ANSI S3.25-1989
(ASA 80-1989)
(Revision of ANSI S3.25-1979)

AMERICAN NATIONAL STANDARD
For an Occluded Ear Simulator

ACCREDITED STANDARDS COMMITTEE S3, BIOACOUSTICS

ABSTRACT

The physical configuration and acoustical performance of an occluded ear simulator are specified. This device is designed to simulate the acoustical behavior of that portion of the ear canal between the tip of an earmold and the eardrum, including the acoustic impedance at the eardrum of a median adult human ear over the frequency range from 100 Hz–10 kHz. The occluded ear simulator is suitable especially for transducers that are sensitive to acoustic load. Specific physical realizations of the ear simulator are described.

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FOREWORD

[This Foreword is not a part of American National Standard for an Occluded Ear Simulator, ANSI S3.25-1989 (ASA Catalog No. 80-1989).]

The American National Standard Method for Coupler Calibration of Earphones, ANSI S3.7-1973, describes several earphone calibration couplers. These different couplers were developed to meet various earphone and hearing aid measurement needs as they arose over the past 40 years. Because each coupler had a different purpose, little attention was given to the interrrelationship among them. 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 ears. This is a primary distinction between earphone calibration couplers described in ANSI S3.7-1973 (R 1979) and the ear simulator described in this standard.

A large amount of data has been collected that permits one to define the geometry and related acoustics characteristics of a median adult ear. Performance specifications based on these data provide the primary basis for describing ear simulators. A large body of data exists on the four-branch ANSI Occluded Ear Simulator. Thus this revision describes only a four-branch simulator, and deletes any discussion of a two-branch or composite simulator, which appeared in ANSI S3.25-1979. A parallel project for specification of an occluded ear simulator resulted in publication IEC 711-1982.

This standard was developed under the jurisdiction of Accredited Standards Committee S3, Bioacoustics, using the American National Standards Institute (ANSI) Accredited Standards Committee Procedure. The Acoustical Society of America provides the Secretariat for Accredited Standards Committee S3, Bioacoustics.

Accredited Standards Committee S3, Bioacoustics, under whose jurisdiction this standard was developed, has the following scope:

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

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

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

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Suggestions for improvements in this standard will be welcomed. They should be sent to **Accredited Standards Committee S3 at the Standards Secretariat, in care of the Acoustical Society of America, 335 East 45th Street, New York, NY 10017-3483. Telephone (212) 661-9404.**

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For an Occluded Ear Simulator

1 SCOPE

1.1 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. They provide data equivalent to sound pressures at the eardrum generated by various sources in and around the ear. A schematic or conceptual representation of a complete ear simulator is given in Fig. 1.

1.2 The occluded ear simulator described in this standard is that portion below the line *X–X′* in the schematic representation of a conceptual ear simulator in Fig. 1.

1.3 This standard gives physical performance criteria for a mechanical structure that provides acoustic impedance and exhibits sound-pressure distributions approximating those found in a median adult human ear between an earmold and the eardrum. It also describes a specific device whose performance conforms to these criteria.

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

1.5 Procedures are outlined for determining that the occluded ear simulator has the acoustic performance specified in this standard.

1.6 Appendix A presents an acoustsic performance comparison of the ANSI occluded ear simulator with the IEC 711 (1982) occluded ear simulator.

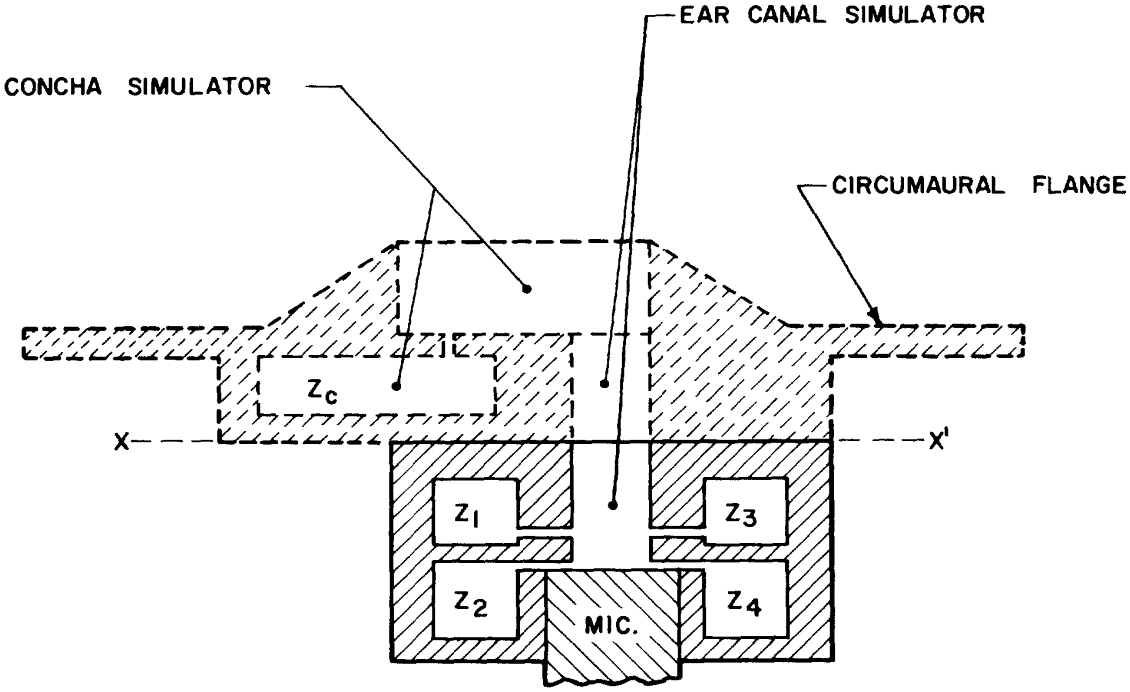

FIG. 1. Simplified cross-section diagram of an ear simulator, for measurement of earphone responses. The construction should permit a separation of the portion below the plane *X–X′* for measurements involving hearing aid or insert earphone outputs. Z_1, Z_2, Z_3, Z_4, and Z_c are acoustic networks comprising resistance, inertance, and compliance. This standard describes the portion below *X–X′*.