



ASA/ANSI S3.6-2018

Reaffirmed by ANSI March 23, 2023

AMERICAN NATIONAL STANDARD

Specification for Audiometers

Secretariat:

Acoustical Society of America

Approved on September 20, 2018:

American National Standards Institute, Inc.

Abstract

The audiometers covered in this specification are devices designed for use in determining the hearing threshold level of an individual in comparison with a chosen standard reference threshold level. This standard provides specifications and tolerances for pure tone, speech, and masking signals and describes the minimum test capabilities of different types of audiometers.

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Accredited Standards Committee S3, Bioacoustics

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

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The Acoustical Society of America (ASA) is an organization of scientists and engineers formed in 1929 to generate, disseminate, and promote the knowledge and practical applications of acoustics.



ANSI/ASA S3.6-2018
(Revision of ANSI/ASA S3.6-2010)

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AMERICAN NATIONAL STANDARDS ON BIOACOUSTICS

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Foreword

[This Foreword is for information only and is not a part of ANSI/ASA S3.6-2018 American National Standard Specification for Audiometers. 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 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/ASA S3.6-2010 and replaces all prior revisions of this standard. This 2018 revision has been technically revised to incorporate changes to keep this standard compatible with other equivalent international (IEC and ISO) standards. This standard contains comparable information to current ISO Standards for pure-tone thresholds, bone conduction and sound field.

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

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Suggestions for improvements to 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, 1305 Walt Whitman Road, Suite 300, Melville, New York 11747. Telephone: 631-390-0215; Fax: 631-923-2875; E-mail: asastds@acousticalsociety.org.

American National Standard

Specification for Audiometers

1 Scope, purpose, and applications

1.1 Scope

Audiometers are electronic instruments intended for the testing of human hearing. This standard includes specifications and tolerances for audiometers and standard reference threshold levels for audiometric transducers such as supra-aural, circumaural, and insert earphones; bone vibrators; and loudspeakers.

This standard classifies audiometers according to the type of signal generated (pure tones, speech, or both), mode of operation, and complexity or range of auditory functions tested. Audiometers are also classified by type and class. Audiometers used for pure-tone diagnostic assessment are classified as Type 1, 2, or 3, while audiometers having only air-conduction capability are classified as Type 4. Audiometers used for speech assessment are classified as class A or B according to the complexity of the instrument's capability.

1.2 Purpose

The purpose of this standard is to ensure that tests of hearing, and particularly tests of hearing threshold, performed on the same individual with different audiometers complying with this standard shall give equivalent results when used under comparable test conditions. Further, the test results shall accurately and validly represent the level difference, if any, that may exist between the threshold of the individual tested and the reference threshold of hearing. This standard covers the general specifications for audiometers that require behavioral responses from a listener, as well as specific requirements governing the functional units of audiometric equipment such as type or types of signal, signal level control mechanisms, and types of transducers. In addition, instruments which are not audiometers but are used primarily for audiometric testing purposes which incorporate calibrated sound sources (e.g., acoustic immittance systems, otoacoustic emission systems, or narrowband noise generators), shall, whenever possible, conform to clauses 4 through 10 of this standard.

1.3 Applications

This standard specifies requirements for audiometers used primarily to determine hearing threshold levels with respect to standard reference threshold levels.

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 American National Standard Acoustical Terminology

ANSI/ASA S1.4-2014/Part 1 / IEC 61672:1-2013 American National Standard Specification for Sound Level Meters

ANSI/ASA S3.1-1999 (R2013) American National Standard Maximum Permissible Ambient Noise Levels for Audiometric Test Rooms

ANSI/ASA S3.7-2016 American National Standard Method for Measurement and Calibration of Earphones

ANSI/ASA S3.13-1987 (R2012) American National Standard Mechanical Coupler for Measurement of Bone Vibrators

ANSI/ASA S3.20 American National Standard Bioacoustical Terminology

ANSI/ASA S3.21-2004 (R2009) Methods for Manual Pure-Tone Threshold Audiometry

ANSI/ASA S3.25-2009 (R2014) American National Standard for an Occluded Ear Simulator

ANSI/ASA S3.52-2016 American National Standard Measurements of the Threshold of Hearing and Signal Detectability in a Sound Field

