
AMERICAN NATIONAL STANDARD

Bioacoustical Terminology

ANSI/ASA S3.20-2015

Accredited Standards Committee S3, Bioacoustics

Standards Secretariat
Acoustical Society of America
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Secretariat:

Acoustical Society of America

Approved on October 22, 2015 by:

American National Standards Institute, Inc.

Abstract

This standard provides definitions for a wide variety of terms used in human bioacoustics, including hearing, speech, psychoacoustics, and physiological acoustics. It is intended to supplement ANSI/ASA S1.1-2013 American National Standard Acoustical Terminology in which more generally used terms in acoustics are defined, including a number of terms from physiological and psychological acoustics and music. Those terms from ANSI/ASA S1.1-2013 that are related to bioacoustics are included in this Standard as annexes.

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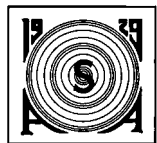
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Foreword

[This Foreword is for information only, and is not a part of the American National Standard ANSI/ASA S3.20-2015 American National Standard Bioacoustical Terminology. 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 S3.20-1995, which has been technically revised. New terms have been added, deprecated terms removed, and a number of terms have had their definitions updated. The normative references have been updated, and updated terms from ANSI/ASA S1.1-2013 appear in the annexes. Additional information has been added in **blue** font to some of the terms in the annexes for completeness, clarity, and consistency in bioacoustics.

This standard is not comparable to any existing ISO Standard.

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American National Standard

Bioacoustical Terminology

1 Scope

This American National Standard provides definitions for terms used in human bioacoustics. Some additional general terms for measurement and instruments related to applications in psychoacoustics are also provided.

Acoustical terms of more general use in the performance of acoustical measurements, the properties of electroacoustic transducers, and applications in the fields of architectural acoustics, environmental acoustics, underwater sound, and music are provided in ANSI/ASA S1.1-2013 *American National Standard Acoustical Terminology*. A selected set of terms from clause 3 of ANSI/ASA S1.1-2013 involving acoustical levels is listed here in Annex A, and terms from clause 6 on transducer and linear system properties are included here as Annex B. The entire clause 11 of ANSI/ASA S1.1-2013 containing psychoacoustics and physiological acoustical terminology is included here in Annex C, and the entire clause 12 on musical acoustics is included here in Annex D. All terms defined in the body of the text and in the annexes are listed in an alphabetical index.

2 References

Many of the terms in this standard are taken from the following referenced documents. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ANSI/ASA S1.1-2013 *American National Standard Acoustical Terminology*

ANSI/ASA S3.1-1999 (R 2013) *American National Standard Maximum Permissible Ambient Noise Levels for Audiometric Test Rooms*

ANSI/ASA S3.4-2007 (R 2012) *American National Standard Procedure for the Computation of Loudness of Steady Sounds*

ANSI/ASA S3.5-1997 (R 2012) *American National Standard Methods for Calculation of the Speech Intelligibility Index*

ANSI/ASA S3.6-2010 *American National Standard Specification for Audiometers*

ANSI/ASA S3.7-1995 (R 2008) *American National Standard Method for Coupler Calibration of Earphones*

ANSI S3.13-1987 (R 2012) *American National Standard Mechanical Coupler for Measurement of Bone Vibrators*

ANSI/ASA S3.21-2004 (R 2009) *American National Standard Methods for Manual Pure-Tone Threshold Audiometry*

ANSI/ASA S3.22-2009 *American National Standard Specification of Hearing Aid Characteristics*

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

ANSI/ASA S3.35-2010 (R2015) *American National Standard Method of Measurement of Performance Characteristics of Hearing Aids under Simulated Real-Ear Working Conditions*

ANSI/ASA S3.36-2012 *American National Standard Specification for a Manikin for Simulated in situ Airborne Acoustic Measurements*

ANSI/ASA S3.39-1987 (R2012) *American National Standard Specifications for Instruments to Measure Aural Acoustic Impedance and Admittance (Aural Acoustic Immittance)*

ANSI/ASA S3.45-2009 (R2014) *American National Standard Procedures for Testing Basic Vestibular Function*

