AMERICAN NATIONAL STANDARD

Specification for a Manikin for Simulated *in-situ* Airborne Acoustic Measurements

ANSI/ASA S3.36-2012

Accredited Standards Committee S3, Bioacoustics

Standards Secretariat
Acoustical Society of America
35 Pinelawn Road, Suite 114 E
Melville, NY 11747-3177

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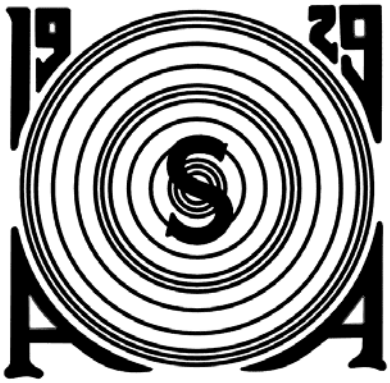

ANSI/ASA S3.36-2012
(Revision of ANSI S3.36-1985)

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Specification for a Manikin for Simulated *in-situ* Airborne Acoustic Measurements

Secretariat:

Acoustical Society of America

Approved on November 30, 2012 by:

American National Standards Institute, Inc.

Abstract

The present standard describes a manikin for airborne acoustic measurements. It comprises a head with external ears and ear canals, and a torso that simulates a median human adult. It is intended primarily as an instrument for measuring the response of acoustical devices under simulated *in situ* conditions. Acoustical performance requirements are given as well as informative geometric descriptions.

AMERICAN NATIONAL STANDARDS ON ACOUSTICS

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Foreword

[This Foreword is for information only, and is not a part of the American National Standard ANSI/ASA S3.36-2012 *American National Standard Specification for a Manikin for Simulated in situ Airborne Acoustic Measurements*.]

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.*

This standard is a revision of ANSI S3.36-1985, which has been technically revised. At the time of preparation of this standard there was a parallel effort in IEC/TC 29, SC-29C Working Group 9 to revise IEC/TR 60959:1990 (in fact, identical to ANSI S3.36-1985), which resulted in IEC 60318-7. The IEC 60318-7 document and this standard have many common elements; however, this standard does differ from IEC 60318-7 in some respects. Notable differences include:

- The Scope of Use for the manikin includes other applications in addition to hearing aid measurements.
- Dimensional information is found in informative annexes.
- Recommendations for documentation of the manikin calibration are included.
- Specification of harmonic distortion of the test system is reduced to 0.5%.
- Conditions and specifications for the free field sound source are detailed.
- Angular resolution for tests is reduced to ±1°.
- The specification for the free field on-axis response of the manikin is revised, considering the response of several different commercially available manikins.
- The free field manikin response tolerance is specified only at 0° azimuth, whereas tolerances in IEC 60318-7 apply to all azimuth angles (0°, 90°, 180°, and 270°).
- The manikin diffuse field response is specified in place of the 90°, 180°, and 270° angle responses.
- A diffuse field response test procedure is detailed.
- Nominal manikin response and tolerances are provided in both graphical and tabular format.
- Requirements for field pressure calibration are provided.
- A number of application-specific requirements are included. For mouth-simulator-equipped manikins for telecom applications, reference is made to ITU-T Rec. P.58.
- The DRP to ERP transfer function is provided in an annex instead of the DRP to EEP transfer function.
- A table of the dimensional data for three commercially available manikins and average human data is included in an informative annex.

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

C.J. Struck, *Chair*
G.J. Frye, *Vice-Chair*

S.B. Blaeser, *Secretary*

Acoustical Society of America ..... C.J. Struck
..... M.D. Burkhard (Alt.)

American Academy of Audiology ..... D. Ostergren
..... S. Gordon-Salant (Alt.)

American Academy of Otolaryngology, Head and Neck Surgery, Inc. ..... R.A. Dobie
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Council for Accreditation in Occupational Hearing Conservation (CAOHC) ..... L.D. Hager

ETS – Lindgren Acoustic Systems ..... S. Dunlap
..... D. Winker (Alt.)

Etymotic Research, Inc. ..... M.C. Killion
..... J.K. Stewart (Alt.)

Food and Drug Administration ..... S-C Peng

Frye Electronics, Inc. ..... G.J. Frye
..... K.E. Frye (Alt.)

G.R.A.S. Sound & Vibration ..... J. Soendergaard
..... B. Schustrich (Alt.)

Hearing Industries Association ..... T.A. Victorian
..... C.M. Rogin (Alt.)

National Electrical Manufacturers Association,
Signaling Protection & Communication Section (NEMA – 3SB) ..... J. McNamara
..... R. Reiswig (Alt.)

National Hearing Conservation Association ..... G.L. Poling

National Institute for Occupational Safety and Health (NIOSH) ..... M. Stephenson
..... W.J. Murphy (Alt.)

National Institute of Standards and Technology ..... V. Nedzelnitsky
..... R.P. Wagner (Alt.)

National Park Service ..... G.R. Stanley
..... K. Fristrup (Alt.)

Natus Medical, Inc. ..... Y. Hekimoglu
..... P. Becke (Alt.)