ANSI/ASA S3.55-2014/Part 1/IEC 60318-1:2009 American National standard Electroacoustics – Simulators of Human Head and Ear – Part 1: Ear Simulator for the Measurements of Supra-aural and Circumaural Earphone (a nationally adopted international standard – technically equivalent to IEC 60318-1:2009)

ANSI/ASA S3.55-2015/Part 3/IEC 60318-3:2014 American National Standard Electroacoustics – Simulators of Human Head and Ear – Part 3: Acoustic Coupler for the Calibration of Supra-aural Earphones used in Audiometry (a nationally adopted international standard – technically equivalent to IEC 60318-3:2014)

ANSI/ASA S3.55-2014/Part 5/IEC 60318-5:2006 (MOD) American National Standard Electroacoustics – Simulators of Human Head and Ear – Part 5: 2 cm³ Coupler for the Measurement of Hearing Aids and Earphones Coupled to the Ear by Means of Ear Inserts (a modified nationally adopted international standard – technically equivalent to IEC 60318-5:2006 with some clearly marked U.S. additions and clarifications)

ANSI/AAMI ES60601-1 Medical Electrical Equipment, Part 1: General Requirements for Basic Safety and Essential Performance

IEC 60268-17 Ed. 1.0 b:1990, Sound system equipment, Part 17: Standard volume indicators

IEC 60318-4:2010, Electroacoustics – Simulators of human head and ear – Part 4: Occluded-ear simulator for the measurement of earphone coupled to the ear by means of ear inserts (revision of IEC 60711:1981)

IEC 60318-6:2007, Electroacoustics – Simulators of human head and ear - Part 6: Mechanical coupler for the measurement of bone vibrators

IEC 60601-1:2005, Medical electrical equipment, Part 1: General requirements for basic safety and essential performance

IEC 60601-1-2:2014, Medical electrical equipment – Part 1-2: General requirements for basic safety and essential performance - Collateral standard: Electromagnetic disturbances – Requirements and tests

IEC 61094-4:1995 Measurement microphones – Part 4: Specifications for working standard microphones

ISO 389-1:1998, Acoustics – Reference zero for the calibration of audiometric equipment – Part 1: Reference equivalent threshold sound pressure levels for pure tones and supra-aural earphones

ISO 389-2: 1994, Acoustics – Reference zero for the calibration of audiometric equipment – Part 2: Reference equivalent threshold sound pressure levels for pure tones and insert earphones.

ISO 389-3:2016, Acoustics – Reference zero for the calibration of audiometric equipment – Part 3: Reference equivalent threshold force levels for pure tones and bone vibrators.

ISO 389-4:1994, Acoustics – Reference zero for the calibration of audiometric equipment – Part 4: Reference levels for narrow-band masking noise.

ISO 389-5:2006, Acoustics – Reference zero for the calibration of audiometric equipment – Part 5: Reference equivalent threshold sound pressure levels for pure tones in the frequency range 8 kHz to 16 kHz.

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

ISO 389-7:2005, Acoustics – Reference zero for the calibration of audiometric equipment – Part 7: Reference threshold of hearing under free-field and diffuse-field listening conditions.

ISO 389-8:2004 Acoustics – Reference zero for the calibration of audiometric equipment – Part 8: Reference equivalent threshold sound pressure levels for pure tones and circumaural earphones.

ISO 389-9:2009, Acoustics -- Reference zero for the calibration of audiometric equipment -- Part 9: Preferred test conditions for the determination of reference hearing threshold levels

ISO 8253-1:2010, Acoustics -- Audiometric test methods -- Part 1: Basic pure tone air and bone conduction threshold audiometry

ISO 8253-2:2009, Acoustics – Audiometric test methods – Part 2: Sound field audiometry with pure tone and narrow-band test signals.

ISO 8253-3:2012, Acoustics - Audiometric test methods -- Part 3: Speech audiometry

UL 60601-1, Medical Electrical Equipment, Part 1: General Requirements for Safety.

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in ANSI/ASA S1.1, ANSI/ASA S3.20, and the following apply:

NOTE All definitions are technically equivalent to ANSI/ASA S3.20; some have been editorially expanded to assist the user, specific to the term's application in this standard.