ANSI/ASA S3.46-2013 *American National Standard Methods of Measurement of Real-Ear Performance Characteristics of Hearing Aids*

ANSI/ASA S3.47-2014 *American National Standard Specification of Performance Measurement of Hearing Assistance Devices/Systems*

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 Measurement of Supra-aural and Circumaural Earphones (a nationally adopted international standard)*

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)*

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 cm² Coupler for the Measurement of Hearing Aids and Earphones Coupled to the Ear by Means of Ear Inserts (a modified Nationally adopted international standard)*

ANSI/IEEE 260.4-1996 (R2008), *Standard Letter Symbols and Abbreviations for Quantities Used in Acoustics*

IEC 60050-801:1994 *International Electrotechnical Vocabulary, Chapter 801: Acoustics and electroacoustics*

IEC/TR 60268-13:1998 *Sound system equipment Part 13: Listening tests on loudspeakers*

IEC 60268-16:2011 *Sound system equipment - Part 16: Objective rating of speech intelligibility by speech transmission index*

3 Anatomy and physiology of the human auditory system

3.01 acoustic nerve; auditory nerve; eighth cranial nerve; vestibulocochlear nerve. Nerve, consisting of two sets of fibers: the anterior branch or cochlear nerve and the posterior branch or vestibular nerve. Afferent fibers of the nerve conduct neural signals from the inner ear to the central nervous system; efferent fibers transmit signals from the central nervous system to the inner ear.

3.02 acoustic reflex. Middle-ear muscle (stapedius and tensor-tympani) reflex elicited by an acoustic stimulus.

3.03 acoustic-reflex activating stimulus. Acoustic signal that is used to elicit an acoustic reflex. See 3.02, 3.62.

3.04 auditory ossicles; ossicles. Three small bones in the middle ear; i.e., the malleus, the incus and the stapes. These bones transmit mechanical vibrations from the tympanic membrane to the oval window of the cochlea.

3.05 auditory tube; Eustachian tube. Tube that connects the middle ear with the nasal part of the pharynx. The auditory tube serves to equalize air pressure on the two sides of the tympanic membrane, i.e., middle ear pressure and ambient pressure.

3.06 auricle; pinna. The external and visible portion of the ear comprising an ovoid-formed, skin-covered, fibro-cartilaginous appendage that is attached to the head around the opening of the external auditory meatus. The auricle contributes to the localization of sounds in the front-back and vertical directions.

NOTE See E.A.G. Shaw, "Transformation of sound pressure level from the free field to the eardrum in the horizontal plane," *J. Acous. Soc. Am.*, 56, No. 6 (1974) 1848-1861.

3.07 basilar membrane. Fibrous plate extending from the osseous spiral lamina to the spiral ligament on the outer wall of the cochlea. The basilar membrane separates the scala media from the scala tympani and supports the organ of Corti.

3.08 border cells. A single row of supporting cells lying on the inward side of (medial to) the inner hair cells in the organ of Corti. The upper part (or superior surfaces) of the border cells form part of the reticular lamina. See 3.43.

3.09 cells of Claudius. Cells that lie on the outward side of (lateral to) the cells of Hensen in the organ of Corti.

3.10 cells of Deiter; outer phalangeal cells. Several rows of supporting cells that extend from the basilar membrane and support the outer hair cells in the organ of Corti. Processes from the cells of Deiter form part of the reticular lamina.

3.11 cells of Hensen. Several rows of supporting cells lying on the outward side of (lateral to) the cells of Deiter in the organ of Corti. Processes from the cells of Hensen form part of the reticular lamina.

3.12 cerumen; ear wax. Secretion from the ceruminous glands of the external auditory meatus, typically brown-yellow-black in color.

3.13 cochlea. Spirally coiled, tapered cavity within the temporal bone consisting of about two and three-eighths turns in humans. The cochlea contains the receptor organs essential to hearing. Part of the osseous labyrinth, see 3.44.

3.14 cochlear duct. That portion of the membranous labyrinth contained within the cochlea. The cochlear duct is an endolymph-filled duct following the spiral shape of the cochlea, and contains the organ of Corti. The cavity of the cochlear duct is called the scala media.

