## BS EN 61669:2016



**BSI Standards Publication** 

Electroacoustics — Measurement of real-ear acoustical performance characteristics of hearing aids



...making excellence a habit."

### National foreword

This British Standard is the UK implementation of EN 61669:2016. It is identical to IEC 61669:2015. It supersedes BS ISO 12124:2001 and BS EN 61669:2001 which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/29, Electroacoustics.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2016. Published by BSI Standards Limited 2016

ISBN 978 0 580 82916 1 ICS 17.140.50

# Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 29 February 2016.

### Amendments/corrigenda issued since publication

Date Text affected

# EUROPEAN STANDARD NORME EUROPÉENNE EUROPÄISCHE NORM

## EN 61669

February 2016

ICS 17.140.50

Supersedes EN 61669:2001

**English Version** 

## Electroacoustics - Measurement of real-ear acoustical performance characteristics of hearing aids (IEC 61669:2015)

Électroacoustique - Mesure des caractéristiques de performances acoustiques des appareils de correction auditive sur une oreille réelle (IEC 61669:2015) Elektroakustik - Messung der Kenndaten von Hörgeräten am menschlichen Ohr (IEC 61669:2015)

This European Standard was approved by CENELEC on 2015-12-09. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization Comité Européen de Normalisation Electrotechnique Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

© 2016 CENELEC All rights of exploitation in any form and by any means reserved worldwide for CENELEC Members.

### European foreword

The text of document 29/886/FDIS, future edition 2 of IEC 61699, prepared by IEC/TC 29 "Electroacoustics" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61699:2016.

The following dates are fixed:

•	latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2016-09-09
•	latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2018-12-09

This document supersedes EN 61699:2001.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

### **Endorsement notice**

The text of the International Standard IEC 61699:2015 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60118-0	NOTE	Harmonized as EN 60118-0.
IEC 60118-7	NOTE	Harmonized as EN 60118-7.
IEC 60118-8	NOTE	Harmonized as EN 60118-8.
IEC 60118-15	NOTE	Harmonized as EN 60118-15.
IEC 60318-4	NOTE	Harmonized as EN 60318-4.

## Annex ZA

(normative)

# Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here:

Publication	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	Year
IEC 60318-5	-	Electroacoustics - Simulators of human head and ear Part 5: 2 cm <sup>3</sup> coupler for the measurement of hearing aids and earphones coupled to the ear by means of ear inserts	EN 60318-5	-
IEC 60601-1	-	Medical electrical equipment Part 1: General requirements for basic safety and essential performance	EN 60601-1	-
IEC 60601-1-2	-	Medical electrical equipment Part 1-2: General requirements for basic safety and essential performance - Collateral standard: Electromagnetic disturbances - Requirements and tests	EN 60601-1-2	-
IEC 60942	-	Electroacoustics - Sound calibrators	EN 60942	-
IEC 61260-1	-	Electroacoustics - Octave-band and fractional-octave-band filters Part 1: Specifications	EN 61260-1	-
ISO 266	-	Acoustics - Preferred frequencies	EN ISO 266	-
ISO 8253-2	-	Acoustics - Audiometric test methods - Part 2: Sound field audiometry with pure-tone and narrow-band test signals	EN ISO 8253-2	-
ISO/TR 25417	-	Acoustics Definitions of basic quantities and terms	-	-

## CONTENTS

FC	FOREWORD4			
IN	TRODU	CTION	6	
1	Scop	e	7	
2	Norm	ative references	7	
3	Term	s and definitions	8	
4	Test	setup diagrams	13	
5	Limit	ations	15	
6	Test	equinment	16	
0	6 1		16	
	0.1 6.2	Ambient conditions	10	
	0.2 6.3		16	
	6.4	Sound field source	17	
	6.5	Coupled sound source	17	
	6.6	Test signal range	17	
	6.7	Test signal level indication	17	
	6.8	Equalization	17	
	6.9	Frequency	17	
	6.10	Harmonic distortion	17	
	6.11	Probe microphone measurement	17	
	6.12	Noise floor of probe microphone measurement	17	
	6.13	Attenuation of probe microphone to external signals	18	
	6.14	Analysis characteristics	18	
	6.15	Output indication	18	
	6.16	Graphical printout	18	
7	Test	conditions	19	
	7.1	Ambient conditions in the test space	19	
	7.2	Background noise	19	
	7.3	Acoustical properties	19	
	7.4	Sound field characteristics	19	
	7.5	Calibration	19	
	7.6	Equalization	19	
	7.6.1	General	19	
	7.6.2	Substitution method	19	
	7.6.3	Modified pressure method – Stored equalization	20	
	7.6.4	Modified pressure method – Concurrent equalization	20	
	1.1	lest signal level	20	
	7.8	Location of the subject	20	
	7.9	Location of the field reference point	20	
	7.1U 7.14	Location of the measurement point	20	
	7 10	Instructions to the subject	21	
	7 13	Location and counling of the hearing aid	21	
	7 1 <i>4</i>	Operating conditions for the hearing aid	21	
8	Meas	urements	21	
5	g 1	General	21	
	0.1	Uchicial	<b>∠</b> I	

