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INTERNATIONAL STANDARD

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colour inside

Electroacoustics – Audio-frequency induction loop systems for assisted hearing –
Part 1: Methods of measuring and specifying the performance of system components

Électroacoustique – Systèmes de boucles d'induction audiofréquences pour améliorer l'audition –
Partie 1: Méthodes de mesure et de spécification des performances des composants de systèmes

IEC 62489-1:2010

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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Tél.: +41 22 919 02 11
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Part 1: Methods of measuring and specifying the performance of system components

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

CDV	Report on voting
29/667/CDV	29/668/RVC

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.

This part is to be used in conjunction with IEC 60118-4:2006, *Electroacoustics – Hearing aids – Part 4: Induction loop systems for hearing aid purposes – Magnetic field strength.*

A list of all the parts in the IEC 62489 series, under the general title *Electroacoustics – Audio-frequency induction loop systems for assisted hearing*, can be found on the IEC website.

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

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ELECTROACOUSTICS – AUDIO-FREQUENCY INDUCTION LOOP SYSTEMS FOR ASSISTED HEARING –

Part 1: Methods of measuring and specifying the performance of system components

1 Scope

This part of the IEC 62489 series applies to the components of audio-frequency induction-loop systems for assisted hearing. It may also be applied to such systems used for other purposes, as far as it is applicable. This standard is intended to encourage accurate and uniform presentation of manufacturers' specifications, which can be verified by standardized methods of measurement. It is intended for type testing.

The components considered are the following:

– amplifiers;
– microphones;
– other components, such as playback equipment.

This standard does not deal with safety, for which IEC 60065 applies. It also does not deal with EMC (Electromagnetic compatibility) and EMF (Electromagnetic fields, in the context of human exposure).

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 60118-4:2006, *Electroacoustics – Hearing aids – Part 4: Induction loop systems for hearing aid purposes – Magnetic field strength*

IEC 60268-1:1985, *Sound system equipment – Part 1: General*

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

IEC 60268-3:2000, *Sound system equipment – Part 3: Amplifiers*

IEC 60268-4:2004, *Sound system equipment – Part 4: Microphones*

IEC 61938, *Audio, video and audiovisual systems – Interconnections and matching values – Preferred matching values of analogue signals*

ISO/IEC Guide 98-3, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms and definitions

For the purposes of this document, the following definition applies.

3.1
useful magnetic field volume
volume within which the system provides hearing-aid users with a signal of acceptable quality (see 6.7 of IEC 60118-4:2006)

4 Rated values

The term “rated” means the value stated by the manufacturer. Rated values are of two kinds; rated conditions, fundamental values that can be determined only by the manufacturer, and others that can be measured. See 5.2.1. For a full explanation, see IEC 60268-2.

5 Amplifiers

5.1 General

In most systems, the amplifier(s) accepts input from microphone(s) and delivers current to the induction loop(s). If there are separate preamplifier or mixer and final amplifier components, the methods described can be used with the interpretation that input signals are applied to the preamplifier or mixer and measurements of output characteristics are made at the output of the final amplifier.

The characteristics to be specified are consistent with the lists in Annex C of IEC 60118-4:2006.

NOTE For characteristics not mentioned in this standard, the provisions of IEC 60268-3 can be applied, with the provisions of 5.2 of this standard replacing those of 3.1 of IEC 60268-3:2000.

5.2 Rated conditions and standard measuring conditions

5.2.1 Rated conditions

The rated conditions for amplifiers are the following:

- rated power supply voltage;
- rated source impedance;
- rated source e.m.f. (electromotive force);
- rated load;
- rated temperature-limited output current;
- rated maximum time for delivery of rated distortion-limited output current (see below);
- rated total harmonic distortion of the output current;
- rated mechanical and climatic conditions.

NOTE 1 Total harmonic distortion and (distortion-limited) output current are interdependent. Both cannot be taken as rated conditions simultaneously because normally a given sample amplifier produces less than rated total harmonic distortion at rated output current.

NOTE 2 If the power supply frequency is critical, it is also a rated condition.

NOTE 3 The rated temperature-limited output current and the rated maximum time for delivery of rated distortion-limited output current need not be included in published specifications, provided they are supplied on request.

To obtain the correct conditions for measurements, the values for the above-mentioned rated conditions shall be taken from the manufacturer's specification. These values themselves are

not subject to verification, but they constitute the basis for measuring the other characteristics.

Methods of measurement for these other characteristics are given in this standard and the manufacturer is required or permitted to state rated values for these characteristics in the specification of the equipment. These include

- rated maximum distortion limited output current;
- rated equivalent noise source e.m.f., or a measure of noise performance related to it.

