# IEC 60118-0

Edition 4.0 2022-08

# 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**



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## 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



INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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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IEC 60118-0 has been prepared by technical committee 29: Electroacoustics. It is an International Standard.

This fourth edition merges and updates the methods previously described in IEC 60118-0:2015 and IEC 60118-7:2005. It cancels and replaces the third edition of IEC 60118-0 published in 2015. This edition constitutes a technical revision.

Measurements for quality control as described in IEC 60118-7:2005 can be found in Clause 10 of this document.

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

a) the default use of an acoustic coupler according to IEC 60318-5,
b) addition of the optional use of an occluded ear simulator according to IEC 60318-4,

c) addition of the optional use of an acoustic coupler according to IEC 60318-8 (new standard based on IEC TS 62886) when information about the response above 8 kHz is needed, or the optional use of the acoustic coupler according to IEC 60318-8 for deep insert hearing aids,

d) the addition of measurements of the performance of hearing aids for production, supply and delivery quality assurance purposes,

e) corrected and updated measurement configuration and methods, adding the use of a sequential measurement as preferred configuration,

f) updated and expanded measurement procedures for the non-acoustic inputs of the hearing aid.

NOTE The substitution method described in Annex B has no relation to the substitution method described in IEC 60118-0:2015.

The text of this International Standard is based on the following documents:

| Draft | Report on voting |
|---|---|
| 29/1126/FDIS | 29/1129/RVD |

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

The language used for the development of this International Standard is English.



This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.



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.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under 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.

# 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 measured with an acoustic coupler or occluded ear simulator.

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

This document is also applicable for the measurement of the performance characteristics of hearing aids for production, supply and delivery quality-assurance purposes.

The measurement results obtained by the methods specified in this document will express the performance under conditions of the measurement and can deviate substantially from the performance of the hearing aid under actual conditions of use.



This document primarily uses an acoustic coupler according to IEC 60318-5 which is only intended for loading a hearing aid with specified acoustic impedance and is not intended to reproduce the sound pressure in a person's ear. For measurements reflecting the output level in the normal human ear the occluded ear simulator according to IEC 60318-4 can be used. For extended high-frequency measurements and for deep insert hearing aids, the acoustic coupler according to IEC 60318-8 can be used.



This document also covers measurement of hearing aids with non-acoustic inputs, such as wireless, inductive or electrical input.

This document does not cover the measurement of hearing aids for simulated in situ working conditions, for which IEC 60118-8 can be applied.

This document does not cover the measurement of hearing aids under typical user settings and using a speech-like signal, for which IEC 60118-15 can be applied.

## 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 60118-12, *Hearing aids – Part 12: Dimensions of electrical connector systems*

IEC 60318-4:2010, *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 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*

IEC 60318-8, *Electroacoustics – Simulators of human head and ear – Part 8: Acoustic coupler for high-frequency measurements of hearing aids and earphones coupled to the ear by means of ear inserts*

IEC 60268-2, *Sound system equipment – Part 2: Explanation of general terms and calculation methods*

IEC 60263, *Scales and sizes for plotting frequency characteristics and polar diagrams*

IEC 61094-4, *Measurement microphones – Part 4: Specifications for working standard microphones*

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

## 3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp



**3.1**
**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



[SOURCE: ISO/TR 25417:2007, 2.2, modified – The abbreviated term has been added and the formula and notes to entry have been omitted.]

**3.2**
**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 battery and possibly also containing alternative means of signal pickup such as induction coil, wireless input or electrical input. It is fitted using audiometric and prescriptive methods.

Note 2 to entry: A hearing aid can be placed on the body (BW), behind the ear (BTE), in the ear (ITE, also named full concha), in the canal (ITC), receiver in canal (RIC) or completely in the canal (CIC).

**3.3**
**directional hearing aid**
hearing aid for which the acoustic gain is dependent on the direction of sound incidence when measured under free-field conditions

Note 1 to entry: Generally, a hearing aid with a single sound inlet port is non-directional and an aid with multiple sound inlet ports is directional.

