IEC 60118-0

Edition 3.0 2015-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electroacoustics – Hearing aids –
Part 0: Measurement of the performance characteristics of hearing aids

Électroacoustique – Appareils de correction auditive –
Partie 0: Mesure des caractéristiques fonctionnelles des appareils de correction auditive

IEC 60118-0:2015-06(en-fr)

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CONTENTS

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**ELECTROACOUSTICS –
HEARING AIDS –**

Part 0: Measurement of the 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.
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International Standard IEC 60118-0 has been prepared by IEC technical committee 29: Electroacoustics.

This third edition cancels and replaces the second edition published in 1983 and its Amendment 1:1994 as well as IEC 60118-1:1995, Amendment 1:1998, IEC 60118-2:1983, Amendment 1:1993, Amendment 2:1997 and IEC 60118-6:1999. This edition constitutes a technical revision.

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

a) the use of an acoustic coupler according to IEC 60318-5;
b) the addition of measurements for automatic gain control circuits, for induction pick-up coil inputs and for electrical inputs.

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

FDIS	Report on voting
29/867A/FDIS	29/874/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.

A list of all parts in the IEC 60118 series, published under the general title *Electroacoustics – Hearing aids*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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.

ELECTROACOUSTICS – HEARING AIDS –

Part 0: Measurement of the performance characteristics of hearing aids

1 Scope

This part of IEC 60118 gives recommendations for the measurement of the performance characteristics of air conduction hearing aids based on a free field technique and measured with an acoustic coupler.

This part of IEC 60118 is applicable to the measurement and evaluation of the electroacoustical characteristics of hearing aids, for example for type testing and manufacturer data sheets.

The test results obtained by the methods specified in this part of IEC 60118 will express the performance under conditions of the test and may deviate substantially from the performance of the hearing aid under actual conditions of use.

This part of IEC 60118 uses an acoustic coupler according to IEC 60318-5 which is only intended for loading a hearing aid with a specified acoustic impedance and is not intended to model the sound pressure in a person's ear. The use of this acoustic coupler will yield different results from those obtained using the occluded ear simulator of IEC 60318-4 as used in former editions of IEC 60118-0.

For the measurement of the performance characteristics of hearing aids for simulated *in situ* working conditions, IEC 60118-8 can be used. For measurement of hearing aids under typical user settings and using a speech-like signal, IEC 60118-15 can be used.

For the measurement of the performance characteristics of hearing aids for production, supply and delivery quality-assurance purposes, IEC 60118-7 can be used. The frequency range has been extended to 8 kHz in this part of IEC 60118 as opposed to 5 kHz in IEC 60118-7.

Though the number of measurements covered by this part of IEC 60118 is limited, it is not intended that all measurements described herein are mandatory.

In cases of custom-made in-the-ear instruments, the data supplied by the manufacturer applies only to the particular hearing aid being tested.

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

ISO 3, *Preferred numbers -- Series of preferred numbers*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
hearing aid
wearable instrument intended to aid a person with impaired hearing

Note 1 to entry: A hearing aid usually consists of a microphone, amplifier, signal processor and earphone, powered by a low-voltage battery and possibly also containing an induction pick-up coil. It is fitted using audiometric and prescriptive methods.

Note 2 to entry: Hearing aids can be placed on the body (BW), behind the ear (BTE), in the ear (ITE) or in the canal (ITC).

3.2
SPL
sound pressure level
ten times the logarithm to the base 10 of the ratio of the square of the sound pressure, p, to the square of a reference value, p_0, expressed in decibels, where the reference value, p_0, is 20 μPa

Note 1 to entry: This note applies to the French language only.

[SOURCE: ISO/TR 25417:2007, 2.2]

3.3
acoustic coupler
device for measuring the acoustic output of sound sources where the sound pressure is measured by a calibrated microphone coupled to the source by a cavity of predetermined shape and volume which does not necessarily approximate the acoustical impedance of the normal human ear

3.4
ear simulator
device for measuring the acoustic output of sound sources where the sound pressure is measured by a calibrated microphone coupled to the source so that the overall acoustic impedance of the device approximates that of the normal human ear at a given location and in a given frequency band

[SOURCE: IEC 60318-4:2010, 3.4]

3.5
input sound pressure level
sound pressure level at the hearing aid reference point

3.6
frequency response
sound pressure level measured in the acoustic coupler expressed as a function of frequency under specified test conditions

3.7
basic frequency response curve
frequency response curve obtained at RTS with an input sound pressure level of 60 dB

3.8
input-output characteristic
for a single frequency, a plot of the sound pressure level measured in the acoustic coupler on the ordinate, against the sound pressure level applied to the hearing aid on the abscissa, with equal decibel scale divisions on each axis

3.9
vertical reference
line through or on a hearing aid which is vertical when the aid is positioned as worn on a head and torso simulator (as per Figure C.1 in IEC 60118-8:2005) or, in the case of custom-made hearing aids, as worn by a seated individual

3.10
reference point
point on the hearing aid chosen for the purpose of defining its position

3.11
test point
position in the test enclosure to which the measurements of the sound pressure level refer or at which the strength of the magnetic field is determined and at which the hearing aid reference point is located for test purposes

3.12
test space
space which contains the test point where the hearing aid is placed for testing

3.13
HFA
high-frequency average
average of gain or SPL in decibels at 1 000 Hz, 1 600 Hz and 2 500 Hz

Note 1 to entry: This note applies to the French language only.