3.15 cochlear nerve. Anterior branch of the vestibulocochlear (8th cranial) nerve. The cochlear nerve arises from the nerve cells of the spiral ganglion of the cochlea and terminates in the dorsal and ventral cochlear nuclei in the brain stem. It contains both afferent and efferent nerve fibers.

3.16 cochlear structures. Term used collectively to describe the partitions of the scala media, the most significant of which are the basilar membrane, the tectorial membrane, Reissner's membrane, and the organ of Corti.

3.17 concha. A depression in the external ear surrounding the meatus bounded in front by the **tragus** (3.69) and above, to the rear and below by cartilaginous ridges. It and the boundary ridges contribute to sound source direction and location. It also aids fitting and retention of ear molds in the meatus.

NOTE Of the visible and identified anatomical features of the pinna, the concha and tragus together are acoustically its most important features because of their shape, dimensions and location relative to and surrounding the entrance to the ear canal.

3.18 contralateral reflex; crossed reflex. Middle-ear muscle reflex that is elicited in the ear contralateral (opposite) to the stimulus ear. When the stimulus is acoustic, the resulting middle-ear muscle reflex is sometimes called contralateral acoustic reflex or crossed acoustic reflex.

3.19 cross hearing. Phenomenon in which sounds presented to one ear are coupled around or through the head and are heard in the other ear.

3.20 ear. Organ of hearing. In humans it consists of three parts: external (outer) ear, middle ear or tympanic cavity, and the inner ear or labyrinth.

3.21 endocochlear potential. Resting electric polarization of the endolymph of the scala media, positive relative to the perilymph in the scala vestibuli and scala tympani and also to tissues outside of these canals. Abbreviation, EP. Unit, volt. Symbol, V.

3.22 endolymph. Fluid, high in potassium and low in sodium content, contained within the membranous labyrinth.

3.23 external acoustic meatus; external auditory meatus; external auditory canal; ear canal. Canal that directs sound from the auricle to the tympanic membrane.

3.24 external ear; outer ear. Combination of the auricle and the external acoustic meatus.

3.25 hair cells in organ of Corti. Sensory receptor cells for hearing. Hair cells are ciliated epithelial cells located within the organ of Corti and are subdivided into the inner hair cells and the outer hair cells. Nerve innervation is different for the inner and outer hair cells. Several dozen hairlike processes, called stereovilli, are attached to the cuticular surface at the free end of each hair cell; the cuticular surface forms part of the reticular lamina. The bases of the hair cells are in contact with the dendritic processes of the neurons of the spiral ganglion of the cochlea.

NOTE 1 The inner hair cells in the organ of Corti form a single row supported on one side by the inner rods of Corti and on the other by the inner phalangeal cells and the border cells. The human organ of Corti contains approximately 3500 inner hair cells for young persons and typically declines with age.

NOTE 2 The outer hair cells in the organ of Corti form three rows at the base of the cochlea and four rows at the apex. They are supported by the cells of Deiter. The human organ of Corti contains approximately 15,000 outer hair cells for young persons and typically declines with age.

3.26 helicotrema. Narrow aperture within the apex of the cochlea that allows communication between the scala vestibuli and the scala tympani.

3.27 incus; anvil. Middle member of the three auditory ossicles that are located in the middle ear. The body of the incus is attached to the head of the malleus and the rounded projection at the lower end of the incus (lenticular process) is attached to the head of the stapes.

3.28 inner hair cells. See 3.25, 3.43.

3.29 inner phalangeal cells. Single row of supporting cells lying on the inward side of (medial to) the inner rods of Corti in the organ of Corti. The upper part of the inner phalangeal cells partially encloses the cuticular plates of the inner hair cells.

3.30 inner tunnel of Corti; tunnel of Corti. Fluid-filled space of approximately triangular cross-section formed by the inner and outer rods of Corti and the basilar membrane, extending the length of the organ of Corti from base to apex.

3.31 inner ear; internal ear. Portion of the ear, located within the petrous part of the temporal bone, containing the cochlear and vestibular systems. Consists of the osseous labyrinth and the membranous labyrinth.

