ASA/ANSI S3.13-1987
(ASA 74-1987)
(Revision of ANSI S3.13-1972)

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AMERICAN NATIONAL STANDARD

Mechanical Coupler for Measurement of Bone Vibrators

Secretariat:

Acoustical Society of America

Approved on 16 November 1987:

American National Standards Institute, Inc.

Abstract

This standard specifies requirements for mechanical couplers used for calibrating bone-conduction audiometers and making measurements on bone vibrators and bone-conduction hearing aids. Specific design features are given for the mechanical coupler when driven by a vibrator with a prescribed plane circular tip area and applied with a specific static force. An appendix provides an example of a specific construction of a mechanical coupler.

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Standards Secretariat
Acoustical Society of America
335 East 45th Street
New York, New York 10017-3483

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This standard specifies requirements for mechanical couplers used for calibrating bone-conduction audiometers and making measurements on bone vibrators and bone-conduction hearing aids. Specific design features are given for the mechanical coupler when driven by a vibrator with a prescribed plane circular tip area and applied with a specific static force. An appendix provides an example of a specific construction of a mechanical coupler.

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AMERICAN NATIONAL STANDARDS ON ACOUSTICS

The Acoustical Society of America holds the Secretariat for Accredited Standards Committees S1 on Acoustics, S2 on Mechanical Shock and Vibration, S3 on Bioacoustics, and S12 on Noise. Standards developed by those committees, which have wide representation from the technical community (including manufacturers, consumers, and general-interest representatives), are published for the Acoustical Society of America by the American Institute of Physics as American National Standards after approval by their respective standards committees and the American National Standards Institute.

These standards are developed as a public service to provide standards useful to the public, industry, and consumers, and to Federal, State, and local governments.

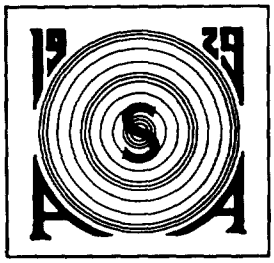
This standard was approved by the American National Standards Institute as ANSI S3.13-1987 on the 16 November 1987.

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether he has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review and users are cautioned to obtain the latest editions.

Caution Notice: An American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to affirm, revise, or withdraw this standard no later than five years from the date of publication.

The Acoustical Society of American (ASA) is an organization of scientists and engineers formed in 1929 to increase and diffuse the knowledge of acoustics and to promote its practical applications.

The American National Standards Institute, Inc. (ANSI) is the national coordinator of voluntary standards development and the clearing house in the U.S. for information on national and international standards.



FOREWORD

[This Foreword is not a part of American National Standard Mechanical Coupler for Measurement on Bone Vibrators ANSI S3.13-1987 (ASA Catalog No. 74-1987).]

This standard is a revision of American National Standard Artificial Headbone for the Calibration of Audiometer Bone Vibrators, S3.13-1972, developed originally to provide standardized mechanical impedance values for couplers used in the calibration of audiometer bone vibrators. These values were arrived at by comparing data published in the scientific literature between 1954 and 1959. Experience in the manufacture of mechanical couplers has shown that the design target was difficult to attain. In particular, the dependence of mechanical impedance on frequency did not closely correspond to that of physically realizable devices. The present revision has been developed with consideration of these problems and with tolerances based on quantity production of mechanical couplers in the intervening years. The values of mechanical impedance for the mechanical coupler, included in this revision, correspond to those proposed in the revision of International Electrotechnical Committee (IEC) Publication 373.

Further experimental work on the mechanical impedance of the human headbone is encouraged, especially investigations to combine systematically results obtained in several laboratories. Such results could provide a set of physical parameters that is more representative of the mechanical impedance of the human headbone.

Future study and review of basic impedance data may permit development of a more stable and reproducible mechanical coupler that is a closer representation of the human headbone.