Ocean Conservation Research ..... M. Stocker

Starkey Laboratories ..... D.A. Preves
..... T.H. Burns (Alt.)

U.S. Air Force ..... R.L. McKinley
..... B.D. Simpson (Alt.)

U.S. Army Aeromedical Research Lab ..... W.A. Ahroon

U.S. Army CERL ..... D.K. Delaney
..... M.J. White (Alt.)

U.S. Army Research Laboratory, Human Research and Engineering Directorate ..... T.R. Letowski
..... P. Henry (Alt.)

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

Individual Experts of the Accredited Standards Committee S3, Bioacoustics, were:

J.R. Bareham	K.D. Kryter	H. Teder
A.J. Brammer	R.L. McKinley	L.A. Wilber
R.F. Burkard	P.D. Schomer	W.A. Yost
A.J. Campanella	C.J. Struck	

Working Group S3/WG 67, Manikins, which assisted Accredited Standards Committee S3, Mechanical Vibration and Shock, in the development of this standard, had the following membership.

C.J. Struck, Chair

M. Alexander	R. McKinley	J. Soendergaard
W. Bray	W. Murphy	J. Stewart
M. Killion	M. Nilsson	R. Wagner
T. Letowski	D. Preves	K. A. Woo

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.

Introduction

This standard describes a head and torso simulator (a.k.a. manikin) for acoustical measurements such as hearing aid simulated insertion gain, insertion loss of hearing protectors, headphone and earphone response, speech and room acoustics, automotive acoustics, measurements of telephone handsets, headsets, and hands-free or loudspeaking telephones.

The manikin described in this standard is intended for airborne acoustic measurements and is not suitable for measurements which depend upon vibration transmission paths such as bone conduction, nor for measurements requiring the simulation of bone or flesh. The acoustical performance of the head and torso simulator has been specified to provide diffraction effects similar to those encountered around the median adult human head and torso.

The frequency response tolerances in this document were developed using free and diffuse field data provided by the three known manufacturers of compliant test manikins. Additional data for a common alternative configuration of one of the manikins with a legacy ear simulator was also included.

Significant changes to this document since the last revision (1985) include:

- Emphasis is on the acoustical response of the manikin. Dimensional information is moved to informative annexes.
- The Scope of Use for the manikin includes other applications in addition to hearing aid measurements.
- Recommendations for documentation of the manikin calibration are included.
- Specification of harmonic distortion of the test system is reduced to 0.5%.
- Conditions and specifications for the free field sound source are detailed.
- Angular resolution for tests is reduced to ±1°.
- The specification for the free field on-axis response of the manikin is revised, considering the response of three different commercially available manikins, one equipped with either of the ANSI/ASA S3.25 ear simulators.
- The manikin response tolerances are reduced in the critical frequency range from 1 to 5 kHz, considering the small variation between the data for the different manikins.
- The manikin diffuse field response is specified in place of the 90°, 180°, and 270° angle responses.
- The figure depicting the pinna simulator is updated.
- A diffuse field response test procedure is detailed.
- Nominal manikin responses and tolerances are also depicted as graphs.
- Requirements for field pressure calibration are provided.
- A number of application-specific requirements are included. For mouth-simulator-equipped manikins for telecom applications, reference is made to ITU-T Rec. P.58.
- A table of the dimensional data for three commercially available manikins and average human data is included in an informative annex.
- An informative annex provides the DRP to ERP transfer function.
- The bibliography includes additional updated references.

American National Standard

Specification for a Manikin for Simulated *in-situ* Airborne Acoustic Measurements

1 Scope

This standard describes a manikin which is intended to simulate the acoustical effects of a median human adult, including diffractions affecting the in-situ performance of electroacoustic devices used on or near a person. The manikin consists of a head mounted on a torso that extends to the waist. The head is equipped with pinnae and ear simulators with acoustic impedance terminations and microphones located at positions corresponding to those of eardrums on a median human adult. Measurement results obtained with the manikin may differ substantially from similar results obtained on an individual person due to anatomical variations. Median dimensions provided in the annexes were drawn from the population samples described in the Bibliography.

The manikin is described by the acoustical performance requirements of this standard. Physical dimensions of manikins that meet these requirements are provided for information but are not part of the standard. Dimensional information can be found in Annexes B, C and D.

For test application specific requirements, the user is referred to clause 8 for additional information, pertinent test standards, and/or any modifications to the basic specifications required for that particular application.

Manikins for binaural recording are outside the scope of this standard.

2 Normative references

The following referenced documents are useful 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 S1.11 American National Standard Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters

ANSI/ASA S3.20 American National Standard Bioacoustical Terminology

ANSI/ASA S3.25 American National Standard for an Occluded Ear Simulator

ANSI/ASA S3.35 American National Standard Methods of Measurement of Performance of Hearing Aids under Simulated *in-situ* Working Conditions

ANSI/ASA S12.42 American National Standard Methods for the Measurement of Insertion Loss of Hearing Protection Devices in Continuous or Impulsive Noise Using Microphone-in-Real-Ear or Acoustic Test Fixture Procedures

ANSI/ASA S12.51 / ISO 3741 American National Standard Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure – Precision methods for reverberation test rooms