BS EN 60118-7:2005

Electroacoustics — Hearing aids —

Part 7: Measurement of the performance characteristics of hearing aids for production, supply and delivery quality assurance purposes

The European Standard EN 60118-7:2005 has the status of a British Standard

ICS 17.140.50

British Standards

National foreword

This British Standard is the official English language version of EN 60118-7:2005. It is identical with IEC 60118-7:2005. It supersedes BS EN 60118-7:1993 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/29, Electroacoustics, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

Cross-references

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Summary of pages

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English version

Electroacoustics – Hearing aids Part 7: Measurement of the performance characteristics of hearing aids for production, supply and delivery quality assurance purposes (IEC 60118-7:2005)

Electroacoustique –
Appareils de correction auditive
Partie 7: Mesure des caractéristiques fonctionnelles des appareils de correction auditive aux fins d'assurance de la qualité de la production, de la livraison et des approvisionnements
(CEI 60118-7:2005)

Akustik –
Hörgeräte
Teil 7: Messung der Übertragungseigenschaften von Hörgeräten zum Zwecke der Qualitätssicherung in der Herstellung, Versorgung und Lieferung
(IEC 60118-7:2005)

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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 Central Secretariat has the same status as the official versions.

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CENELEC
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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Foreword

The text of document 29/585/FDIS + 29/587/INF, future edition 2 of IEC 60118-7, prepared by IEC TC 29, Electroacoustics, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60118-7 on 2005-12-01.

This European Standard supersedes EN 60118-7:1993 + A1:1994.

This European Standard includes major changes, e.g. regarding the definition of reference test gain. In general this edition aligns IEC 60118-7 and the ANSI S3.22 (2003) standard.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2006-09-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2008-12-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60118-7:2005 was approved by CENELEC as a European Standard without any modification.

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ELECTROACOUSTICS – HEARING AIDS –

Part 7: Measurement of the performance characteristics of hearing aids for production, supply and delivery quality assurance purposes

1 Scope

This part of IEC 60118 gives recommendations for the measurement of the performance characteristics of air-conduction hearing aids of a particular model for production, supply and delivery quality assurance purposes. The manufacturer will normally assign nominal values.

This standard does not relate to mechanical or environmental tests. It should not be used as the basis for the exchange of information about hearing aid characteristics in general, nor is it intended to be used as a predictor for real-ear performance.

NOTE Terms such as "manufacturer" and "purchaser" are used in this standard. These terms may be understood, however, to refer to the supplier and recipient respectively in any arrangement for the supply of hearing aids in which the use of this standard is called for.

Though the number of measurements covered by this standard is limited, it is not intended that all measurements described herein shall be made in every case.

This second edition now specifies performance requirements. Conformance to the specifications in this standard is demonstrated only when the result of a measurement, extended by the actual expanded uncertainty of measurement of the testing laboratory, lies fully within the tolerances specified in this standard extended by the values for U_{max} given in Table 4.

In case 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 referenced documents are indispensable for the application 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 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* [1)]

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply:

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1) To be published. IEC 60318-5 is a revision of IEC 60126:1973, *IEC reference coupler for the measurement of hearing aids using earphones coupled to the ear by means of ear inserts.*

3.1
sound pressure level
SPL
all sound pressure levels specified are measured in decibels (dB) referenced to 20 μPa

3.2
high-frequency average
HFA
average of gain or SPL in decibels at 1 000 Hz, 1 600 Hz and 2 500 Hz

3.3
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. If the requirements for being a special purpose hearing aid are met, the manufacturer may substitute the SPA for the HFA

NOTE The frequencies used for the SPA should be specified by the manufacturer and used for all measurements.

3.4
special purpose average
SPA
average of gain or SPL in dB at 3 special purpose frequencies for a special purpose hearing aid. The manufacturer shall specify and state three special purpose one-third-octave-band frequencies each separated by two-third octave

NOTE Throughout this standard, wherever the term HFA appears, SPA may be substituted for these aids.

3.5
acoustic gain
at each test frequency, the difference in decibels obtained by subtracting the input SPL to the hearing aid microphone from the SPL developed by the output from the hearing aid in the acoustic coupler

3.6
gain control
manually or electronically operated control for the adjustment of overall gain

3.7
output SPL for 90-dB input SPL
OSPL90
SPL developed in the acoustic coupler with an input SPL of 90 dB with the gain control of the hearing aid full-on

NOTE 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.