3.32 intra-aural muscles. See 3.61 stapedius and 3.68 tensor tympani.

3.33 intracellular potentials. Negative polarizations of cells with respect to surrounding extracellular fluid.

3.34 ipsilateral reflex; uncrossed reflex. Middle-ear muscle reflex that is elicited in the stimulus ear. When the reflex is acoustical, the resulting middle-ear reflex is sometimes called the ipsilateral acoustical reflex or uncrossed acoustical reflex.

3.35 lateral inhibition. Mechanism which is thought to increase the frequency selectivity of neurons in the central nervous system. Neurons with a specific best frequency inhibit neurons with different best frequencies, thus reducing response to frequencies remote from best frequency, sharpening the tuning curve.

3.36 malleus; hammer. Outmost of the three ossicles that are located in the middle ear. The shape of the malleus resembles a club. The handle of the malleus (manubrium) is attached to the tympanic membrane; the head of the malleus (capitulum) is attached to the body of the incus.

3.37 manubrium. See 3.36.

3.38 membranous cochlea. Scala media and its walls, including the basilar membrane, Reissner's membrane, and the stria vascularis.

3.39 membranous labyrinth; otic labyrinth. Closed system of endolymph-filled ducts and sacs contained within the inner ear. The membranous labyrinth takes the same general shape as the osseous labyrinth. Consists of the cochlear duct, utricle, saccule, and semicircular ducts.

3.40 middle ear; tympanic cavity; tympanum. Air-filled cavity within the mastoid portion of the temporal bone typically described as containing the eardrum and ossicles and inner opening of the Eustachian tube.

3.41 middle-ear muscle reflex. Change in the tonus of muscles of the middle ear in response to an acoustical or tactile stimulus.

NOTE Contractions of the middle-ear muscles may be monitored by measurement of the change in acoustic impedance or acoustic admittance within the external auditory meatus.

3.42 modiolus. Conical shaped central core of the cochlea. The modiolus contains the spiral ganglion of the cochlear nerve and forms the inner wall of the scala vestibuli and the scala tympani.

3.43 organ of Corti. A series of neuroepithelial hair cells (receptor cells for hearing) and their supporting structures lying against the osseous spiral lamina and the basilar membrane within the scala media of the cochlea. The organ of Corti extends from the base of the cochlea to its apex.

NOTE In cross-section, the inner and outer pillar cells (rods of Corti) of the organ of Corti form the triangular inner tunnel of Corti. The inner rods rest on the edge of the osseous spiral lamina and the outer rods rest on the basilar membrane. A single row of sensory cells (inner hair cells) is found on the inward side of (medial to) the inner rods (toward the modiolus), and three or four rows of sensory cells (outer hair cells) are located on the outer side of the outer rods. The upper ends of the hair cells form part of the reticular lamina that is supported by the rods of Corti and constitute the upper surface of the organ of Corti. The tectorial membrane, in which the hairlike processes extending from the upper ends of the outer hair cells are imbedded, lies above the reticular lamina. Nerve fibers of the cochlear nerve make contact with the lower ends of the inner and outer hair cells.

3.44 osseous labyrinth. Complex of cavities and canals within the temporal bone, part of the inner ear. The osseous labyrinth is divided into the cochlea, the vestibule, and the semicircular canals, and contains the membranous labyrinth and perilymph.

3.45 osseous spiral lamina. Bony ledge that projects from and winds around the modiolus for about 2-3/8 turns from the base of the cochlea to the apex in humans. The basilar membrane is attached to the free border of the osseous spiral lamina and runs parallel to it.

3.46 outer hair cells. See 3.25, 3.43.

3.47 outer tunnel of Corti. Fluid-filled space formed by the cells of Hensen and the outermost row of the outer hair cells, extending the length of the organ of Corti from base to apex.

3.48 oval window; vestibular window. Opening through the bone that separates the middle ear from the scala vestibuli of the cochlea. The oval window is closed by the footplate of the stapes. The footplate is fixed in the oval window by the annular ligament.

3.49 perilymph. Fluid, high in sodium and low in potassium, contained within the osseous labyrinth.