An amplifier, considered as a four-terminal network with regard to a specified pair of input terminals and a specified pair of output terminals, shall be understood to be working under rated conditions when the following conditions are fulfilled:

a) the amplifier is connected to its rated power supply;

b) the source e.m.f. is connected in series with the rated source impedance to the input terminals;

c) the output terminals are terminated with the rated load;

d) the terminals which are not used during the measurement are terminated, if necessary, as specified by the manufacturer;

e) the source e.m.f. is a sinusoidal voltage equal to the rated source e.m.f. at 1 000 Hz according to IEC 60268-1;

f) the volume control, if any, is set to such a position that the rated distortion-limited output current appears at the output terminals;

g) the tone controls, if any, are set to a specified position to give as flat a frequency response as possible;

h) other controls, if any, are set to their normal positions as specified by the manufacturer;

i) the climatic conditions given in Clause 8 of IEC 60268-1:1985 are complied with.

Amplifiers for which the rated distortion-limited output current exceeds the rated temperature-limited output current are likely to be subject to unacceptable effects when operated under rated conditions for an extended period of time. For these amplifiers, rated conditions shall be maintained for no longer than can be tolerated by the amplifier.

5.2.2 Standard measurement conditions

Standard measurement conditions are obtained by bringing the amplifier under rated conditions (see 5.2.1) and then reducing the output current to a level of –10 dB referred to the rated output current.

NOTE 1 Since testing for temperature rise is carried out according to IEC 60065 under conditions normally requiring an input source e.m.f. greater than that specified above, it is not expected that amplifier would overheat under standard measuring conditions.

NOTE 2 Many amplifiers have an output current control that can be adjusted for the above purpose. For an amplifier without such a control, the source e.m.f. can be adjusted instead.

5.3 Pre-conditioning

Immediately before any measurements are made, the amplifier shall be operated under standard measuring conditions for at least 10 min. The measurements may be made in any order.

5.4 Characteristics to be specified, methods of measurement and presentation of results

NOTE 5.4.1 to 5.4.5 describe rated conditions, which can be determined only by the manufacturer. See 5.2.1.

5.4.1 Rated source impedance

5.4.1.1 Characteristic to be specified

For each input, the internal impedance of the signal source, or range of acceptable impedances, stated by the manufacturer. This is a rated condition.

NOTE The relevant provisions of IEC 61938 should be applied.

5.4.1.2 Presentation of results

The value or range shall be stated in ohms or a suitable SI multiple, and is assumed to be a pure resistance unless otherwise stated.

5.4.2 Rated source e.m.f.

5.4.2.1 Characteristic to be specified

For each input, the e.m.f. of the signal source, stated by the manufacturer, which, when connected through the rated source impedance to the input, produces rated output current into the rated load impedance, with all controls set as specified in 5.2.1. This is a rated condition.

NOTE The signal levels and impedance values given in IEC 61938 should be applied.

5.4.2.2 Presentation of results

The value for each input shall be stated in volts or millivolts, or as a level in decibels referred to 1 V or 0,775 V. See IEC 60268-1.

5.4.3 Rated load

5.4.3.1 Characteristic to be specified

The load, stated by the manufacturer, to which the amplifier output shall be connected for measurement purposes. This is a rated condition.

NOTE 1 Example of values for typical loops are given in Annex B.

NOTE 2 It is essential that both the resistor and the inductor do not introduce amplitude distortion, and are able to carry the output current without overheating or changing in value. The inductor can usually be made as an air-cored component of acceptable size for use in measurements.

5.4.3.2 Presentation of results

The load shall be stated as a series combination of resistance and inductance.

5.4.4 Rated temperature-limited output current

5.4.4.1 Characteristic to be specified

The maximum output current, stated by the manufacturer, that can be delivered for an indefinite period to the rated load without unacceptable effects. This is a rated condition.

5.4.4.2 Presentation of results

The value is expressed in amperes.

5.4.5 Rated time for delivery of rated distortion-limited output current

5.4.5.1 Characteristic to be specified

The time, stated by the manufacturer, for which rated distortion-limited output current can be delivered to the rated load without unacceptable effects.

5.4.5.2 Presentation of results

The value is expressed in seconds or minutes.

NOTE A value of less than 30 s is likely to make some measurements difficult.

5.4.6 Rated total harmonic distortion of the output current

5.4.6.1 Characteristic to be specified

The value of total harmonic distortion, stated by the manufacturer, which is not exceeded when delivering the rated maximum (distortion-limited) current to the rated load. This is a rated condition.