3.8
high-frequency average OSPL90
HFA-OSPL90
high-frequency average of the OSPL90 SPL levels

3.9
high-frequency average full-on gain
HFA-FOG
HFA gain for an input SPL of 50 dB when the gain control of the hearing aid is at its full-on position

3.10
reference test setting of the gain control
RTS
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. If the full-on HFA gain for an input SPL of 60 dB is less than the HFA-OSPL90 minus 77 dB, the RTS is the full-on position of the gain control

NOTE For linear hearing aids, the use of an input SPL of 60 dB and a 17 dB gain control setback from the OSPL90 helps to ensure that, for an overall speech level of 65 dB SPL, peaks should not exceed the OSPL90.

3.11
reference test gain
RTG
HFA gain for an input SPL of 60 dB with the gain control at RTS

3.12
input-output function
single frequency plot of acoustic coupler SPL on the ordinate as a function of input SPL on the abscissa with equal decibel scale divisions on each axis

3.13
automatic gain control
AGC
means (other than peak clipping) by which the gain is automatically controlled as a function of the level of the signal being amplified

3.14
AGC hearing aid
hearing aid incorporating automatic gain control (AGC)

3.15
directional hearing aid
hearing aid for which the gain is dependent on the direction of sound incidence when measured under free-field conditions

3.16
non-directional hearing aid
hearing aid for which the gain is independent of the direction of sound incidence when measured under free-field conditions

3.17
SPL in a magnetic field
SPLI
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 and the input selector of the hearing aid is in T-position (see 8.8)

3.18
high frequency average SPL in a magnetic field
HFA-SPLI
high-frequency average of the SPLI SPL levels

3.19
equivalent test loop sensitivity
ETLS
difference obtained by subtracting the (RTG + 60 dB) from the HFA-SPLI

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 reference point of the hearing aid is kept constant. This is accomplished in an 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 standard.

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

The sound output from the hearing aid is coupled to the IEC acoustic coupler according to IEC 60318-5.

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

NOTE 2 For measuring the variation of acoustical parameters of hearing aids as a function of the direction of sound incidence, progressive wave conditions are required. Small acoustic test boxes in which progressive wave conditions are not present cannot be used for this purpose.

NOTE 3 For testing directional hearing aids, manufacturer and purchaser should use acoustic test boxes of the same make and type to secure identical measurement conditions. The results from such measurements may not represent the true directional characteristics of the hearing aid.

4.2 Reporting of data

All data reported shall be clearly labelled: "According to IEC 60118-7:2005".

5 Nominal characteristics and tolerances

The characteristics with the prefix "nominal" listed below are those that are assigned by the manufacturer for the hearing aid model in question (see also Figure 1 and Figure 2) and are subject to verification, using the methods described in this standard:

- nominal reference test gain (see 3.11);
- nominal OSPL90 (see 8.2);
- nominal maximum OSPL90 (see 8.2);
- nominal full-on gain (see 8.3);
- nominal frequency response curve (see 8.4);
- nominal bandwidth frequencies f_1 + f_2 (see 8.4.2);
- nominal battery or supply voltage (see 7.3.2);
- nominal battery current (see 8.5);
- nominal total harmonic distortion (see 8.6);
- nominal equivalent input noise level (see 8.7);
- nominal equivalent test loop sensitivity (see 8.8.1);
- nominal maximum magneto acoustical sensitivity level (MASL) (see 8.8.2);
- nominal steady state input-output AGC characteristics (see 8.9.2);
- nominal attack- and release time (see 8.9.3).

6 Test box and test equipment

6.1 General

The following conditions should be met, for ambient conditions stated in 7.3.4.

6.2 Unwanted stimuli in the test box

Unwanted stimuli in the test box, 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, when the signal source is switched off.

6.3 Sound source

6.3.1 The sound source (pure tone), in combination with a pressure-calibrated controlling microphone, 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, within a tolerance of ± 1,5 dB over the frequency range 200 Hz to 2 000 Hz and within ±2,5 dB over the range 2 000 Hz to 5 000 Hz.

If the calibration of the sound source depends on ambient conditions, corrections for such dependence shall be made when necessary.

6.3.2 The frequency of the sound source shall be within ±2 % of the indicated value. The frequency interval between data points in frequency response curves shall not exceed one-twelfth-octave or 100 Hz, whichever is greater.

6.3.3 For frequency response and full-on gain measurements, the total harmonic distortion of the acoustic signal shall not exceed 2 %.

For harmonic distortion measurements, the total harmonic distortion of the acoustic signal up to a sound pressure level of 70 dB shall not exceed 0,5 %.