3.1

Pure-tone audiometer

Instrument used to measure hearing sensitivity, specifically hearing level for pure tones, as a function of frequency.

3.2

Extended high frequency audiometer

A pure-tone audiometer providing test frequencies in the 8000 to 16000 Hz range.

3.3

Békésy or automatic recording audiometer

A pure-tone audiometer in which the frequency, repetition rate, and rate of change in amplitude of the signal are automatically controlled, but in which the direction of change in signal level, whether increasing or decreasing, is under control of the subject whose responses are recorded automatically.

3.4

Manual audiometer

A pure-tone audiometer in which the signal presentations, frequency, hearing level selection, and recording the results are performed manually.

3.5

Computer-controlled audiometer

An audiometer which the test procedure is controlled by means of a computer.

3.6

Speech audiometer

An audiometer which facilitates the use of either live or recorded speech or speech-like signals for measurement of hearing.

3.7

Air conduction

Transmission of sound through the outer and middle ear to the inner ear.

3.8

Bone conduction

Transmission of sound to the inner ear primarily by means of mechanical vibration of the cranial bones.

3.9

Equivalent threshold sound pressure level

At a specified frequency, for a specified type of earphone, and for a stated force of application of the earphone to a human ear, the sound pressure level (SPL) generated by the earphone in a specified acoustic coupler, or ear simulator when the earphone is driven by that voltage which, with the earphone applied to the ear concerned, would correspond with the threshold of hearing. Abbreviation, ETSPL.

3.10

Equivalent threshold force level

At a specified frequency, for a specified type of bone vibrator, and for a stated force of application of the bone vibrator to a human head, the vibratory force level generated by the bone vibrator on a specific mechanical coupler when the vibrator is driven by that voltage which, with the bone vibrator applied to the mastoid prominence or to the forehead, would correspond to the threshold of hearing provided the non-test ear is adequately masked. Abbreviation, ETFL.

3.11

Reference equivalent threshold sound pressure level

The mean/modal equivalent threshold sound pressure level at a specified frequency as measured in a specified acoustic coupler or ear simulator based upon hearing threshold data from a sufficiently large number of otologically normal individuals of both genders ranging in age from 18 to 25 years. Abbreviation, RETSPL; unit, decibel (dB).

NOTE RETSPLs are specified in clause 9.

3.12

Reference equivalent threshold force level

The mean/modal equivalent threshold force level at a specified frequency as measured on a specified mechanical coupler based upon hearing threshold data from a sufficiently large number of otologically normal individuals of both genders, from 18 to 25 years of age. Abbreviation, RETFL; unit, decibel (dB); symbol, L_F .

NOTE RETFLs are specified in clause 9.

3.13

Occlusion effect

Increase in loudness of bone-conducted signals at frequencies below 2000 Hz when the external ear(s) are covered. Typically observed in bone-conduction audiometry as an enhancement in threshold when an ear is covered with an earphone (occluded) or external ear is occluded compared with an ear being uncovered (unoccluded).

3.14

Hearing threshold

For a specified signal, the minimum sound pressure level or vibratory force level that is capable of evoking an auditory sensation in a specified fraction of trials. The characteristics of the signal, the way it is presented to the subject, and the method by which the sound pressure level or force level is measured must be specified. Sound pressure levels and force levels are relative to the standard reference of 20 μPa and 1 μN , respectively. A pure-tone threshold measurement procedure is described in ANSI/ASA S3.21 which recommends defining threshold as the lowest signal level at which responses occur in at least 50% of a series of ascending trials.

3.15

Hearing level for pure tones

Hearing threshold of a given ear at a specified frequency and for a specified type of transducer when measured with an audiometer calibrated to reference equivalent threshold levels for air or bone conduction. The ET SPL or ET FL minus the appropriate RET SPL or RET FL. Abbreviation, HL.

3.16

Speech level

The sound pressure level or the vibratory force level of a speech signal as measured in an appropriate coupler, ear simulator, or in a sound field with a specified frequency and time weighting.

NOTE 1 Speech level may be expressed as time-average C-weighted sound level, where the duration of the integration is the duration of the speech signal. For speech test lists based on single items, the integration should not include the silent interval between items. For test lists based on single test items with a carrier phrase, the integration should include only the test items.