3.50 Reissner's membrane; vestibular membrane. Delicate cellular membrane attached to the inner part of the spiral limbus and to the spiral ligament. Reissner's membrane separates the scala media from the scala vestibuli and forms one wall of the cochlear duct:

3.51 rods of Corti. Two rows of stiff rod-like structures (inner and outer rods) supported by the basilar membrane. Each rod consists of a base, a striated body, and a head. The heads of the inner and outer rods are in contact and form part of the reticular lamina. The rods and the basilar membrane enclose the inner tunnel of Corti. The openings between successive rods allow communication among the inner and outer tunnels of Corti, the space of Nuel, and the internal spiral sulcus.

3.52 round window. Opening through the bone that separates the middle ear from the scala tympani of the cochlea. The round window is located behind and below the oval window and is closed by the round window membrane (secondary tympanic membrane).

3.53 round window membrane. See 3.52.

3.54 scala media. Cavity of the cochlear duct, filled with endolymph. The scala media is separated from the scala vestibuli by Reissner's membrane and from the scala tympani by the basilar membrane. The scala media has a closed end at the helicotrema. See 3.26.

3.55 scala tympani; tympanic scala. Perilymph-filled passage of the cochlear canal that extends from the round window at the base to the helicotrema at the apex. The scala tympani is separated from the scala media by the basilar membrane and the cellular structures attached to it.

3.56 scala vestibuli; vestibular scala. Perilymph-filled passage of the cochlear canal that extends from the oval window at the base to the helicotrema at the apex. The scala vestibuli is separated from the scala media by Reissner's membrane.

3.57 space of Nuel. Fluid-filled space between the outer rods of Corti and the inner row of the outer hair cells, extending the length of the organ of Corti from base to apex.

3.58 spiral ganglion of the cochlea. Cell bodies of the neurons of the cochlear nerve, located within the modiolus. The dendritic processes of these bipolar neurons make synaptic contact with the hair cells. The axons terminate in the cochlear nucleus in the lateral brainstem.

3.59 spiral lamina. Osseous spiral lamina and the basilar membrane (membranous spiral lamina).

3.60 spiral ligament. Periosteum-like outer wall of the scala media. The spiral ligament is attached to the outward (lateral to) border of the basilar membrane at the basilar crest. It is covered by the stria vascularis within the cochlear duct.

3.61 stapedius. Middle-ear muscle attached to the neck of the stapes. The reflex response of the auditory ossicles to an intense sound stimulus is to swing the footplate of the stapes outward (lateral to) and backward from the oval window. The action of the stapedius muscle is to limit the motion of the ossicles and thereby protect the inner ear from damage by intense sounds, especially at low frequencies, although no protection is provided for high frequencies or impulsive sounds. See 3.68.

3.62 stapedius reflex. See 3.61.

3.63 stapes; stirrup. Innermost and smallest of the three auditory ossicles that are located in the middle ear. The shape of the stapes resembles a stirrup. The head of the stapes is attached to the lenticular process of the incus. The footplate of the stapes nearly fills the oval window and is attached to it by the annular ligament.

3.64 stria vascularis. Vascularized epithelial structure that covers the spiral ligament within the scala media. The stria vascularis is thought to be the source of the endolymph and endolymphatic potential.

NOTE The endolymphatic potential is about + 80 mV resting potential measured in the scala media.

3.65 summing potentials. Positive and negative changes in the direct current polarization of the cochlea in response to a sound stimulus. Unit, volt (V).

3.66 supporting cells. Cells extending from the basilar membrane which support the organ of Corti. The free ends of these cells form the reticular lamina. Supporting cells consist of the (a) inner rods of Corti, (b) outer rods of Corti, (c) inner phalangeal cells, (d) outer phalangeal cells (cells of Deiter), (e) border cells, and (f) cells of Hensen.

3.67 tectorial membrane. Gelatinous, ribbonlike structure attached along one edge to the spiral limbus and along the other edge to the outer border of the organ of Corti. The tectorial membrane is in contact with, or closely approximates, the stereovilli of the hair cells.