6.4 Acoustic coupler

The IEC reference coupler in accordance with IEC 60318-5 shall be used. For behind-the-ear type hearing aids, sound leakage from the coupling tube shall be low enough not to affect the test result. The dimensions of the tubing shall be maintained in accordance with IEC 60318-5.

NOTE One way of accomplishing this is to use a rigid tube.

6.5 Measurement system for the measurement of sound pressure level and harmonic distortion in the acoustic coupler

The equipment for the measurement of the coupler sound pressure level produced by the hearing aid shall fulfil the following requirements:

a) the sound pressure level measurement system shall be accurate within ±1,0 dB at the frequency of calibration;

b) the indication of sound pressure level in the acoustic coupler relative to the indication at the frequency of calibration shall be measured with an expanded uncertainty of no more than ±1,0 dB in the frequency range 200 Hz to 5 000 Hz;

   If, under certain conditions, it is necessary to use a selective measuring system in order to ensure that the response of the hearing aid to the signal can be differentiated from inherent noise in the hearing aid, the use of the selective system shall be stated in the test report.

Direct current measurement system:

The direct-current measuring system shall have the following characteristics:

a) a tolerance of ±5 % at the value of current measured;

b) direct-current voltage drop across current-measuring device ≤ 50 mV;

c) an impedance not exceeding 1 Ω over the frequency range 200 Hz to 5 000 Hz.

NOTE One method of realizing item c) above is to bypass the current meter with an 8 000 μF capacitor. The capacitor should not shunt the battery or the power supply.

7 Test conditions

7.1 General

Procedures for controlling the sound field and establishing test conditions for the hearing aid are described below.

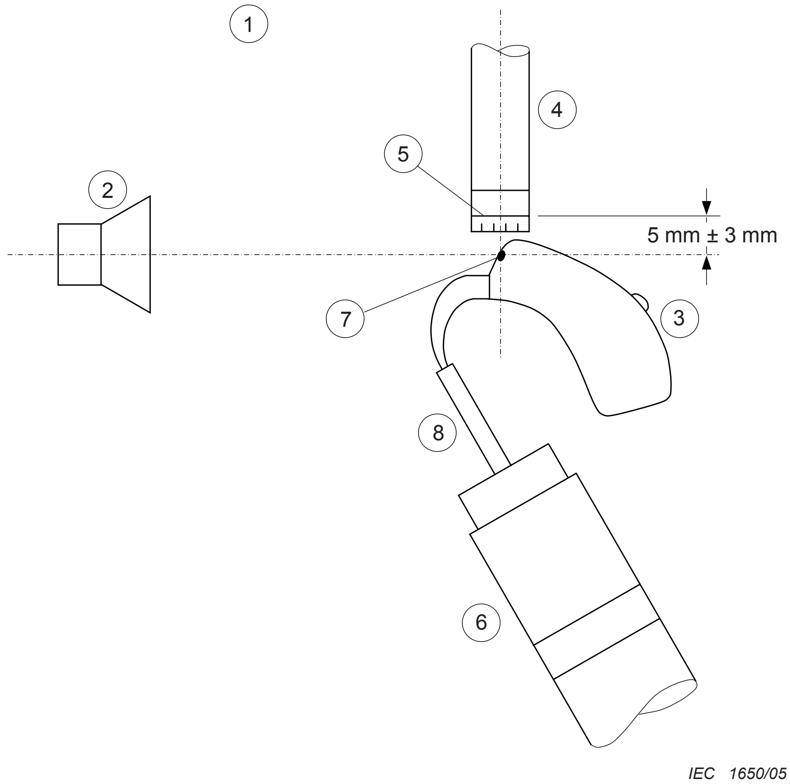
7.2 Control of the sound field

7.2.1 The input SPL at the hearing aid reference point is kept constant:

a) by means of a control microphone (pressure method – see 7.2.2);

b) with electronic data storage (substitution method – see 7.2.3).

7.2.2 If the pressure method is used, the inlet to the control microphone shall be placed as close as possible to the hearing aid reference point without touching it. For a 15 mm or smaller diameter microphone, the distance from the centre of the diaphragm to the reference point shall be 5 mm ± 3 mm. Figures 1 and 2 show examples of test arrangements.



