Proceedings of The Institute of Acoustics

ELECTRO ACOUSTIC STANDARDS IN AUDIOLOGY

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Standards in audiology may be divided into four interrelated section as follows:-

(a) standards concerned with specifying subjective parameters i.e. thresholds of hearing.
(b) ear simulators i.e. acoustic couplers and artificial ears.
(c) the evaluation of equipment performance.
(d) performance specification and methods of audiological testing.

Appendix I lists the current standards relating to audiology.

Pure tone audiometry using earphones is universally used as a means of describing hearing loss. The reference point for audiometry (audiometric zero) is the threshold of hearing for young otologically normal people with no history of ear disease or noise exposure. It is therefore vital that there is a clear unequivocal standard for audiometric zero. However in spite of that situation being apparently obtained this is not the case due to problems associated with the measurement of the acoustical output of earphones. Ideally we would present the earphone with an acoustical load that would represent an average adult ear. Artifical ears have been produced which meet this need but the urgency to make these measurements has lead to the use of simplified devices called acoustic couplers. Consequently an unusual situation in standardisation has arisen whereby audiometric zero is expressed in terms of a range of commercially available earphones all to be measured on different ear simulators or by a further range of earphones measured on one acoustic coupler. The situation is untidy but in practice works reasonably well as most audiometers tend to use one commercial brand of earphone.

To improve the situation one set of values for audiometric zero will be available in the IEC Wide Band Artificial ear. This will allow earphones of the supra aural type to be calibrated to a uniform set of values and therefore extend the range that is currently available.However this still leaves threshold values for circumaural earphones without standardised values and even without an agreed coupler to measure them on.

For measurements on earphones of the hearing aid type we now have an agreed Insert Ear Simulator(to be published in due course as IEC Standard). Whether there is a need for a standardised value of threshold for this mode of listening has not been decided and is debatable.

A major diagnostic indicator is the bone conduction threshold of hearing compared with air conduction a difference between the two indicating a conductive hearing loss. No international agreement has yet been reached on an audiometric zero for bone conduction. A British Standard BS2497 Part IV gives a single figure of acceleration for bone conduction threshold as

measured on a Mechanical Coupler. The term mechanical coupler has been chosen as analogous to acoustic coupler rather than the term Artificial Mastoid because the match between real mastoids and the measuring device is not as close as might be desired. The current commercially available design of Mechanical Coupler is based upon the NPL design of Artificial Mastoid. This device however has shown up one of the problems of trying to standardise an important measuring tool with no prospect of large scale commercial exploitation. The net result is that one manufacturer produces the device and if he cannot meet the standard the standard has to change, hence a revision of IEC 373.

Little use is made of ISO R226 as free field testing is not often used. However more free field testing is likely to be undertaken in connection with hearing aid evaluation. A revision of R226 is being contemplated.

In order to be able to evaluate audiological equipment it is clear that a set of test procedures have to be draw up. Hearing aids are a particular case where there is no specification of what the performance should be but detailed methods of test. The hearing aid also exemplifies the problem of having different methods of measurement giving very different results for exactly the same item under test, i.e. the performance of an aid may be measured in a 2cc coupler, an insert artifical ear or on an artifical head and torso. Furthermore the level of input signal will also dramatically alter the apparent frequency response, hearing aids being very non linear devices in many respects.

A device that has recently come upon the audiological scene is the Tinnitus Masker which provides a wide band masking noise to the ear and obviously its characteristics will appear very different if measured with different bandwidth filters or in different ear simulators. No current proposal exists in IEC for standardisation of a method of measurement and it is unlikely that any standard will be produced within 3 years,hence the dilemma of producing international standards. Start too soon and you do not have enough information, start too late and varied practices have grown up throughout the world and are difficult to change.

The performance of audiometers is closely specified and they are divided into five types depending upon their sophistication, type 1 being the most complex. The threshold of hearing and supra threshold values can be influenced by a number of changes in audiometer performance, hence the need for maintaining close tolerances for some functions. At present the current standard for Audiometers, IEC 645, does not deal with acoustic impedance measurements but a working group is at present producing a draft document. Standards are not available or being considered for audiometric electro physiological measurements. Procedures for undertaken audiometry have not so far been internationally standardised but for industrial screening purposes a draft ISO Proposal has been issued.

An area of standardisation that might be considered remote from audiology but which is of prime importance in rehabilitation is the specification of audio frequency induction field strength for hearing aid purposes. Due to the introduction of appropriate pick up coils on all NHS hearing aids some one million people can use an induction loop system. Consequently an upsurge of interest in fitting loops has taken place. However a dilemma exists in that IEC 118-4 has recently standardised the field strength to be used but Home Office regulation BR19 legally presents its use. The Home Office regulations have not yet been amended in spite of the UK voting in

favour of the standard. This illustrates a point that standards cannot overrule national legal requirements.

APPENDIX I

STANDARDS RELATING TO AUDIOMETERS

BS 2497	Reference zero for the calibration of pure-tone audiometers.
Part 1:1968/ISO 389	Data for earphone coupler combinations maintained at certain standardising laboratories.
Part 2: 1969 (AMD 705: 1971)	Data for certain earphones used in commercial practice.
Part 3: 1972	Data for a wide band artificial ear complying with BS 4669.
Part 4: 1972	Normal threshold of hearing for pure tones by bone conduction.
BS 3383: 1961 ISO R226: 1961	Normal equal loudness contours for pure tones and normal threshold of hearing under free-field listening conditions.
IEC 645: 1979 BS 5996: 1980	Audiometers
BS 2042: 1953 (PD 1795: 1954)	An artificial ear for the calibration of earphones of the external type.
BS 4009: 1966 IEC 373: 1971	An artificial mastoid for the calibration of bone vibrators used in hearing aids and audiometers.
BS 4668: 1971 IEC 303: 1970	An acoustic coupler (IEC Reference type) for the calibration of earphones used in audiometry.
IEC ... 1980	Occluded ear simulator for measurement of earphones coupled to the ear by ear inserts.

STANDARDS RELATING TO HEARING AIDS

IEC 118: 1959 Under Review Amendment No.1 1973 Amendment No.2 1980 Amendment No.3 1980	Recommended methods for measurement of the electro-acoustical characteristics of hearing aids.
IEC 118-1: 1975	Recommended method of measurement of the characteristics of hearing aids with induction pick up coil input.
IEC 118-2: 1979	Hearing aids with automatic gain control circuit.

IEC 118-3: 1979	Hearing aids not entirely worn on the listener.
IEC 118-4: 1980	Magnetic field strength in audio frequency induction loops for hearing aids.
BS 3171: 1968 (Under Review)	Methods of test of air conduction hearing aids.
ANSI S3. 22-1976	Specification of hearing aid characteristics.
IEC 90: 1973	Dimensions of plugs for hearing aids.
IEC 126 (1973)	IEC Reference coupler for the measurement of hearing aids using earphones coupled to the ear by means of ear inserts.
IEC 224 (Under revision to become 118-11)	Symbols and other markings on hearing aids and related equipment.

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STANDARDS IN OCCUPATIONAL NOISE AND HEARING CONSERVATION

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Paper not received.