3.68 tensor tympani. Middle-ear muscle attached to the handle of the malleus. Its reflex contraction, in response to tactile stimulation to parts of the face, draws the auditory ossicles inward, which increases the tension on the tympanic membrane.

3.69 tragus. A small pointed eminence of the external ear in front of the concha and projecting backward over the meatus; contributes to front-rear direction hearing.

3.70 traveling wave. Base-to-apex displacement pattern of the basilar membrane in response to acoustic stimulation.

3.71 tympanic membrane; eardrum; drum membrane. Conical shaped translucent membrane that separates the external acoustic meatus from the middle ear cavity. The handle of the malleus is attached to the tympanic membrane medially.

NOTE The amplitude of displacement of the tympanic membrane for a 1000 Hz tone at the threshold of audibility is about 10 nm. For low-frequency tones at the threshold of feeling the amplitude of displacement is about 0.1 mm.

3.72 vestibule. Perilymph-filled oval-shaped central cavity of the osseous labyrinth. The vestibule contains the oval window, which is located in its wall facing the middle ear cavity (tympanic wall), as well as the utricle and the saccule.

4 Hearing assessment

4.01 audiogram. Graph of hearing threshold level (4.42) as a function of frequency. Also see C11.27.

NOTE Standard audiograms for pure-tone air or bone-conduction thresholds are generally plotted for hearing levels from -10 to 120 dB HL for audiograms used in clinical environments and from 0 to 100 dB for audiograms used in industrial settings, at frequencies from 125 to 8000 Hz; see C11.26.

4.02 audiologist. Individual whose primary expertise is in the identification and measurement of hearing loss and the rehabilitation of those with hearing impairments.

4.03 audiology. The study of hearing and hearing disorders, with primary emphasis on the conservation of hearing; the prevention, identification, and assessment of hearing impairment; and the rehabilitation of persons with hearing impairments.

4.04 audiometer. Electronic instrument for measuring hearing sensitivity, specifically hearing levels, as a function of frequency.

4.05 Békésy audiometer; automatic recording audiometer. Pure-tone audiometer where hearing level variations are under the subject's control. Signal presentations, hearing level variation, frequency selection or variation, and recording of subject responses are implemented and recorded automatically.

4.06 computer-controlled audiometer. Audiometer in which the test procedure is controlled by a computer or microprocessor.

4.07 extended high-frequency audiometer. Audiometer providing test frequencies in the 8000 to 16000 Hz range.

4.08 manual audiometer. Pure-tone audiometer in which the signal presentations, frequency, hearing level selection, and recording of results are performed manually.

4.09 pure-tone audiometer. Device used to measure hearing sensitivity, specifically hearing level for pure tones, as a function of frequency.

4.10 speech audiometer. Audiometer for measurement of hearing by use of either live or recorded speech test signals.

4.11 audiometrically normal listener. Individual having hearing threshold levels within a percentile range, typically 10th to 90th percentile values, for a population specified in reference to age, ethnic background, and gender at the audiometric frequency of interest. See C11.26.

NOTE Hearing threshold levels are determined in accordance with ANSI/ASA S3.6.

4.12 audiometric test room. Enclosed space used for testing hearing.

NOTE 1 An audiometric test room may also be known as an audiometric test area, hearing test space, or hearing test room. An example would be a prefabricated room known as an audiometric test booth, suite, or room.

NOTE 2 See ANSI/ASA S3.1-1999.

4.13 audiometry. Measurement of hearing, including aspects other than hearing sensitivity.

4.14 audition. Sense of hearing.

4.15 auditory adaptation; perstimulatory adaptation. Change (decrease) in loudness during presentation of an acoustic stimulus.

NOTE 1 Auditory adaptation may occur following acoustic stimulation too weak to produce auditory fatigue and its effects on the threshold of audibility are much milder and of shorter duration than those caused by auditory fatigue.

NOTE 2 Temporary threshold shift due to auditory adaptation occurs primarily near the frequency of the stimulus.

4.16 auditory brainstem response; brainstem auditory evoked response. Electrical response emanating from the auditory nerve and brainstem, which can be obtained from electrodes on the scalp.