NOTE 2 For tests of single items, the time-average sound level may be estimated from the average of the maximum C-weighted sound levels measured with fast time weighting.

3.17

Hearing level for speech

Hearing threshold of a given ear for a specified speech signal, for a specified type of transducer, and for a specified manner of presentation calculated as the speech level minus the appropriate reference equivalent speech recognition threshold level.

3.18**Speech recognition threshold level**

The lowest speech level for given ear, for a specified speech signal, for a specified type of transducer, and for a specified manner of presentation at which the speech signal is recognized 50% of the time. Abbreviation, SRT.

NOTE Speech recognition threshold was previously called speech reception threshold.

3.19**Equivalent speech recognition threshold sound pressure level**

For a specified speech signal, type of transducer, and manner of signal presentation, the sound pressure level produced by a transducer in a specified acoustic coupler when the voltage applied to the transducer is that which produces sound pressure at the speech recognition threshold when the transducer is applied to an ear. Abbreviation, ESRTSPL.

3.20**Reference equivalent speech recognition threshold level**

For a specified speech signal, type of transducer, and method of signal presentation, the mean value of the speech recognition threshold levels of a sufficiently large number of otologically normal persons of both genders aged 18 to 25 years inclusive, expressing the threshold of hearing in a specified acoustic coupler. Abbreviation, RESRTL.

3.21**Free-field equivalent earphone sensitivity**

The mean ratio of the progressive sound wave pressure level and the electrical signal applied to the terminals of the earphone when the sound produced by the earphone is judged by at least 10 otologically normal subjects to be equivalent in loudness to the same signal when it is generated as a plane progressive sound wave of zero-degree incidence (frontal presentation) in a sound field. Both sounds to be compared shall be delivered to the same ear, with the opposite ear occluded when an earphone is evaluated.

3.22**Free-field equivalent bone vibrator sensitivity**

The mean ratio of the progressive sound wave pressure level and the electrical signal applied to the terminals of the vibrator when the sound produced by the vibrator is judged by at least 10 otologically normal subjects to be equivalent in loudness to the same signal when it is generated as a plane progressive sound wave of zero-degree incidence (frontal presentation) in a sound field. Both sounds to be compared shall be delivered to the same ear, with the opposite ear masked.

3.23**Free-field equivalent earphone output level**

The sound pressure level generated by an earphone expressed in terms of equivalent free-field sound pressure level. See Annex A and Table A.1 for more information.

NOTE At a given frequency, this level is derived from the sound pressure level generated by the earphone in an acoustic coupler or ear simulator by adding a correction figure representing the difference between the free-field sensitivity level and the coupler sensitivity level for the type of earphone used at the given frequency.

3.24**Free-field equivalent bone vibrator output level**

The vibratory force level generated by the bone vibrator expressed in terms of free-field equivalent sound pressure level. This level is derived from the vibratory force level generated by the bone vibrator on a mechanical coupler by adding the free-field bone vibrator correction for the given frequency, type of bone vibrator, and type of mechanical coupler. Or at a given frequency, force level produced by the bone vibrator on a mechanical coupler plus a correction consisting of the difference

between the free-field sensitivity level and the coupler sensitivity level for the specified bone vibrator.
Unit, decibel (dB).

3.25

Ear simulator

A device that presents to an earphone, an acoustic impedance equivalent to that of the average human ear and incorporates a calibrated microphone to measure the sound pressure level produced by the earphone.

NOTE 1 An ear simulator is specified in ANSI/ASA S3.55/Part 1/IEC 60318-1.

NOTE 2 An occluded ear simulator is specified in ANSI/ASA S3.25 and IEC 60318-4.

3.26

Acoustic coupler

Cavity of specified shape and volume used for the calibration of an earphone or microphone in conjunction with a calibrated microphone adapted to measure the sound pressure level developed within the cavity of the coupler.

NOTE Acoustic couplers are specified in ANSI/ASA S3.55/Part 3/IEC 60318-3 and ANSI/ASA S3.55/Part 5/IEC 60318-5.

