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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 389

STANDARD REFERENCE ZERO FOR THE CALIBRATION OF PURE-TONE AUDIOMETERS

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BRIEF HISTORY

The ISO Recommendation R 389, *Standard Reference Zero for the Calibration of Pure-tone Audiometers*, was drawn up by Technical Committee ISO/TC 43, *Acoustics*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question by the Technical Committee began in 1955 and led, in 1962, to the adoption of a Draft ISO Recommendation.

In January 1963, this Draft ISO Recommendation (No. 554) was circulated to all the ISO Member Bodies for enquiry. It was approved by the following Member Bodies:

Australia	Germany	Republic of South Africa
Austria	Hungary	Romania
Belgium	India	Sweden
Brazil	Italy	Switzerland
Chile	Japan	United Kingdom
Czechoslovakia	Netherlands	U.S.A.
Denmark	Norway	U.S.S.R.
Finland	Poland	Yugoslavia
France	Portugal	

No Member Body opposed the approval of the Draft.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in November 1964, to accept it as an ISO RECOMMENDATION.

FOREWORD

The need has frequently been expressed, both by otologists and audiologists and the makers of audiometers, for an internationally accepted basis of calibration for pure-tone audiometers of the types commonly employed for diagnostic or screening purposes.

This ISO Recommendation specifies a standard reference zero for the scale of hearing threshold level applicable to pure-tone audiometers, which it is hoped will help to promote agreement and uniformity in the expression of hearing threshold level measurements throughout the world.

This ISO Recommendation states the information in a form suitable for direct application to the calibration of audiometers, that is, in terms of the response of certain standard types of earphone measured on an artificial ear or coupler of stated type. The earphone-coupler combinations correspond with those currently used in a number of standardizing laboratories.

This ISO Recommendation is based on an assessment of the information available from the various standardizing laboratories responsible for audiometric standards, and from scientific publications, up to the end of 1961. Some notes on the derivation and application of the recommended reference levels are given in Appendix A to this ISO Recommendation.

ISO Recommendation R 389 November 1964

STANDARD REFERENCE ZERO FOR THE CALIBRATION OF PURE-TONE AUDIOMETERS

1. EXPLANATION OF TERMS

For the purpose of this ISO Recommendation, the following terms are employed:

1.1 *Equivalent threshold sound pressure level (monaural earphone listening)*, of an ear at a specified frequency and for a specified type of earphone and for a stated force of application of the earphone to the human ear. Sound pressure level set up by the earphone at that frequency in a specified artificial ear or coupler when the earphone is actuated by that voltage which, with the earphone applied to the ear concerned, would correspond with the threshold of hearing.

1.2 *Reference equivalent threshold sound pressure level (monaural earphone listening)*, at a specified frequency, for a specified type of earphone and for a specified pattern of artificial ear. Modal value, at that frequency, of the equivalent threshold sound pressure levels of an adequately large number of ears of otologically normal subjects within the age limits of 18 to 30 years inclusive.

NOTE. — For the purpose of this ISO Recommendation, an " otologically normal subject " is understood to be a person in a normal state of health who is free from all signs or symptoms of ear disease and from wax in the ear canal, and has no history of undue exposure to noise.

2. SPECIFICATIONS

The reference equivalent threshold sound pressure level, for constant auditory threshold, is dependent on the pattern of earphone and on the pattern of artificial ear employed for its calibration. Usage in this respect may vary from one nation, or standardizing laboratory, to another.

The recommended standard values are given below in the Table, corresponding to the arrangements adopted by different standardizing laboratories, in so far as these have been reported to the International Organization for Standardization (ISO).

Table. — **Recommended Reference Equivalent Threshold Sound Pressure Levels**

Frequency	Reference equivalent threshold sound pressure levels relative to 2×10^{-5} N/m² (2×10^{-4} dyn/cm²)				
Hz (c/s)	decibels				
125	44.5	47.5	47	45.5	55
250	27.5	28.5	28	24.5	33
500	11.5	14.5	11.5	11	14.5
1000	5.5	8	5.5	6.5	8.5
1500	4.5	7.5	6.5	6.5	8.5
2000	4.5	8	9	8.5	9
3000	6	6	8	7.5	10.5
4000	8	5.5	9.5	9	11.5
6000	17	8	8	8	18.5
8000	14.5	14.5	10	9.5	9.5
Pattern of earphone	Audio 15	Beyer DT 48	S.T.C. 4026-A	W.E. 705-A	T.D.6
Type of artificial ear or coupler	C.N.E.T. artificial ear	N.B.S. type 9-A coupler (with P.T.B. adapter)	B.S.2042 (Fig. 1a, 2b) artificial ear	N.B.S. type 9-A coupler	IU-3 type artificial ear
Country of origin of data	France	Germany	United Kingdom	U.S.A.	U.S.S.R.

APPENDIX A

Notes on the derivation and application of the recommended reference levels

A-1. DERIVATION

A-1.1 It is very important to note that the reference levels shown in the various columns of the Table (page 6), all refer, as closely as can be ascertained from existing data, to the same auditory threshold levels. The differences between the values are due to the use, in various laboratories, of different earphones as calibration standards, and of different types of artificial ear or coupler for measuring their response.

A-1.2 The reference levels listed in the Table (page 6) correspond to an average of 15 determinations published, or otherwise communicated to the International Organization for Standardization (ISO) during the period 1950 to 1961. The relations between the values cited in the various columns of the Table have been determined by a co-operative investigation carried out by the following five standardizing laboratories:

Centre National d'Etudes des Télécommunications, Palaiseau, France,
Physikalisch-Technische Bundesanstalt, Braunschweig, Germany,
National Physical Laboratory, Teddington, United Kingdom,
National Bureau of Standards, Washington, U.S.A.,
V.N.I.I.M. Laboratory, Leningrad, U.S.S.R.

A-2. APPLICATION

A-2.1 As regards the calibration of audiometers which are fitted with earphones of one of the patterns considered in the Table, measurements of the acoustical output, using the specified type of artificial ear or coupler, suffice to calibrate the audiometer in terms of the recommended reference levels given in the appropriate column in the Table.

A-2.2 In the case of audiometers fitted with earphones of other patterns, it is necessary first to determine the corresponding reference levels for this pattern of earphone. This would normally be done by comparing the earphone subjectively with an earphone of one of the patterns considered in the Table, using a suitable " equal-loudness balance " or " threshold balance " technique. In certain cases, the results of such comparisons may already be available. For details of the technical procedures and facilities for such work, reference should be made to the manufacturer or direct to the appropriate standardizing laboratory.