Key

1 test space

2 sound source

3 hearing aid

4 control microphone

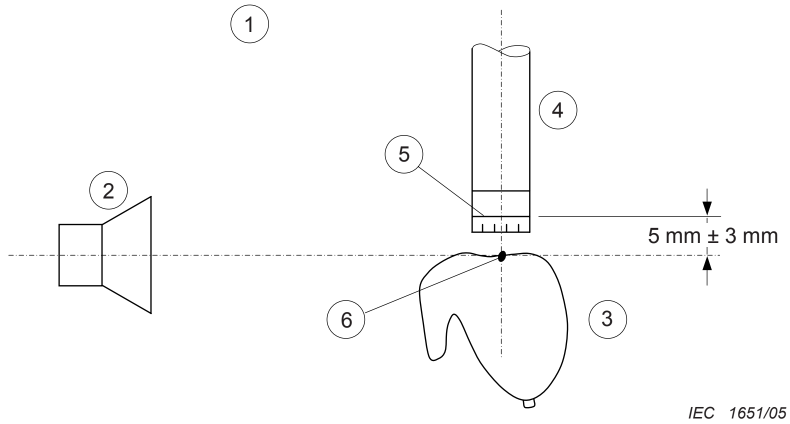
5 diaphragm

6 acoustic coupler

7 reference point of hearing aid. The axis of the control microphone shall be orthogonal to the speaker axis and shall intersect it at the midpoint of the hearing aid sound inlet port or port array. A line through the front and rear sound inlet ports of the hearing aid shall coincide with the speaker axis. In the case of multiple front or rear entry ports, the line is passed through the midpoint of the port array.

8 tubing 25 mm length, ø 2 mm in accordance with IEC 60318-5

Figure 1 – Example of test arrangement for behind the ear hearing aid



Key

1 test space

2 sound source

3 hearing aid

4 control microphone

5 diaphragm

6 reference point of hearing aid

Figure 2 – Example of test arrangement for in-the-ear hearing aid

7.2.3 An alternative method of keeping the sound pressure level constant is to let the pressure calibrated control microphone, 5 mm ± 3 mm from the reference point of the hearing aid, measure the SPL at discrete frequencies with the model of hearing aid to be tested in its test position. By suitable means, for instance digital equipment, store and subsequently reproduce the required voltages for constant SPL at the reference point with either the control microphone still in place or a dummy simulating that microphone in the same place in order to fulfil pressure method conditions.

NOTE Methods of test that do not keep the control microphone or a dummy in place, may give different results between the methods given in 7.2.2 and 7.2.3. Different results may also occur if the sound field is calibrated with a hearing aid other than the model under test in place.

7.2.4 For both methods mentioned above, the use of a 15 mm or smaller microphone is recommended. The diameter of the microphone actually used shall be stated.

7.2.5 Care should be taken that neither the acoustic coupler nor the mechanical support for the hearing aid will appreciably disturb the sound field in the vicinity of the hearing aid at the test frequencies used, and they should not introduce spurious effects arising from mechanical resonances or mechanical vibrations, nor should they in any respect affect any mechanical or acoustical property of the hearing aid under test.

7.3 Normal operating conditions for a hearing aid

7.3.1 General

The normal operating conditions apply for measurements where no other conditions are prescribed. The normal operating conditions are specified in 7.3.2 to 7.3.6.

7.3.2 Battery or supply voltage

Preferably a suitable power supply that simulates the voltage and internal impedance of real batteries should be used. Alternatively an actual battery of the type recommended by the manufacturer for use in the hearing aid may be employed.

The type of power source used and the loaded supply voltage shall be stated.

For the battery simulator, the following open circuit voltages and series internal resistors shall be used (see Table 1):

Table 1 – Resistance and open circuit voltages for battery simulator

Battery type IEC/ANSI designation	Series resistor Ω	Open circuit voltage V
PR521 / 5A	8,2	1,3
PR70 / 10A	6,2	1,3
PR41 / 312	6,2	1,3
PR48 / 13	6,2	1,3
PR44 / 675	3,3	1,3
Tolerance of open circuit voltage: ±0,05 V Tolerance of series resistor: ±5 %		

7.3.3 Settings of controls

The manufacturer shall specify the FOG settings used for testing by providing test settings, a set of programmed settings or by reference to physical control settings and means to obtain RTS.

The hearing aid shall be set to have the widest available frequency response range, the greatest available HFA-OSPL90 and, if possible, the greatest HFA-FOG. Where possible, the AGC function of AGC hearing aids shall be set to have minimum effect for all tests except those of 8.9. For the tests of 8.9, the AGC function shall be set to have maximum effect. For the purposes of this standard expansion shall be considered as a part of the AGC function.

Other adaptive features, such as some noise suppression, and feedback suppression systems etc., which may affect the validity of measurements made with steady-state pure tone signals, should be disabled.