5.4.6.2 Presentation of results

The value shall be stated as a percentage of the total output current or as a level in decibels referred to that current.

5.4.7 Maximum (distortion-limited) output current

5.4.7.1 Characteristic to be specified

The maximum current, produced by a sinusoidal input signal at 1 kHz, deliverable for at least 10 s into the rated load without exceeding the rated total harmonic distortion (THD).

NOTE The value of 10 s is chosen as long enough to make the measurement, while not so long as to cause damage through unacceptable effects. See 5.4.4 and 5.4.5.

5.4.7.2 Method of measurement

With the amplifier initially working under standard measuring conditions, the load current is increased (by adjusting the loop current control, if fitted, or the source e.m.f. if not) until the total harmonic distortion measured, as specified in IEC 60268-3, across the resistive part of the load, is equal to the rated value. The current is then calculated from the total voltage across the resistive part of the load and the resistance value.

NOTE It is usual for neither end of the load resistor to be at signal common potential, so it is necessary to make a balanced floating connection of the THD meter to the resistor. Alternatively, a current transformer or clip-on current probe may be used, provided its own harmonic distortion is negligible.

5.4.7.3 Presentation of results

The result shall be stated in amperes.

5.4.8 Compliance voltage

5.4.8.1 Characteristic to be specified

The average, divided by $\sqrt{2}$, of the maximum positive-going and negative-going peak voltages that the amplifier can deliver to the rated load when the signal is a specified pink-noise signal.

5.4.8.2 Method of measurement

a) With the amplifier working under standard measuring conditions, the loop current is increased to achieve the maximum output current as defined in 5.4.5. The value of this current is noted.

NOTE 1 The measurement should be made as quickly as possible. See 5.4.4 and 5.4.5.

b) An input signal is applied, in accordance with the following specification.

The signal shall be bandwidth limited, with a peak-to-peak voltage (as measured with an oscilloscope) to true RMS voltage ratio of 18 dB ± 2 dB (crest factor = 4), with a third-octave-band spectrum flat within ± 1 dB from 100 Hz to 5 kHz.

Bandwidth limitation shall be carried out by means of at least third-order Butterworth high pass and low pass filters giving –3 dB responses at 75 Hz and 6,5 kHz.

NOTE 2 This specification is given to ensure that the test signal stimulates the system in a manner similar to normal speech.

NOTE 3 The tolerance of ±1 dB is necessary because the theoretical responses of the specified 3rd order Butterworth filters are –0,8 dB at 100 Hz and –0,7 dB at 5 kHz, and component tolerances affect the exact values.

c) The input signal level is adjusted so that automatic gain control (AGC), if fitted, is fully in operation, or until the RMS output current is 6 dB below the maximum output current, measured in step a) above. The positive and negative peak voltages across the load are then measured, over a period of at least 60 s, using a digital oscilloscope (more than 50 000 samples per second or with a bandwidth of more than 25 kHz). The magnitudes of the positive and negative voltages are then arithmetically averaged.

NOTE 4 If possible, a digital oscilloscope with peak capture should be used. The oscilloscope display should be examined to detect any undesirable effect, such as a blocking on peaks of signal.

d) The averaged peak voltage is divided by √2 to derive an equivalent sine-wave r.m.s. voltage, which is recorded as the result.

NOTE 5 For amplifiers with a low-side current-sense resistor of less than 100 mΩ, the measurement can be made from the non-earthy output terminal to functional earth, because the magnitude and phase of the current-sensing signal across the sensing resistor has a negligible effect on the result.

5.4.9 Noise

5.4.9.1 Characteristic to be specified

The equivalent input noise voltage, that is, the 1 kHz sinusoidal input voltage that would produce the same output current as the amplifier noise produces under the conditions specified below.

NOTE This characteristic is chosen because it is independent of the gain (transconductance) of the amplifier. To determine the output current due to noise under a particular condition, multiply the equivalent input noise by the gain under that condition.

Alternatively, the signal-to-noise ratio, expressed as the ratio in decibels of the rated output current to the output current due to noise, measured as specified below, may be specified.

5.4.9.2 Method of measurement

With the amplifier working under standard measuring conditions, the source e.m.f. of a 1 kHz sinusoidal signal is reduced until no AGC action is taking place. If the amplifier has noise gating or low-level volume expansion, the source e.m.f. is adjusted to a value at which a change of input level of 2 dB produces a change of level of output current as close to 2 dB as possible. The source e.m.f., U, and the output current, I, are then measured. The source e.m.f.