

TECHNICAL SPECIFICATION



**Electroacoustics – Simulators of human head and ear –
Part 7: Head and torso simulator for the measurement of air-conduction hearing
aids**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2017 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

TECHNICAL SPECIFICATION



**Electroacoustics – Simulators of human head and ear –
Part 7: Head and torso simulator for the measurement of air-conduction hearing
aids**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 17.140.50

ISBN 978-2-8322-4166-0

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references	6
3 Terms and definitions	7
4 Construction	11
4.1 General.....	11
4.2 Geometrical dimensions of the manikin	12
4.2.1 Head and torso.....	12
4.2.2 Pinna simulators for hearing aid measurements.....	13
4.2.3 Ear canal extension	14
4.2.4 Ear simulator	16
4.2.5 Materials	17
4.3 Acoustical characteristics of the manikin	17
4.3.1 Free-field frequency response	17
4.3.2 Diffuse-field frequency response.....	19
4.3.3 Acceptance intervals	20
4.3.4 Openings.....	20
5 Calibration.....	21
5.1 Reference environmental conditions	21
5.2 Calibration method.....	21
5.2.1 General	21
5.2.2 Test signal, test space and measurement equipment.....	21
5.2.3 Measurement of sound pressure level.....	22
5.2.4 Alignment of manikin azimuth and elevation	23
5.2.5 Test for sound leakage	23
6 Marking and instruction manual	23
6.1 Markings of the manikin	23
6.2 Instruction manual	23
7 Maximum permitted uncertainty of measurements	24
Annex A (informative) Design example of an anatomically shaped manikin	26
Annex B (informative) Design examples of a geometrically shaped manikin	27
Annex C (informative) Relationship between tolerance interval, corresponding acceptance interval and the maximum permitted uncertainty of measurement.....	29
Annex D (informative) 3D representation of example pinna simulators	30
D.1 Background.....	30
D.2 Scanning technique	30
D.3 Examples of pinna simulator shape.....	30
D.4 Verification of conformance.....	31
Bibliography.....	32
Figure 1 – Manikin geometrical references.....	10
Figure 2 – Coordinate scheme for azimuth and elevation angles	11
Figure 3 – Illustration of manikin head and torso dimensions	12
Figure 4 – Illustration of manikin pinna simulator dimensions	15
Figure A.1 – Example of an anatomically shaped manikin	26

Figure B.1 – Example 1 of a geometrically shaped manikin	27
Figure B.2 – Example 2 of a geometrically shaped manikin	28
Figure C.1 – Relationship between tolerance interval, corresponding acceptance interval and the maximum permitted uncertainty of measurement	29
Figure D.1 – (Embedded 3D PDFs) – Examples of a pinna simulator	31
Table 1 – Manikin head and torso dimensions.....	13
Table 2 – Dimensions of the pinna simulator and the cylindrical ear canal extension of the manikin	16
Table 3 – Dimensions of the pinna simulator and the tapered ear canal extension of the manikin	16
Table 4 – Free-field frequency response of the manikin for an azimuth angle of 0° (right ear).....	18
Table 5 – Free-field frequency responses of the manikin for azimuth angles of 90°, 180° and 270° (right ear)	19
Table 6 – Diffuse-field frequency response of the manikin (right ear)	20
Table 7 – Maximum permitted uncertainty U_{\max} for type approval measurements	25

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROACOUSTICS – SIMULATORS OF HUMAN HEAD AND EAR –**Part 7: Head and torso simulator for the measurement of
air-conduction hearing aids****FOREWORD**

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 60318-7, which is a Technical Specification, has been prepared by IEC technical committee 29: Electroacoustics.

This publication contains attached files in the form of 3D PDF files. These files are intended to be used as a complement and do not form an integral part of the publication.

This second edition cancels and replaces the first edition published in 2011. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) the document is based on the designs of three different commonly used types of manikins;
- b) the cross sections of the head and torso and pinna simulators of the previous edition are replaced by maximum and minimum values of their geometric dimensions;
- c) the diffuse field frequency response of the manikin is added;
- d) the usable frequency range is extended to 100 Hz to 16 000 Hz;
- e) in addition to the cylindrical ear canal extension a tapered ear canal extension is added;
- f) design examples of one anatomically shaped manikin and of two different geometrically shaped manikins are given in the annexes;
- g) the relationship between tolerance interval, corresponding acceptance interval and the maximum permitted uncertainty of measurement are given in an annex;
- h) 3D representations of three different types of pinna simulators are given in an annex.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
29/907/DTS	29/921A/RVDTS

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 60318 series, published under the general title *Electroacoustics – Simulators of human head and ear*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

ELECTROACOUSTICS – SIMULATORS OF HUMAN HEAD AND EAR –

Part 7: Head and torso simulator for the measurement of air-conduction hearing aids

1 Scope

This document, which is a Technical Specification, describes a head and torso simulator, or manikin, intended for the measurement of air-conduction hearing aids in the frequency range from 100 Hz to 16 000 Hz.

The manikin described in this document is intended for airborne acoustic measurements only. It is not suitable for measurements which depend upon vibration transmission paths such as bone conduction, or for measurements requiring the simulation of bone or tissue.

This document specifies the manikin in terms of both its geometrical dimensions and its acoustical properties. Only manikins compliant with both sets of specifications are in conformance with this document.

WARNING – It is acknowledged that devices conforming to this document are used as the basis for applications extending beyond this scope, for example the measurement of sound sources close to the ear or of hearing protection devices. In such cases, it is recommended that any necessary design variations are documented, and that a statistical analysis of the measurement data is carried out to determine the level of repeatability that can be achieved. It will also be necessary to assess the relevance of the measurements made with the head and torso simulator to the application in question.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60118-8, *Electroacoustics – Hearing aids – Part 8: Methods of measurement of performance characteristics of hearing aids under simulated in situ working conditions*

IEC 60318-4, *Electroacoustics – Simulators of human head and ear – Part 4: Occluded-ear simulator for the measurement of earphones coupled to the ear by means of ear inserts*

IEC 61260-1, *Electroacoustics – Octave-band and fractional-octave-band filters – Part 1: Specifications*

ISO/IEC Guide 98-4, *Uncertainty of measurement – Role of measurement uncertainty in conformity assessment*

ISO 3:1973, *Preferred numbers – Series of preferred numbers*