7.3.4 Ambient conditions

Actual conditions in the test space at the time of test should be within the following ranges, and shall be stated:

Temperature:	(23 ± 5) °C
relative humidity.	20 % – 80 %
atmospheric pressure:	$101,3\ ^{+5}_{-20}$ kPa

If other conditions apply, these conditions shall be stated. If the calibration of the measurement system depends on ambient conditions, corrections for such dependence shall be made.

7.3.5 Sound outlet system

For sound outlet systems such as insert earphones, ear-hook type or sound tubing. Reference is made to IEC 60318-5.

The sound outlet system used shall be stated.

7.3.6 Accessories

For accessories used in connection with the hearing aid, the particular accessories shall be stated.

8 Measurements, specifications and tolerances

8.1 Frequency response curves

All published curves showing variation of a parameter with frequency shall be plotted on a grid having a linear decibel ordinate scale and a logarithmic frequency abscissa scale with the length of one decade on the abscissa equal to the length of 50 dB ± 2 dB on the ordinate.

8.2 Output sound pressure level frequency response curve for an input sound pressure level of 90 dB (OSPL90 frequency response curve)

The test procedure is:

a) turn the gain control full-on and set other controls as stated in 7.3.3;

b) keeping the input sound pressure level constant at 90 dB, vary the frequency of the sound source over the frequency range from 200 Hz to 5 000 Hz, measure and record the OSPL90 frequency response curve so obtained;

c) obtain from above data the maximum OSPL90 and the HFA-OSPL90 (see Figure 3).

Tolerance:

maximum OSPL90:	nominal value shall not be exceeded by more than 3 dB.
HFA-OSPL90:	within nominal value ±4 dB.

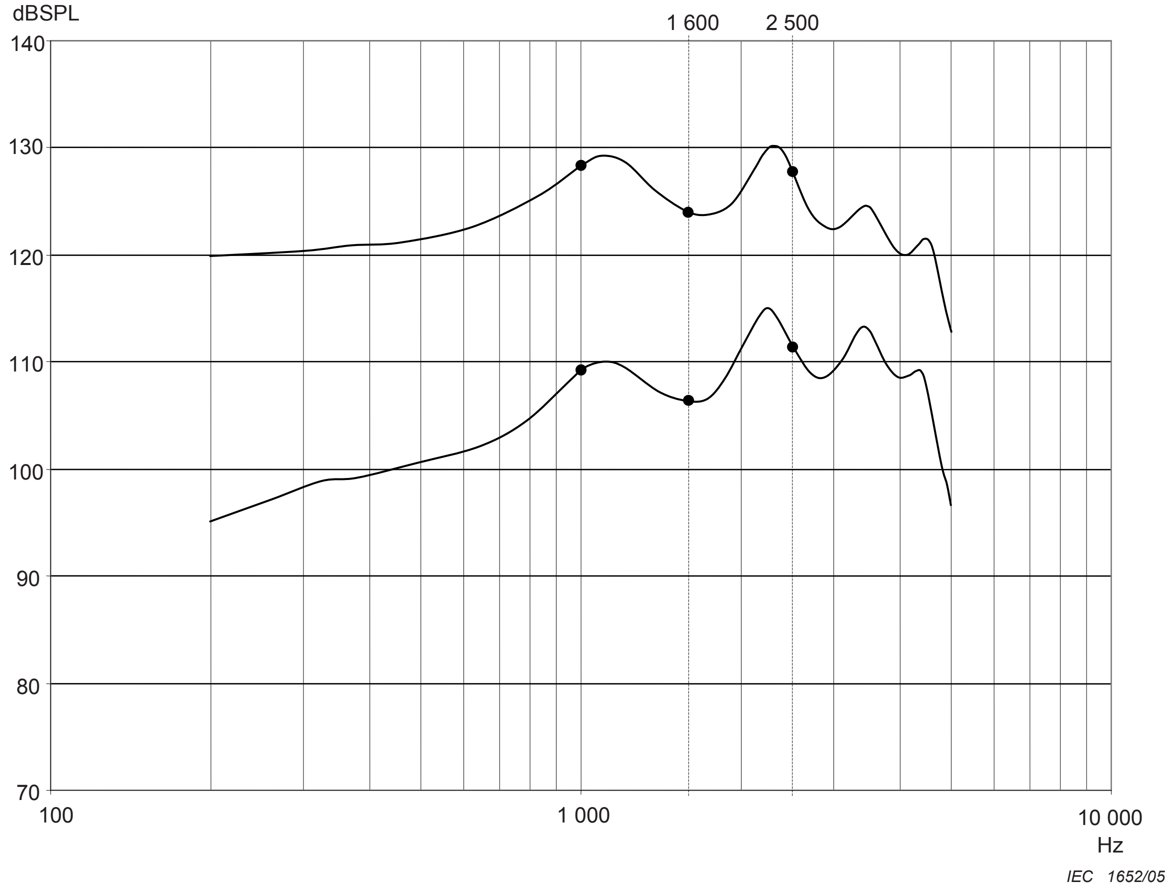


Figure 3 – Example of OSPL90 and basic frequency response curves

8.3 Full-on acoustic gain response curve

The test procedure is:

a) turn the gain control full-on and set other controls as stated in 7.3.3;

b) keeping the input sound pressure level constant at 50 dB, vary the frequency of the sound source over the frequency range from 200 Hz to 5 000 Hz and measure the sound pressure level in the acoustic coupler versus frequency; record the full-on gain frequency response curve so obtained;

c) the full-on acoustic gain is recorded as the difference obtained by subtracting 50 dB from the acoustic coupler SPL versus frequency;

d) obtain from above data the maximum full on gain and the HFA-FOG.

Tolerance:

average full-on gain:	within nominal value ±5 dB.
maximum full-on gain:	nominal value shall not be exceeded by more than 3 dB.

8.4 Basic frequency response curve at reference test gain setting

8.4.1 Test procedure

a) set the gain control to the RTS and set other controls as stated in 7.3.3;

b) keeping the input sound pressure level constant at 60 dB, vary the frequency of the sound source over the frequency range from 200 Hz to 5 000 Hz and measure the sound pressure level in the acoustic coupler versus frequency; record the basic frequency response curve so obtained;

c) record the basic frequency response curve by varying the frequency of the sound source at least over the frequency range 200 Hz to 5 000 Hz keeping the input SPL constant.

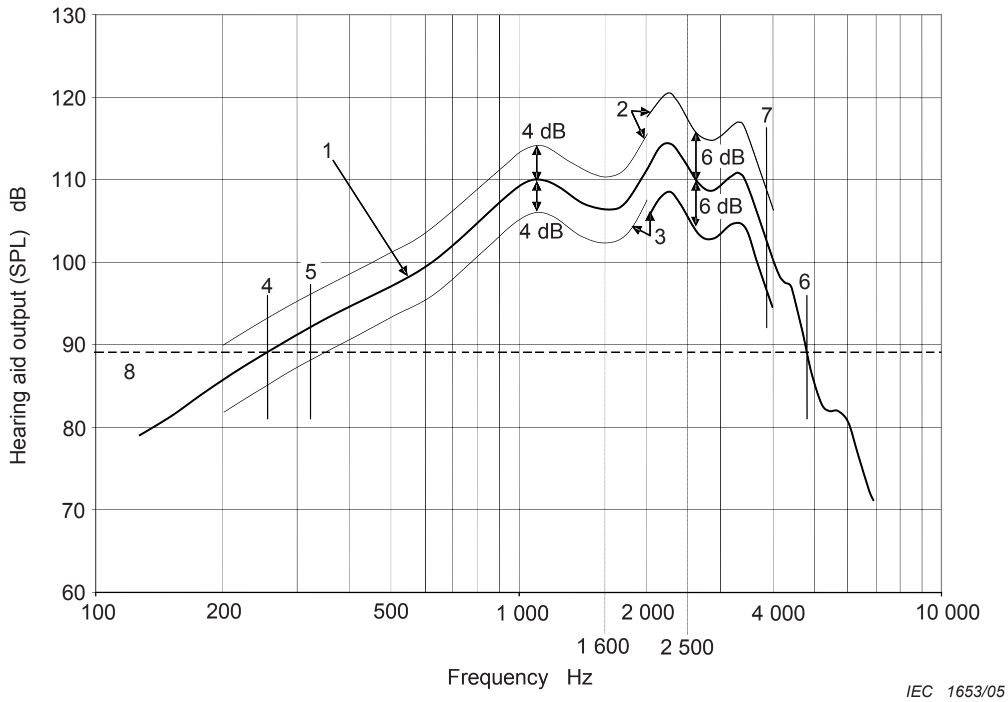
8.4.2 Bandwidth

a) obtain from the above measurement, the HFA output level;

b) determine the lowest (f_1) and highest (f_2) frequencies at which the frequency response curve has the value of HFA output level minus 20 dB (Figure 4);

c) the bandwidth is assigned to being from f_1 to f_2.