**3.4**
**non-directional hearing aid**
hearing aid for which the acoustic gain is independent of the direction of sound incidence when measured under free-field conditions

Note 1 to entry: Generally, a hearing aid with a single sound inlet port is non-directional and an aid with multiple sound inlet ports is directional.

**3.5**
**gain control**
manually or electronically operated control for the adjustment of the overall gain response

**3.6**
**tone control**
manually or electronically operated control for adjusting frequency dependent gain

**3.7**
**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 normally worn by the user

**3.8**
**reference point**
point related to the hearing aid sound inlet port(s) for the purpose of defining the position of the hearing aid or wireless transmitter microphone

Note 1 to entry: For a hearing aid with one sound inlet port the reference point is at the sound inlet port. For a hearing aid with two or more sound inlet ports the reference point is in the geometrical centre between the inlet ports.

**3.9**
**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 reference point of the hearing aid or wireless transmitter microphone is located for test purposes



**3.10**
**test space**
space which contains the test volume and the test point where the hearing aid or wireless transmitter microphone is placed for testing



**3.11**
**test volume**
volume in the test space in which the sound field has the required conditions for testing

**3.12**
**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

**3.13**
**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]

**3.14**
**input SPL**
**input sound pressure level**
sound pressure level at the reference point of the hearing aid

**3.15**
**frequency response**
sound pressure level measured in the acoustic coupler or ear simulator expressed as a function of frequency under specified test conditions

**3.16**
**basic frequency response curve**
frequency response curve obtained at reference test setting with an input sound pressure level of 60 dB

**3.17**
**input-output characteristic**
for a single frequency, a plot of the sound pressure level measured in the acoustic coupler or ear simulator on the ordinate, against the sound pressure level applied to the hearing aid on the abscissa, with equal decibel scale divisions on each axis

**3.18**
**HFA**
**high-frequency average**
average of gain or SPL in decibels at 1 000 Hz, 1 600 Hz and 2 500 Hz

**3.19**
**special purpose hearing aid**
hearing aid whose full-on gain at any frequency exceeds its full-on gain at 1 000 Hz, or at 1 600 Hz, or at 2 500 Hz by more than 15 dB



**3.20**
**SPA**
**special purpose average**
average of gain or SPL in decibels at the three one-third-octave-band frequencies each separated by two-thirds of an octave, selected and stated by the manufacturer



Note 1 to entry: Throughout this document, wherever the term "high-frequency average" or "HFA" appears, "special-purpose average" or "SPA" can be substituted for a special purpose hearing aid.

**3.21**
**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 or occluded ear simulator

**3.22**
**OSPL90**
**output SPL for 90 dB input SPL**
SPL developed in the acoustic coupler or occluded ear simulator with an input SPL of 90 dB with the hearing aid set to the full-on setting

Note 1 to entry: It is recognized that the maximum output level can 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 response curve very convenient.

**3.23**
**HFA-OSPL90**
high-frequency average of the OSPL90

**3.24**
**maximum-OSPL90**
maximum value of the OSPL90 frequency response curve

**3.25**
**FOG**
**full-on gain**
acoustic gain for an input SPL of 50 dB when the hearing aid is set at full-on setting

**3.26**
**HFA-FOG**
high-frequency average of the FOG

**3.27**
**maximum FOG**
maximum value of the FOG frequency response curve

**3.28**
**RTS**
**reference test setting**
for an input SPL of 60 dB, the settings of the hearing aid 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 hearing aid

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.

**3.29**
**RTG**
**reference test gain**
HFA gain for an input SPL of 60 dB with the hearing aid setting at RTS



**3.30**
**FOS**
**full-on setting**
setting of the hearing aid which provides the highest gain within the frequency range of the hearing aid and has the least possible output limitations

**3.31**
**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

**3.32**
**AGC hearing aid**
hearing aid incorporating automatic gain control (AGC)

**3.33**
**compression**
type of AGC in which an incremental change in input sound pressure level produces a smaller incremental change of output sound pressure level

**3.34**
**expansion**
type of AGC in which an incremental change in input sound pressure level produces a larger incremental change of output sound pressure level

**3.35**
**supply voltage**
voltage at the battery terminals of the hearing aid with the hearing aid switched on