3.27

Mechanical coupler (artificial mastoid)

Device presenting a specified mechanical impedance to a vibrator applied with a specified static force and equipped with an electromechanical transducer to measure the alternating force level at the surface of contact between vibrator and mechanical coupler.

NOTE A mechanical coupler is specified in ANSI/ASA S3.13 and in IEC 60318-6.

3.28

Masking

(a) The process by which the threshold of hearing for one sound is raised by the presence of another (masking) sound; (b) The amount by which the threshold of hearing for one sound is raised by the presence of another (masking) sound, expressed in decibels.

3.29

Effective masking level for pure tones

Sound pressure level of a band of noise, whose geometric center frequency coincides with that of a specific pure tone that masks the pure tone to 50% probability of detection. Abbreviation, EM.

NOTE 1 Effective masking level is analogous to hearing level; i.e., a measure of sound on a physical scale, independent of the ear under test.

NOTE 2 In a normally hearing ear the amount of effective masking, abbreviated EM, is equal to the number of decibels that a given band of noise shifts a pure-tone threshold. For example, 20 dB EM would produce a threshold shift of 20 dB when the band of noise and the pure tone are presented simultaneously to the same ear.

NOTE 3 Typically, the output of a pure-tone audiometer for bands of noise is calibrated in effective masking level.

3.30

Effective masking level for speech

Sound pressure level of a specified masking noise that masks a speech signal to 50% probability of recognition. The hearing level reference of the masking signal is equal to that of a speech recognition threshold. Abbreviation, EM.

NOTE On a normally hearing ear the amount of effective masking abbreviated EM, is equal to the number of decibels that a masking noise shifts a speech recognition threshold. For example, 20 dB EM would produce a speech recognition threshold shift of 20 dB when the masking noise and speech signal are presented simultaneously to the same ear.

3.31

Otologically normal subject

Person in a normal state of health who is free from all signs or symptoms of ear disease and from excessive wax in the ear canal which would block incoming sound and has no history of undue exposure to noise.

4 Requirements for specific types of audiometers

Different types of audiometers are specified under the requirements for minimum facilities given in Table 1. Other facilities are not precluded.

4.1 Type and class designation

Type designation shall be marked on the audiometer or indicated on its display. For example, if an audiometer has pure-tone Type 1 facilities and speech class A facility, it will be designated with a marking of ANSI/ASA S3.6 Type 1 class A. If extended high-frequency facilities were added, the new marking would be ANSI/ASA S3.6 Type 1HF class A. Any combination of the following designations may apply. See Table 1 for minimum required facilities.

<u>Pure-tone type</u>	<u>Extended high frequency</u>	<u>Speech class</u>	<u>Free-field equivalent</u>
1	HF	A	E
2		B	
3			
4			

Table 1 — Minimum required facilities for specific type and class of audiometers

Facility	Pure-tone types					Speech class	
	1	2	3	4	HF ^f	A	B
Transducers							
-two earphones	X	X	X	X	X	X ^c	X ^c
-insert earphones	X						
-loud speakers or electrical output ^d	X	X				X	
-bone vibrator	X	X	X			X	
Hearing Levels and Test Frequencies (see Tables 2a and 2b)	X	X	X	X	X	X	X
Test Signal Switching							
-presentation/interruption	X	X	X	X	X	X	X
-pulsed tone	X	X		X ^a	X		
-frequency modulation (FM)	X	X					
Reference Tone							
-alternate presentation	X	X ^b					
-simultaneous presentation	X						
Speech Input							
-speech replay device or electrical input for recorded material ^e	X	X				X	X
-microphone for live voice testing						X	
Masking							
-narrowband noise	X	X	X		X		
-speech spectrum noise						X	X

Facility	Pure-tone types					Speech class	
	1	2	3	4	HF ^f	A	B
Routing of Masking							
-contralateral earphone	X	X	X		X	X	X
-ipsilateral earphone	X					X	
-loudspeaker or electrical output	X	X				X	
-bone vibrator	X						
Subject Response System	X	X	X	X ^a	X		
Signal Indicator	X	X			X	X	X
Audible Monitoring of Test Signal	X					X	X
Operator and subject Speech Communications	X	X				X	

^a Not mandatory for manual audiometers.

^b Not mandatory for automatic recording audiometers.

