall	A. Supin

Suggestions for improvements to this standard will be welcomed. They should be sent to Accredited Standards Committee S3/SC 1, Animal Bioacoustics, in care of the Standards Secretariat of the Acoustical Society of America, 1305 Walt Whitman Road, Suite 300, Melville, New York 11747. Telephone: 631-390-0215; FAX: 631-923-2875; E-mail: asastds@acousticalsociety.org.

Introduction

This standard establishes procedures for estimating frequency-specific hearing thresholds in odontocetes (toothed whales) through the use of auditory evoked potential (AEP) methods. The objective of the standard is to provide consistent guidelines for the collection of audiograms. The rapid proliferation of AEP hearing tests in odontocetes has been accompanied by varied ways of calibrating test stimuli and calculating hearing thresholds with resulting wide variances in threshold estimates across laboratories for the same species and frequencies tested. The variability has introduced confusion into stakeholder communities that utilize marine mammal hearing thresholds both in academic contexts, and to predict, mitigate, and regulate the potential impact of sound on marine mammals. This standard establishes consistent test methods and quantities to report so better comparability in odontocete AEP threshold estimates can be achieved.

The use of the auditory steady-state response (ASSR) is recommended for obtaining frequency-specific thresholds due to the high amplitude modulation rates that are available for odontocetes, its ease of analysis in the frequency domain, its common usage, and its amenability to objective statistical response detection methods.

American National Standard

Procedure for Determining Audiograms in Toothed Whales through Evoked Potential Methods

1 Scope

The use of AEPs to obtain audiograms from odontocetes (toothed whales) has become increasingly common. The use of sinusoidally amplitude-modulated (SAM) tones to elicit the ASSR is the most typical of the AEP approaches used in determining frequency-specific hearing thresholds in odontocetes. Trains of tone bursts provide an alternative means for eliciting the ASSR, and both approaches are amenable to objective analysis in the frequency domain. This standard establishes methods for the measurement of the ASSR generated by SAM tones and tone-burst trains in odontocetes, including instructions for appropriate stimulus waveforms and stimulus calibration. The standard further establishes configurations for electrode placement and stimulus delivery, and minimum requirements for reporting electrophysiological and acoustical noise.

Data collected according to this standard is to be used in the creation of audiograms for individually tested odontocetes. The data is anticipated for use in interspecies comparisons of hearing abilities and to improve the ability to predict and mitigate the potential impact of underwater sound on odontocetes. It is expected that users of the standard will include scientists interested in marine mammal hearing; users of the data collected according to the standard will include academia, regulators, and government and private agencies required to address the potential impact of human-caused sound on marine mammals. Data collected according to the standard will increase comparability of frequency-specific threshold estimates made by different individuals and laboratories under varying constraints on test conditions. This standard is limited to the determination of frequency-specific hearing thresholds in odontocetes via ASSR evoked potential audiometry; it does not preclude the use of different AEP techniques for studying other aspects of odontocete hearing. None of the procedures described in this standard can be used for monaural hearing tests; all methods described result in binaural stimulation to some degree.

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/ASA S1.1-2013 *American National Standard Acoustical Terminology*

ANSI/ASA S1.11-2014/Part 1/IEC 61260-1:2014 A*merican National Standard Electroacoustics – Octave-band and Fractional-octave-band Filters – Part 1: Specifications (a nationally adopted international standard)*

ANSI/ASA S3.6-2010 *American National Standard Specification for Audiometers*

ANSI/ASA S3.20-2015 *American National Standard Bioacoustical Terminology*

ANSI/ASA S3.21-2004 *American National Standard Methods for Manual Pure-Tone Threshold Audiometry*

IEC 60645-3:2007 *Electroacoustics – Audiometric equipment – Part 3: Test signals of short duration*

ISO 389-6-2007 *Acoustics – Reference zero for the calibration of audiometric equipment – Part 6: Reference threshold of hearing for test signals of short duration*