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 holds 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 approval, the membership was as follows:

L. A. Wilber, *Chairman*
H. Silbiger, *Vice Chairman*
A. Brenig, *Secretary*

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Individual experts of Accredited Standards Committee S3, Bioacoustics, were:

L. Batchelder
R. W. Benson
K. M. Eldred
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K. D. Kryter
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H. E. von Gierke
L. Wilber
W. Yost
R. W. Young

Working Group S3-43, Calibration of Bone Vibrators, which assisted Accredited Standards Committee S3, Bioacoustics, in the development of this standard, has the following membership:

D. D. Dirks, *Chairman*

E. L. R. Corliss
T. A. Franks
S. Gilman
S. F. Lybarger
W. O. Olsen
L. A. Wilber

Suggestions for improvements in this standard will be welcomed. They should be sent to the Standards Manager, Standards Secretariat, Acoustical Society of America, 335 East 45th Street, New York, NY 10017-3483.

CONTENTS

American National Standard Mechanical Coupler for Measurements on Bone Vibrators

1 SCOPE

This standard specifies requirements for mechanical couplers used for calibrating bone-conduction audiometers and for making measurements on bone vibrators and bone-conduction hearing aids, in the frequency range from 125 to 8000 hertz (Hz) inclusive.

1.1 Audiometry

The purpose of this standard, as applied to audiometry, is to provide a means of calibrating bone vibrators of the types used in bone-conduction audiometry by specifying a standardized mechanical impedance with which to load the vibrator and a device for measuring the alternating force produced. Reference equivalent threshold force levels corresponding to the normal threshold of hearing are specified by American National Standard Reference Equivalent Threshold Force Levels for Audiometer Bone Vibrators, S3.26-1981, or future revisions thereof. For this application, the bone vibrator is required to have a plane circular tip area of 175 ± 25 mm^2 and to be applied to the mechanical coupler with a static force of 5.4 ± 0.5 newton (N). The mechanical coupler is also intended for other measurements on bone vibrators for audiometers, viz., frequency response, unwanted sound radiation, harmonic distortion, etc.

1.2 Hearing Aids

The purpose of this standard, as applied to hearing aids, is to provide a means of measuring the electromechanical characteristics (sensitivity, frequency response, harmonic distortion, etc.) of bone vibrators used in hearing aids, or the acoustomechanical characteristics of complete hearing aids of the bone conduction type, when dynamically loaded by a specified mechanical impedance and statically loaded with a force in the range 1.7 to 4 N.

2 DEFINITIONS

For the purpose of this standard the following terms apply.

2.1 Bone Vibrator

An electromechanical transducer intended to produce the sensation of hearing by vibrating the cranial bones.

2.2 Mechanical Coupler

A device designed to present a specified mechanical impedance to a vibrator applied with a specified static force, and equipped with a mechano-electric transducer to determine the alternating force level at the surface of contact between vibrator and mechanical coupler.

2.3 Alternating Force Level (Force Level)

Twenty times the logarithm to the base 10 of the ratio of the rms value of the force transmitting the vibration to the reference value of 1 micro-newton (1 μN). Unit: decibel (dB).

2.4 Mechanical Impedance

Mechanical impedance of a sinusoidally vibrating object at a specified frequency. The complex quotient of the alternating force transmitting the vibration to the component of velocity of the object in the direction of the force. Unit: N s m^{-1} (newton seconds per meter).

2.5 Mechanical Impedance Level

Twenty times the logarithm to the base 10 of the ratio of the absolute value (modulus) of the mechanical impedance to the reference value of 1 N s m^{-1}. Unit: dB.

2.6 Mechanical Resistance

The real part of the (complex) mechanical impedance.

2.7 Mechanical Reactance

The imaginary part of the (complex) mechanical impedance. By convention, mechanical reactance due to inertia is assigned a positive sign.

2.8 Sensitivity Level

Twenty times the logarithm to the base 10 of the ratio of the sensitivity of a mechanical coupler, defined as electrical output in volts for an applied alternating force in newtons, to the reference sensitivity of 1 V/N. Unit: dB.