[SOURCE: IEC 60118-7:2005, 3.2]

3.14
acoustic gain
at each test frequency, the difference in decibels obtained by subtracting the input SPL from the SPL developed by the output from the hearing aid in the acoustic coupler

[SOURCE: IEC 60118-7:2005, 3.5, modified — "to the hearing aid microphone" has been deleted]

3.15
gain control
manually or electronically operated control for the adjustment of overall gain

[SOURCE: IEC 60118-7:2005, 3.6]

3.16
OSPL90
output SPL for 90 dB input SPL
SPL developed in the acoustic coupler with an input SPL of 90 dB with the gain control of the hearing aid full-on

Note 1 to entry: It is recognized that the maximum output level may occur with more, or occasionally with less, input SPL than 90 dB. However, the differences are usually small over the frequency range of interest and the single input SPL of 90 dB makes automatic recording of the OSPL90 curve very convenient.

Note 2 to entry: This note applies to the French language only.

[SOURCE: IEC 60118-7:2005, 3.7]

3.17
HFA-OSPL90
high-frequency average OSPL90
high-frequency average of the OSPL90

Note 1 to entry: This note applies to the French language only.

[SOURCE: IEC 60118-7:2005, 3.8, modified — "SPL levels" has been deleted from the definition.]

3.18
HFA-FOG
high-frequency average full-on gain
HFA gain for an input SPL of 50 dB when the gain control of the hearing aid is at its full-on position

Note 1 to entry: This note applies to the French language only.

[SOURCE: IEC 60118-7:2005, 3.9]

3.19
RTS
reference test setting of the gain control
for an input SPL of 60 dB, the setting of the gain control required to produce an HFA-gain within ± 1,5 dB of the HFA-OSPL90 minus 77 dB, or, if the full-on HFA gain for an input SPL of 60 dB is less than the HFA-OSPL90 minus 77 dB, the full-on setting of the gain control

Note 1 to entry: For most hearing aids, the use of an input SPL of 60 dB and a 17 dB difference from the OSPL90 helps to ensure that, for an overall speech level of 65 dB SPL, peaks do not exceed the OSPL90.

Note 2 to entry: This note applies to the French language only.

[SOURCE: IEC 60118-7:2005, 3.10]

3.20
RTG
reference test gain
HFA gain for an input SPL of 60 dB with the gain control at RTS

Note 1 to entry: This note applies to the French language only.

[SOURCE: IEC 60118-7:2005, 3.11]

3.21
AGC
automatic gain control
means (other than peak clipping) by which the gain is automatically controlled as a function of the level of the signal being amplified

Note 1 to entry: This note applies to the French language only.

[SOURCE: IEC 60118-7:2005, 3.13]

3.22
AGC hearing aid
hearing aid incorporating automatic gain control (AGC)

[SOURCE: IEC 60118-7:2005, 3.14]

3.23
compression
type of AGC in which an incremental change in input sound pressure level produces a smaller incremental change of output sound pressure level

3.24
expansion
type of AGC in which an incremental change in input sound pressure level produces a larger incremental change of output sound pressure level

3.25
directional hearing aid
hearing aid for which the gain is dependent on the direction of sound incidence when measured under free-field conditions

[SOURCE: IEC 60118-7:2005, 3.15]

3.26
non-directional hearing aid
hearing aid for which the gain is independent of the direction of sound incidence when measured under free-field conditions

[SOURCE: IEC 60118-7:2005, 3.16]

3.27
supply voltage
voltage at the battery terminals of the hearing aid with the hearing aid switched on

3.28
magneto-acoustical sensitivity
at a specified frequency and under essentially linear input/output conditions, the quotient of the sound pressure in pascals (Pa) produced by the hearing aid in the acoustic coupler and the magnetic field strength in milliamperes per metre (mA/m) at the test point

3.29
MASL
magneto-acoustical sensitivity level
twenty times the logarithm to the base 10 of the ratio of the magneto-acoustical sensitivity to the reference sensitivity 20 Pa/(1 mA/m)

Note 1 to entry: MASL is expressed in decibels.