^c Free-field equivalent is not mandatory but is recommended. Where this is provided the audiometer shall be designated as a speech class option E.

^d The manufacturer shall specify how conformity with this standard is to be achieved if the loudspeakers are not supplied with the audiometer.

^e The replay device is not always supplied by the manufacturer of the audiometer.

^f Audiometers used for testing extended high frequency pure tones (8000 to 16000 Hz) are designated as a Type HF.

5 General requirements

5.1 Electrical safety requirements

Audiometers shall conform to safety requirements specified in any of the standards listed below. The manufacturer shall label the audiometer in accordance with the requirements set out in the specific standard.

UL 60601-1, Medical Electrical Equipment, Part 1: General Requirements for Safety.

IEC 60601-1, Medical Electrical Equipment, Part 1: General Requirements for Safety.

ANSI/AAMI ES60601-1 Medical Electrical Equipment, Part 1: General Requirements for Basic Safety and Essential Performance

5.2 Acoustic safety requirements

As audiometers are capable of producing sound pressure levels that could be damaging to people with normal hearing, a non-auditory indication to the operator is required for all hearing levels above 100 dB.

5.3 Power supply variation and environment conditions

The maximum warm-up time for the audiometer shall be stated by the manufacturer and shall not exceed 10 minutes when the unit has been stored at room temperature. All performance requirements shall be met after the stated warm-up time has elapsed and after any setting-up adjustments prescribed by the manufacturer have been carried out.

5.3.1 Mains operation

The specifications shall be met when any long-term deviation in supply voltage or mains frequency in combination is the least favorable within the limits of $\pm 10\%$ supply voltage and $\pm 5\%$ mains frequency.

The specifications shall be met for the following short-term voltage reductions of the mains supply, provided that the time interval between such a reduction and the next is at least 10 s:

- reduction by 100% for 10 ms.
- reduction by 50% for 20 ms.
- reduction by 20% for 50 ms.

When any other short-term line voltage variation occurs that can affect its operation, the audiometer shall revert to a condition that will neither endanger the subject's hearing nor yield invalid results.

5.3.2 Electrostatic or electromagnetic interference

5.3.2.1 Immunity to power and radio frequency field / interference

Audiometers shall meet the requirements of IEC 60601-1-2 for electromagnetic compatibility (EMC). During and as a result of any EMC immunity testing, the following shall be met: the audiometer shall revert to a condition that will not endanger the hearing of the test subject. Under the EMC test conditions the unwanted sound from any air conduction transducer shall not exceed a hearing level corresponding to 80 dB.

5.3.2.2 Demonstration of conformity, electromagnetic compatibility

During the EMC tests, the audiometer shall be equipped with all accessories and units specified by the manufacturer. The following positions of the instrument facing the radiating antenna shall be tested: 0, 90, 180, and 270 degrees. The ambient noise in the EMC testing space shall be below 55 dB SPL when measured with a one-third octave filter at 1 kHz. The hearing level control of the audiometer shall be set to its minimum value, the frequency control to 1 kHz, and the tone switch to "on" for the air conduction transducer designated as being the right-hand earphone (if applicable).

The EMC tests shall be performed over the frequency range 80 MHz to 2.5 GHz in steps of 1%. Dwell time for each frequency shall be appropriate to the instrument under test. Testing at a limited number of frequencies does not negate the need to meet all requirements.

NOTE 1 To avoid possible effects of electromagnetic fields on the measuring microphone an acoustic tube should be inserted between the audiometer earphone, together with a suitable adapter, or loudspeaker and the measuring microphone in order to remove it (the microphone) from the higher (EMC) test field.

NOTE 2 Because of the changes a mechanical coupler would cause in the electromagnetic field, this device cannot be used to measure the output of bone vibrators in an electromagnetic field. A suitable method has not been developed.

5.3.3 Battery operation

The manufacturers of audiometers intended to be battery operated shall state the limits of battery voltages within which the specifications will be met. A suitable indicator shall be provided to ensure that the battery voltages are within the specified limits.

5.3.4 Operating ranges for temperature and humidity

The specifications shall be met for all combinations of values of temperature within the range +15 °C to +35 °C and relative humidity within the range of 30% to 90%.