8.2	Real-ear unaided response (REUR) curve	21	
8.3	Real-ear unaided gain (REUG) curve	22	
8.4	Real-ear occluded response (REOR) curve	22	
8.5	Real-ear occluded gain (REOG) curve	22	
8.6	Real-ear aided response (REAR) curve	22	
8.7	Real-ear aided gain (REAG) curve	23	
8.8	Real-ear insertion gain (REIG) curve	23	
8.9	Real-ear to coupler difference (RECD) curve	23	
8.10	Real-ear to dial difference (REDD) curve	23	
9 Mea	surement uncertainty for the performance requirements of Clause 6	24	
Annex A measurer	(informative) Positioning the probe microphone sound inlet at the nent point	25	
A.1	General	25	
A.2	Visual positioning	25	
A.3	Acoustically-assisted positioning	25	
A.4	Acoustic positioning – Method 1	26	
A.5	Acoustic positioning – Method 2	26	
A.6	Geometrical positioning	26	
Annex B	(informative) Issues in RECD measurement and application	27	
B.1	General	27	
B.2	Influence of the coupled sound source	27	
B.3	Estimating ear canal SPL produced by a hearing aid	30	
B.4	Correcting an HL audiogram obtained with an insert earphone and a standard eartip	32	
B.5	Correcting an HL audiogram obtained with an insert earphone and a custom earmould	32	
Annex C	(informative) Relationship between tolerance interval, corresponding		
acceptan	ce interval and the maximum permitted uncertainty of measurement	34	
Bibliogra	ɔhy	35	
Figure 1	– Test set-up	14	
Figure 2	- Real-ear measurement arrangement	15	
Figure B.	1 – Computer-simulated ECLD for an average adult ear	29	
Figure B.	2 – Computer-simulated ECLD for an average 3-month old child's ear	29	
Figure B.	3 – Computer-simulated error in estimating SPL in an average adult ear	31	
Figure B. child's ea	4 – Computer-simulated error in estimating SPL in an average 3-month old	31	
Figure B.	5 - Computer-simulated HL correction for an average 3 month old child's ear	33	
Figure C.1 – Relationship between tolerance interval, corresponding acceptance interval and the maximum permitted uncertainty of measurement			

Table 1 – Tolerance limits, acceptance limits and  $U_{max}$  for basic measurements ......24

### INTERNATIONAL ELECTROTECHNICAL COMMISSION

### ELECTROACOUSTICS – MEASUREMENT OF REAL-EAR ACOUSTICAL PERFORMANCE CHARACTERISTICS OF 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.
- 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.

International Standard IEC 61669 has been prepared by IEC technical committee 29: Electroacoustics.

This second edition cancels and replaces the first edition of IEC 61669:2001 and the first edition of ISO 12124:2001. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 61669:2001 and ISO 12124:2001:

- a) the addition of the International Speech Test Signal as a preferred speech-like stimulus;
- b) definitions and test methods for the real-ear to dial difference;
- c) definitions and test methods for the real-ear to coupler difference and
- d) an annex dealing with issues in the measurement and application of the real-ear to coupler difference;

The text of this standard is based on the following documents:

FDIS	Report on voting
29/886/FDIS	29/893/RVD

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

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

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

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

### INTRODUCTION

The performance characteristics of hearing aids in actual use can differ significantly from those determined in accordance with standards such as IEC 60118-0, and IEC 60118-7, due to differing acoustic influence and coupling presented by individual ears. Measuring methods that take into account the acoustic coupling and the acoustic influence of the individual wearer on the performance of hearing aids are therefore important in the fitting of these devices. Such measuring methods have come to be known as "real-ear measurements" and are sometimes performed clinically in less than ideal acoustic environments. The accuracy and repeatability of measurements made under such conditions are complex functions of the sound field, the test environment, the nature of the test signal, the hearing aid under evaluation, the method of test signal control, the location of the sound field source, the nature of the data acquisition, analysis and presentation as well as the degree of subject movement permitted.

This standard provides definitions for terms used in the measurement of real-ear performance characteristics of hearing aids, provides procedural and reporting guidelines, and identifies essential characteristics to be reported by the manufacturer of equipment used for this purpose. Acceptable tolerances for the control and measurement of sound pressure levels are indicated. Where possible, sources of error have been identified and suggestions provided for their management.

### ELECTROACOUSTICS – MEASUREMENT OF REAL-EAR ACOUSTICAL PERFORMANCE CHARACTERISTICS OF HEARING AIDS

### 1 Scope

This International Standard gives recommendations and requirements for the measurement and estimation of the real-ear acoustical performance characteristics of air-conduction hearing aids and for the measurement of certain acoustic properties of the ear related to the application of hearing aids.

Measurements of real-ear acoustical characteristics of hearing aids which apply non-linear or analytical processing techniques are valid only for the test signals used and conditions employed.

The purpose of this standard is to ensure that measurements of real-ear acoustical performance characteristics of a given hearing aid on a given human ear can be replicated in other locations with other test equipment.

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60601-1, Medical electrical equipment – Part 1: General requirements for basic safety and essential performance

IEC 60601-1-2, Medical electrical equipment – Part 1-2: General requirements for basic safety and essential performance – Collateral Standard: Electromagnetic disturbances – Requirements and tests

IEC 60318-5, Electroacoustics – Simulators of human head and ear – Part 5: 2 cm<sup>3</sup> coupler for the measurement of hearing aids and earphones coupled to the ear by means of ear inserts

IEC 60942, *Electroacoustics – Sound calibrators* 

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

ISO 266, *Acoustics – Preferred frequencies* 

ISO 8253-2, Acoustics – Audiometric test methods – Part 2: Sound field audiometry with puretone and narrow-band test signals

ISO/TR 25417, Acoustics – Definitions of basic quantities and terms