NOTE If f_1 and f_2 cannot be determined because they would fall below 200 Hz or above 5 000 Hz, they may be shown as <200 Hz and >5 000 Hz respectively.



Key

1 specified response curve for the model

2 upper limit

3 lower limit

4 f_1

5 1,25 f_1 (but not less than 200 Hz)

6 f_2

7 0,8 f_2 (but not more than 4 000 Hz)

8 the output level 20 dB lower than the HFA output level

Figure 4 – Example of basic frequency response curve, its tolerances and determination of frequency range

8.4.3 Tolerances of the frequency response

The tolerance is split into two ranges (see Table 2).

Table 2 – Tolerances of the frequency response

Frequency range	Tolerance
Low : 1,25 f_1 or 200 Hz (whichever is higher) to 2 000 Hz	±4 dB of nominal frequency response curve
High : 2 000 Hz to 4 000 Hz or 0,8 f_2 (whichever is lower)	±6 dB of nominal frequency response curve

8.4.4 Reference test gain

Report the reference test gain as the HFA gain with the gain control at RTS and an input SPL of 60 dB. The reference test gain shall be stated for information purposes only.

8.5 Battery current

Set the gain control to the RTS and set other controls as stated in 7.3.3. Measure the current with an input sound pressure level of 65 dB at 1 kHz.

Tolerance of battery current: battery current shall not exceed nominal value plus 20 %.

8.6 Total harmonic distortion

The test procedure is:

a) set the gain control to the RTS and set other controls as stated in 7.3.3;

b) measure and state total harmonic distortion in percent at the frequencies and levels as outlined in Table 3 (the frequencies actually used shall be stated):

Table 3 – Distortion test frequencies and input sound pressure levels

Distortion test frequency		Input SPL
500 Hz	or half the lowest frequency used for the SPA	70 dB
800 Hz	or half the middle frequency used for the SPA	70 dB
1 600 Hz	or half the highest frequency used for the SPA	65 dB

c) in the event the specified frequency response curve rises 12 dB or more between any distortion test frequency and its second harmonic, distortion tests at that frequency may be omitted;

d) measurements below 200 Hz are not required.

NOTE Care should be taken when measuring the total harmonic distortion, because errors can be caused by spurious signals, for example noise and hum.

Tolerance of harmonic distortion: The value shall not exceed the nominal value in percent plus 3 %.

Example:

nominal value: 5 %

maximum value: 8 %

8.7 Equivalent input noise

The test procedure is:

a) set the gain control to RTS and set other controls as stated in 7.3.3;

b) determine the HFA output for an input SPL of 50 dB;

c) switch off the input sound source;

d) measure the total steady state output noise sound pressure level using a measurement bandwidth of 200 Hz to 5 000 Hz and an averaging time of at least 0,5 s;

e) calculate the equivalent input noise level according to the following formula:

equivalent input noise = (total output noise SPL) minus (HFA gain for an input SPL of 50 dB)

If low-level expansion is active in the hearing aid during the measurement, this condition shall be stated by the manufacturer.

Tolerance of equivalent input noise: the value shall not exceed the nominal value plus 3 dB.

8.8 Additional measurements for hearing aids having induction pick-up coil

All measurements shall be made in a vertical magnetic field with the hearing aid placed as normally worn on the ear.

8.8.1 Equivalent test loop sensitivity (ETLS)

The test procedure is:

a) set the gain control to RTS and set other controls as stated in 7.3.3;

b) for a magnetic input of 31,6 mA/m and the input selector of the hearing aid in T-position measure and calculate the HFA-SPLI;

c) calculate the equivalent test loop sensitivity as ETLS = HFA-SPLI – (RTG + 60 dB).

Tolerance of the equivalent test loop sensitivity: the value shall not exceed the nominal value ±4 dB.

8.8.2 Maximum HFA magneto-acoustical sensitivity level (HFA MASL) of induction pick-up coil

The test procedure is:

a) turn the gain control full-on and set other controls as stated in 7.3.3;

b) adjust the magnetic input to –40 dB re 1 A/m (= 10 mA/m);

c) with the hearing aid oriented for maximum pick-up sensitivity, determine HFA output SPL = “D” ;

d) calculate the HFA maximum magneto-acoustical sensitivity level (MASL), expressed as the HFA output SPL for a magnetic field strength of –60 dB re 1 A/m (=1 mA/m), according to the formula: MASL = D – 20 (dB).

Tolerance of HFA MASL: The value shall not deviate from the nominal value by more than ±6 dB.