Note 2 to entry: This note applies to the French language only.

3.30
maximum magneto-acoustical sensitivity level
maximum obtainable MASL, allowing all possible settings of the hearing aid controls

3.31
SPLIV
SPL in a vertical magnetic field
SPL developed in the acoustic coupler with the gain control at RTS when the input is –30 dB re 1 A/m (= 31,6 mA/m) sinusoidal alternating magnetic field parallel to the vertical reference with T-programme selected

Note 1 to entry: This note applies to the French language only.

3.32
HFA-SPLIV
high frequency average SPL in a vertical magnetic field
high-frequency average of the SPLIV levels

Note 1 to entry: This note applies to the French language only.

3.33
ETLS
equivalent test loop sensitivity
difference in decibels obtained by subtracting the RTG + 60 dB from the HFA-SPLIV

Note 1 to entry: This note applies to the French language only.

[SOURCE: IEC 60118-7:2005, 3.19, modified — In the definition, "HFA-SPLI" has been replaced by "HFA-SPLIV".]

3.34
SPLITS
SPL for an inductive telephone simulator
SPL developed in the coupler by a hearing aid with the gain control in the RTS when the input is the magnetic field generated by a telephone magnetic field simulator

Note 1 to entry: This note applies to the French language only.

3.35
HFA-SPLITS
high frequency average (HFA) SPL for an inductive telephone simulator
high-frequency average of the SPLITS values

Note 1 to entry: This note applies to the French language only.

3.36
RSETS
relative simulated equivalent telephone sensitivity
difference in decibels obtained by subtracting the RTG + 60 dB SPL from the HFA-SPLITS

Note 1 to entry: This note applies to the French language only.

3.37
TMFS
telephone magnetic field simulator
device for producing a magnetic field of consistent level and geometric shape when driven by a current of $I = 6/N$ mA, where N is the number of coil turns

Note 1 to entry: This note applies to the French language only.

4 General conditions

4.1 Acoustic test method

The preferred acoustic test procedure is based on a method of measurement in which the sound pressure level at the hearing aid reference point is kept constant to simulate free field conditions. This is accomplished in a test enclosure or acoustic test box by the use of a pressure-calibrated control microphone, on the assumption that the sound field is homogeneous around the reference point of the hearing aid.

This method is designated "constant entrance sound pressure method" or shortened "pressure method" throughout this part of IEC 60118.

As an alternative to the pressure method, storage of a test enclosure frequency response correction curve may be used. This method is designated “substitution method”.

For testing directional hearing aids, manufacturer and purchaser should use acoustic test boxes of the same make and type to secure identical measurement conditions.

NOTE 1 The test results can differ substantially from those obtained under real free-field conditions, especially for body-worn types of hearing aids having the sound entry located on the surface of the outer housing where the housing may have physical dimensions comparable to the wavelength of the incident sound.

For measuring the variation of acoustical parameters of hearing aids as a function of the direction of sound incidence, plane progressive wave conditions (i.e. not having standing wave conditions) are required.

NOTE 2 Small acoustic test boxes in which progressive wave conditions are not present cannot therefore be used for this purpose.

NOTE 3 The results from testing directional hearing aids may not represent the true directional characteristics of the hearing aid.

4.2 Acoustic coupler

Measurements of the hearing aid performance characteristics are made using a 2 cm^3 acoustic coupler in accordance with IEC 60318-5.

NOTE The basic specifications of IEC 60318-5 are limited to the frequency range 125 Hz to 8 000 Hz.

For any type of air conduction hearing aids, sound leakage from the coupling tube shall be low enough not to affect the test result. One way of accomplishing this is to use a rigid tube. The dimensions of the tubing shall be maintained in accordance with IEC 60318-5.

4.3 Measurement frequency range

All measurements shall be made for a stated frequency range (also named bandwidth) of 200 Hz to 8 000 Hz.

4.4 Reporting of data

All data reported shall be clearly labelled: "According to IEC 60118-0:2015".

5 Test enclosure and test equipment

5.1 General

The conditions specified in 5.2 to 5.6 apply. Measurements shall be made at the ISO R40 preferred frequencies (1/40 decade or 1/12 octave) as specified in ISO 3 unless otherwise stated.

5.2 Unwanted stimuli in the test enclosure

Unwanted stimuli in the test enclosure, such as ambient noise, mechanical vibrations and electrical or magnetic stray fields shall be sufficiently low so as not to affect the test results by more than 0,5 dB. This can be verified if the output level of the hearing aid falls by at least 10 dB in each frequency analysis band, when the signal source is switched off.

5.3 Sound source

5.3.1 The sound source (pure-tone) shall be capable of producing at the test point the requisite sound pressure levels between 50 dB and 90 dB, with a minimum step size of 5 dB.