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ANSI/ASA S3.25-2009
(Revision of ANSI S3.25-1989)

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AMERICAN NATIONAL STANDARD

For an Occluded Ear Simulator

ANSI/ASA S3.25-2009

Accredited Standards Committee S3, Bioacoustics

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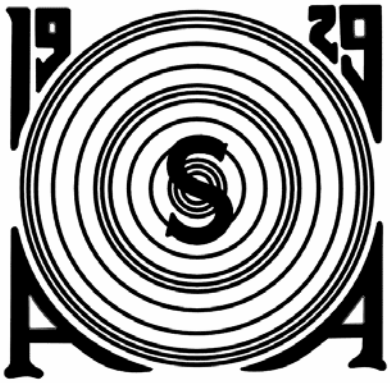

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(Revision of ANSI S3.25-1989)

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For an Occluded Ear Simulator

Secretariat:

Acoustical Society of America

Approved August 31, 2009 by:

American National Standards Institute, Inc.

Abstract

The acoustical performance of an occluded ear simulator is specified. This device is designed to simulate the acoustical behavior of the ear canal between the tip of an ear mold and the eardrum, including the acoustic impedance at the eardrum of a median adult human ear. The occluded ear simulator is intended for transducers that are sensitive to acoustic load. It is also suitable as the basis for extensions intended to simulate the complete ear canal and the outer ear (e.g., head and torso simulators). Specific physical realizations of the ear simulator are described.

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Foreword

[This Foreword is not a part of ANSI/ASA S3.25-2009 *American National Standard for an Occluded Ear Simulator*.]

This standard comprises a part of a group of definitions, standards, and specifications for use in bioacoustics. It was developed and approved by Accredited Standards Committee S3, 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 is as follows:

> *Standards, specifications, methods of measurement and test, and terminology in the fields of psychological and physiological acoustics, including aspects of general acoustics which pertain to biological safety, tolerance and comfort.*

ANSI/ASA S3.7-1995 (R 2008) *American National Standard Method for Coupler Calibration of Earphones* describes several earphone calibration couplers. These different couplers were developed to meet various earphone and hearing aid measurement needs over the past 60 years. Although all of these couplers are intended to provide a driving point impedance that is an approximation to the acoustic load presented by a median human ear, none of them is designed to represent standing wave sound fields found in the real ear. This is a primary distinction between earphone calibration couplers described in ANSI/ASA S3.7-1995 (R 2008) and the occluded ear simulator described in this standard.

A large amount of data has been collected that permits one to define the geometry and related acoustical characteristics of a median adult ear. Performance specifications based on these data provide the primary basis for describing ear simulators. A large body of performance data also exists which was obtained using the legacy 4-branch Zwislocki ear simulator that was defined in ANSI S3.25-1979 (updated and superseded by S3.25-1989). A parallel project for specification of an occluded ear simulator resulted in publication IEC 711-1981 (now IEC 60318-4). Both the Zwislocki ear simulator and the IEC 711 ear simulator have been widely deployed and used. In addition, as of the publication of this document, the Zwislocki ear simulator is no longer manufactured. Therefore, this revision describes both the legacy Zwislocki ear simulator and the IEC 60318-4 ear simulator. Both types of occluded ear simulator are now compliant with this standard.

This standard contains technical revisions of ANSI S3.25-1989. Major non-editorial revisions in this edition include:

- Harmonization with IEC 60318-4 (formerly IEC 711). Both the legacy Zwislocki ear simulator and the IEC ear simulator are compliant with this standard.
- Emphasis is on the acoustical performance specification. Mechanical construction details and drawings for both the legacy Zwislocki ear simulator and the IEC ear simulator have been moved to Annexes.
- Specifications and tolerances are expressed as levels in decibels.
- The acoustical transfer impedance phase tolerance has been removed as this was deemed redundant for any physically realizable embodiment.
- Specifications for the IEC ear simulator have been added.
- Graphs of the transfer impedance level re level at 500 Hz for both ear simulators are shown.
- Provision for field calibration using a pistonphone or acoustic calibrator has been added.
- Descriptions of the acoustic coupling for testing hearing aids and earphones are included.

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

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A.J. Brammer	R. McKinley	H. Teder
R.F. Burkhard		L.A. Wilber
A.J. Campanella		W.A. Yost

Working Group S3/WG 37, Coupler Calibration of Earphones, which assisted Accredited Standards Committee S3, Bioacoustics, in the development of this standard, had the following membership.

C. J. Struck, Chair

M. Alexander	G.J. Frye	V. Nedzelnitsky
J.R. Bareham	M. Killion	D.A. Preves
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Suggestions for improvements of this standard will be welcomed. They should be sent to Accredited Standards Committee S3, Bioacoustics, 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

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Introduction

In 2003, commercial production of the legacy 4-branch Zwislocki ear simulator ceased. As of the date of this revision, it is recognized that many legacy 4-branch Zwislocki ear simulators are still in the field, functional and in daily use. Therefore, the legacy 4-branch Zwislocki ear simulator is maintained as a viable standardized ear simulator in this revision. This revision also recognizes that the ear simulator described in IEC 60318-4 (formerly IEC 711) is actively manufactured and supported and is the viable alternative. The two types of ear simulators are recognized as functionally equivalent in this standard.

The structure of this revised standard places emphasis on the acoustical performance of the ear simulator rather than the physical (or mechanical) embodiment. Acoustical coupling for hearing aids, earphones, and telecommunication devices is also included. Mechanical construction details for both ear simulators appear in the Annexes. Extension of the frequency range of applicability was also considered; however, there were insufficient data to validate this use.

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American National Standard

For an Occluded Ear Simulator

1 Scope

Ear simulators are intended for earphone response determination, measurement of hearing aid gain and performance, and measurements requiring simulation of the sound transmission characteristics of an external ear. Measurements performed with ear simulators are intended to provide data equivalent to sound pressures at the eardrum generated by sound sources in and around the ear.

This standard gives acoustical performance criteria for a device that provides acoustic impedance and exhibits sound-pressure distributions approximating the median adult human ear between an ear mold and the eardrum. Two specific embodiments whose performance conforms to these criteria are described. Construction details can be found in the annexes.

As a simulation of part of a median adult human ear, the occluded ear simulator is suitable for use in test systems such as manikins, where the complete ear is to be simulated.

Procedures are given for determining that the occluded ear simulator has the specified acoustic performance.

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 S3.7, *American National Standard Methods for coupler calibration of earphones*

ANSI S3.36, *American National Standard Specification for a Manikin for Simulated* in situ *Airborne Acoustic Measurements*

IEC 60318-4, *Electroacoustics – Simulators of human head and ear - Part 4: Occluded-ear simulator for the measurement of earphones coupled to the ear by means of ear inserts (Revision of IEC 711:1981)*

IEC 61094-4, *Measurement microphones – Part 4: Specifications for working standard microphones*

3 Terms and Definitions

3.1
equivalent volume
volume of air having the same acoustic compliance

3.2
occluded ear simulator
device which approximates the acoustic transfer impedance of the inner part of the human ear canal, from the tip of an ear mold to the eardrum

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