4.17 auditory fatigue; fatigue; post-stimulatory fatigue. Temporary decrease in hearing sensitivity resulting from a previous auditory stimulus. Auditory fatigue produces a temporary threshold shift that may last for seconds, minutes, hours, or days.

NOTE Auditory fatigue is a post-stimulatory phenomenon that involves a temporary loss in the ability of the auditory system to respond to acoustic stimulation; it should be differentiated from perstimulatory adaptation.

4.18 Bing test; occlusion test. Test used to distinguish between conductive and sensorineural hearing losses. A vibrating tuning fork is placed on the center of the subject's forehead and the external acoustic meatus is gently occluded. If the ear is normal or if there is a pure sensorineural hearing loss present, the loudness to a low-frequency stimulus is increased, but if there is a conductive hearing loss there is no change in loudness. See also 4.59.

4.19 bone conduction vibrator; bone vibrator. Electromechanical transducer intended to produce the sensation of hearing by vibrating the cranial bones.

4.20 central hearing loss; central deafness; central auditory processing disorder. Hearing impairment that occurs when there is damage to or dysfunction of the central auditory pathways.

NOTE Damage may occur due to tumors, arteriosclerosis, cerebral hemorrhage, chronic otitis media, thrombosis, embolisms, syphilis, brain abscess, ototoxicity (see 4.52), radiation, birth injuries, skull fractures, or wounds, scars and adhesions. Disorder may be of unknown cause.

4.21 cochlear microphonic. Alternating current electric potential generated within the cochlea in response to a sound stimulus. At low and moderate sound pressures the amplitude of the cochlear microphonic is proportional to the instantaneous sound pressure of the stimulus, and is a faithful reproduction of the stimulus waveform. The source of the cochlear microphonic is believed to be the hair cells in the organ of Corti. Unit, volt (V).

NOTE 1 At low and moderate sound pressures, the amplitude of the cochlear microphonic is a linear function of the instantaneous displacement of the basilar membrane.

NOTE 2 Maximum peak amplitude of the cochlear microphonic within the scala media is 2 to 5 mV.

4.22 conductive hearing loss. Impairment of hearing that occurs when there is interference with the transmission of sound waves through the external or middle ear.

NOTE 1 Some causes of conductive hearing loss are: wax (cerumen) accumulation in the external ear; inflammation in the external ear (otitis externa); hardening or perforation of the tympanic membrane; inflammation in the middle ear (otitis media); formation of cysts in the middle ear (cholesteatoma); formation of bony deposits near or at the stapes (otosclerosis); and congenital defects of the external or middle-ear structures.

NOTE 2 Conductive hearing loss often can be successfully treated by medical procedures.

4.23 damage risk criteria. For hearing, the level of sound exposure which a population may receive for a specified time with a specified risk of hearing loss. See also 4.32 and 4.45.

NOTE Damage risk criteria are often specified in terms of a frequency-weighted sound pressure level and duration as a surrogate for sound exposure (see A3.22).

4.24 deafness. Condition caused by a hearing loss which results in a person's inability to use auditory information effectively for communication or other daily activities, even with amplification.

4.25 effective masking. Occurs when the masker is just strong enough to prevent a listener from hearing the test stimulus when stimulus and masking signals are presented simultaneously to the same ear.

4.26 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. The hearing level reference of the masking signal is equal to that of the pure tone. Unit, decibel (dB).

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 On 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 decibels EM would produce a threshold shift of 20 decibels when the band of noise and 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.

4.27 effective masking level for speech. Sound pressure level of a specified masking noise that masks a speech signal to 50 percent probability of recognition. The hearing level reference of the masking signal is equal to that of a speech recognition threshold.

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.

4.28 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; unit, decibel (dB).

4.29 equivalent threshold level (monaural earphone listening). 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 set up by the earphone in a specified coupler or artificial ear when the earphone is activated by that voltage which, with the earphone applied to the ear concerned, would correspond with the threshold of hearing. Abbreviation, ETSPL; unit, decibel (dB).

