Australian Standard®

Acoustics—Reference zero for the calibration of audiometric equipment

Part 3: Reference equivalent threshold force levels for pure tones and bone vibrators

This Australian Standard® was prepared by Committee AV-003, Acoustics—Human Effects. It was approved on behalf of the Council of Standards Australia on 3 November 2006. This Standard was published on 20 February 2007.

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- Association of Australian Acoustical Consultants
- Association of Consulting Engineers Australia
- Audiological Society of Australia
- Australasian Faculty of Occupational Medicine
- Australian Acoustical Society
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- New South Wales Nurses, Association
- Royal Institute of Naval Architects
- Safety Institute of Australia
- The Australian Society of Otolaryngological Head and Neck Surgery
- Victorian WorkCover Authority
- WorkCover New South Wales

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Part 3: Reference equivalent threshold force levels for pure tones and bone vibrators

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee AV-003, Acoustics—Human Effects. After consultation with stakeholders in both countries, Standards Australia and Standards new Zealand decided to develop this Standard as an Australian Standards rather than as an Australian/New Zealand Standard.

The objective of this Standard is to specify data applicable to the calibration of bone vibrators for pure-tone bone-conduction audiometry.

As this Standard is reproduced from an International Standard, the following applies:

(a) Its number does not appear on each page of text and its identity is shown only on the cover and title page.

(b) In the source text 'part of ISO 389' should read 'this Australian Standard'.

(c) A full point should be substituted for a comma when referring to a decimal marker.

As forecast in a footnote, ISO reissued the referenced document ISO 389:1997 as ISO 378-1:1998.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

Reference to International Standard[*]		*Australian Standard*	
ISO		AS/ISO	
389	Acoustics—Reference zero for the calibration of audiometric equipment	389	Acoustics—Reference zero for the calibration of audiometric equipment
389-1	Part 1: Reference equivalent threshold sound pressure levels for pure tones and supra-aural earphones	389.1	Part 1: Reference equivalent threshold sound pressure levels for pure tones and supra-aural earphones
389-2	Acoustics—Reference zero for the calibration of audiometric equipment, Part 2: Reference equivalent threshold sound pressure levels for pure tones and insert earphones	389.2	Part 2: Reference equivalent threshold sound pressure levels for pure tones and insert earphones

The term 'informative' has been used in this Standard to define the application of the annex to which it applies. An 'informative' annex is only for information and guidance.

[*] Only referenced international Standards that have been adopted as an Australian/New Zealand Standard have been listed.

INTRODUCTION

Each part of ISO 389 specifies a specific reference zero for the calibration of audiometric equipment. ISO 389:1991 (to be re-issued as ISO 389-1) and ISO 389-2 are applicable to audiometric equipment for the transmission of pure tones by air conduction.

For clinical diagnostic and other audiometric purposes, it is often necessary to compare the measured hearing threshold levels of a person for sound transmitted to the inner ear by the air-conduction and bone-conduction pathways, respectively. Bone-conducted sound is provided for this purpose by an electromechanical vibrator applied to the mastoid prominence or to the forehead of the person under test.

The reference zero for the calibration of audiometric equipment for air conduction is defined in ISO 389:1991 and ISO 389-2 in terms of reference equivalent threshold sound pressure levels (RETSPLs), i.e. threshold sound pressure levels produced in a coupler, ear simulator or artificial ear of specified characteristics by supra-aural or insert earphones of various patterns, when excited electrically at a level corresponding to the threshold of hearing of young otologically normal persons. Similarly, this part of ISO 389 provides a reference zero for bone-conduction audiometry in terms of reference equivalent threshold force levels (RETFLs), i.e. the vibratory force levels produced by a bone vibrator on a specified mechanical coupler when the vibrator is excited electrically at a level corresponding to the threshold of hearing of young otologically normal persons. In some countries, the preferred location is the mastoid prominence; in other countries, the forehead location is used in addition to the mastoid prominence. Different RETFL values are valid for each of the two positions (see annex C).

For bone-conduction measurements, it is necessary to specify the static force of application of the vibrator to the skull of the test subject and to the mechanical coupler, as well as certain geometrical features of the vibrator tip. In addition, it is usually necessary to apply masking noise to the ear not under test, since excitation of the skull by the vibrator may be heard by that ear instead of (or in addition to) the ear intended for the test. An appropriate specification of the masking noise is, therefore, required as an adjunct to the reference equivalent threshold force levels, and such a specification is given in this part of ISO 389. Due to the so-called "occlusion effect" caused by the wearing of the transducer needed to provide the (air-conducted) masking noise causes a lowering of the bone-conduction threshold of hearing of the ear receiving the masking signal, it is necessary for the level of masking noise to be raised to cancel out the occlusion effect and provide adequate masking of the ear not under test. The specification of masking noise given in this part of ISO 389 is based on the procedures used in the experimental investigations from which the reference zero of this part of ISO 389 is derived.

Use of this reference zero to calibrate audiometers will ensure that measured bone-conduction hearing threshold levels of persons with un-

impaired hearing or with hearing losses of purely sensorineural type (i.e. having unimpaired outer and middle ear function) will be compatible with the air-conduction hearing threshold levels of the same persons when using the reference zero of ISO 389:1991 or ISO 389-2, respectively. Although exact equivalence of air-conduction and bone-conduction thresholds for any individual in these classes cannot be expected, due to biological variability of sound tansmission through the external and middle ear and through the skull, this part of ISO 389 will ensure that systematic deviations averaged over groups of such persons are reduced to a practical minimum.

This part of ISO 389 is based on an assessment of technical data provided by laboratories in three countries using methods of threshold testing which, in the respects described, were essentially uniform. Examination of the data showed that the experimental results were consistent. It has, therefore, been possible to standardize a reference zero by means of RETFL values which are to be used for all bone vibrators used in audiometry having similar characteristics to those used by the laboratories. The systematic uncertainties introduced by this deliberate simplification will be small in comparison to the usual step size of hearing level controls in clinical audiometers (5 dB).

AUSTRALIAN STANDARD

Acoustics—Reference zero for the calibration of audiometric equipment

Part 3:
Reference equivalent threshold force levels for pure tones and bone vibrators

1 Scope

This part of ISO 389 specifies the following data applicable to the calibration of bone vibrators for pure-tone bone-conduction audiometry.

a) Reference equivalent threshold force levels (RETFLs), corresponding to the threshold of hearing of young otologically normal persons by bone-conduction audiometry. RETFL is the vibratory force level transmitted to a mechanical coupler of specified characteristics (see 5.3) by a vibrator when applied to the mechanical coupler under stated conditions of test and when energized at the voltage level corresponding to the normal threshold of hearing for location on the mastoid prominence.

NOTE 1 Interim values for the difference in reference equivalent threshold force levels between location on the forehead and mastoid are included for information in annex C.

b) Essential characteristics of the bone vibrator and of its method of coupling to a person under test and to the mechanical coupler.

c) Essential characteristics and datum level of the masking noise applied to the ear not under test.

Guidance on the practical application of this part of ISO 389 in the calibration of audiometers is given in annex B.

NOTE 2 Recommended procedures for carrying out bone-conduction audiometry are specified in ISO 8253-1.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 389. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 389 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 389:1991, *Acoustics — Standard reference zero for the calibration of pure-tone air conduction audiometers.*[1)]

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.*

IEC 373:1990, *Mechanical coupler for measurements on bone vibrators.*

1) To be re-issued as ISO 389-1.