8.9 Additional measurements applying to AGC hearing aids

8.9.1 General

These measurements shall be performed at 2 000 Hz and may also be performed at one or more of the following test frequencies:

250 Hz, 500 Hz, 1 000 Hz, 4 000 Hz.

The selected frequencies shall be stated by the manufacturer.

8.9.2 Steady state input-output characteristics

The test procedure is:

a) set gain control to RTS and set other controls as stated in 7.3.3;
b) measure the acoustic coupler SPL for input sound pressure levels in the range from at least 50 dB to 90 dB, in steps not greater than 5 dB, at each of the selected AGC test frequencies;
c) plot the output SPL versus input SPL; use linear dB scales and same size divisions for ordinate and abscissa.

Tolerance of steady state input-output characteristics:

a) the measured curve and the nominal curve shall be normalized at an input sound pressure level of 70 dB;
b) the max. deviation at input sound pressure levels of 50 dB and 90 dB input shall not deviate by more than ±5 dB.

Duration of each of the steps should be sufficiently long to allow output signal to reach steady state conditions.

8.9.3 Dynamic AGC characteristics (attack- and release time)

The test procedure is:

a) set gain control to RTS and set other controls as stated in 7.3.3;
b) select an AGC test frequency with the input sound pressure level alternating between 55 dB and 90 dB;
c) measure acoustic coupler SPL over time; the duration at each level has to be sufficiently long to allow output signal to reach steady state conditions;

   NOTE To display the output signal over time an oscilloscope may be connected to the measuring amplifier.

d) determine attack time from time plot of the envelope of acoustic output;

   The attack time is defined as the time span from the level change from 55 dB to 90 dB SPL to the point where the signal has stabilized within 3 dB;

e) determine release time from time plot of the envelope of acoustic output;

The release time is defined as the time span from the level change from 90 dB to 55 dB SPL to the point where the signal has stabilized to within 4 dB.

Tolerance of attack- and release times: the attack- and release time shall not exceed the larger of either ±5 ms or ±50 % of the nominal value.

9 Maximum permitted expanded uncertainty of measurements

The following table specifies the maximum permitted expanded uncertainty for a coverage factor of k = 2, associated with the measurements undertaken in this standard.

The expanded uncertainties of measurement given in Table 4 are the maximum permitted for demonstration of conformance to the requirements of this standard.

If the actual expanded uncertainty of a measurement exceeds the maximum permitted value in Table 4, the measurement shall not be used to demonstrate conformance to the requirements of this standard.

Table 4 – Values of U_{max} for basic measurements

Measured quantity	U_{max}
Sound pressure level 200 Hz to 4 000 Hz	1,0 dB
Sound pressure level greater than 4 000 Hz	1,5 dB
Magnetic Field Strength level	1,0 dB
Frequency	0,5 %
Total harmonic distortion	0,5 %
Temperature	0,5 °C
Relative humidity	5 %
Ambient pressure	0,1 kPa

The measurement uncertainty is composed of several factors:

– uncertainty of equipment used, such as sound generators, level meters, measuring microphones, coupler etc.;

– tolerances of the acoustic coupling of the hearing aid to the coupler. Such tolerances could be related to diameter and length of tubing;

– accuracy and care of positioning the hearing aid in the test space.

Considering the above factors the measurement uncertainty can be determined.

NOTE It is good practice to validate the uncertainty by comparing measurement results with an accredited test laboratory.

The interpretation of the measurement uncertainty is different for the manufacturer, who has to guarantee the nominal data, and the purchaser.

Manufacturer production test limits: tolerance minus measurement uncertainty. Purchaser measurement acceptance limits: nominal data plus measurement uncertainty.

Bibliography

IEC 60068 (all parts), *Environmental testing*

NOTE Harmonized in the EN 60068 series (not modified).

IEC 60118-0, *Hearing aids – Part 0: Measurement of electroacoustical characteristics*

NOTE Harmonized as EN 60118-0:1993 (not modified).

IEC 60118-1, *Hearing aids – Part 1: Hearing aids with induction pick-up coil input*

NOTE Harmonized as EN 60118-1:1995 (not modified).

IEC 60118-2, *Hearing aids – Part 2: Hearing aids with automatic gain control circuits*

NOTE Harmonized as EN 60118-2:1995 (not modified).

BIPM, IEC, IFCC, ISO, IUPAC, IUPAP,OIML:1995, *Guide to the expression of uncertainty in measurement (GUM)*

ANSI S3.22, *Specification of hearing aid characteristics*

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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.

NOTE Where an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60318-5	- [1)]	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	-	-

1) At draft stage.

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