4.30 equivalent threshold force level (monaural listening). At a specified frequency, for a specified configuration of a bone vibrator on a specified mechanical coupler, the vibration force level set up by the bone vibrator in a specified coupler when the bone vibrator is activated by that voltage which, with the bone vibrator applied to the mastoid concerned, would correspond with the threshold of hearing. Abbreviation, ETFL; unit, decibel (dB).

NOTE The non-test ear must be masked.

4.31 evoked otoacoustic emission. See C11.39.

4.32 exchange rate. The level in decibels that the sound level of daily noise exposure must increase (decrease) to preserve a selected measure hearing damage risk when the exposure duration is halved (doubled). See also 4.23, 4.45 and A3.22.

4.33 free-field equivalent bone vibrator output level. At a given frequency, vibration 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).

4.34 free-field equivalent earphone output level. At a given frequency, sound pressure level produced by the earphone in an acoustic coupler or ear simulator plus a correction consisting of the difference between the free-field sensitivity level and the coupler sensitivity level for the specified earphone. Unit, decibel (dB).

4.35 free-field sensitivity (of an earphone). At a given frequency, for at least 10 otologically normal subjects, quotient of sound pressure level, or force level, of a frontally incident plane progressive wave by input voltage to an earphone, or bone vibrator, such that on average the subjects judge the direct sound wave and the sound produced by the earphone, or bone vibrator, to be equally loud, when judged with the same ear, the opposite ear being occluded.

4.36 hearing. Sense by which sound is perceived.

4.37 hearing level for speech. For a specified speech signal, for a specified type of transducer, and for a specified manner of presentation, the speech level minus the appropriate speech recognition threshold signal. Unit, decibel (dB).

NOTE Typically, a speech audiometer is calibrated so that an indicated output hearing level of 0 dB for a specified transducer is equal to the appropriate reference speech recognition threshold level. Thus, if a listener had a speech recognition threshold equal to an appropriate reference speech recognition threshold, the listener's speech recognition threshold would be 0 dB. If a listener had a speech recognition hearing level threshold equal to 40 dB, the listener's speech recognition threshold would be 40 dB higher than the appropriate reference speech threshold level.

4.38 hearing loss; hearing impairment; hypoacusis; impairment of hearing. Term denoting an impairment of auditory sensitivity. Can range from mild, to moderate, to profound. See also C11.24.

4.39 mixed hearing loss. Impairment of hearing caused by combined conductive and sensorineural components.

4.40 permanent hearing loss. Permanent impairment of hearing sensitivity, usually but not exclusively, related to cochlear damage.

4.41 hearing screening. A component of an audiological test program that attempts to determine which individuals of a total population may have a hearing problem and therefore require further audiological evaluation.

4.42 hearing threshold 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. See also C11.26. Unit, decibel (dB).

4.43 minimum audible field. Sound pressure level of a tone at the threshold of audibility measured in a free sound field for a subject listening with both ears and facing the sound source. The magnitude of the sound pressure level at the position to be occupied by the center of the subject's head is measured with the subject removed from the field. Abbreviation, MAF; unit, decibel (dB).

4.44 minimum audible sound pressure level. Sound pressure level of a tone at the threshold of audibility that is presented by an earphone and measured or inferred at the tympanic membrane. Abbreviation, MAP; unit, decibel (dB).

4.45 noise dose. Percentage of a maximum permissible daily exposure to noise; typically, the combination of the A-weighted L_{eq} and corresponding exposure duration. See also 4.23, 4.32, and A3.22.

4.46 noise-induced hearing loss. Permanent hearing loss which progressively increases (at most frequencies the loss will eventually approach an asymptote) due to cumulative daily or regular exposures to hazardous noise not intense enough to cause immediate acoustic trauma. See also C11.53.

4.47 nonacoustic reflex. Middle-ear muscle reflex elicited by a nonacoustic stimulus.

4.48 nonacoustic reflex activating stimulus. Electric, tactile, pneumatic, photic, or other nonacoustic signals used to elicit a middle-ear muscle reflex.

4.49 occlusion effect. Increase in loudness of conductive signals, usually at frequencies below 2000 Hz, when the external ear(s) are covered. Typically observed in bone-conduction audiometry as