IEC 60118-4

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INTERNATIONAL STANDARD

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Electroacoustics – Hearing aids – Part 4: Induction-loop systems for hearing aid purposes – System performance requirements

Électroacoustique – Appareils de correction auditive – Partie 4: Systèmes de boucles d'induction utilisées à des fins de correction auditive – Exigences de performances système

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ELECTROACOUSTICS – HEARING AIDS –

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FOREWORD

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International Standard IEC 60118-4 has been prepared by IEC technical committee 29: Electroacoustics.

This third edition cancels and replaces the second edition published in 2006. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition: Addition of Annexes G, H and I where more information is provided about practical considerations and methods of measurement.

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

FDIS	Report on voting
29/855/FDIS	29/861/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 of 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 publication will remain unchanged until the stability 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

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- withdrawn,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

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INTRODUCTION

Audio-frequency induction-loop systems are widely used to provide a means for hearing aid users, whose hearing aids are fitted with induction pick-up coils, generally known as 'telecoils', to minimise the problems of listening when at a distance from a source of sound, shielded from the person speaking by a protective window, and/or in a background noise. Background noise and distance are two of the main causes of hearing aid users being unable to hear satisfactorily in other than face-to-face quiet conditions. Induction-loop systems have been widely installed in churches, theatres and cinemas, for the benefit of hearing-impaired people. The use of induction-loop systems has been extended to many transient communication situations such as ticket offices, bank counters, drive-in/drive-through service locations, lifts/elevators etc. The widespread provision of telephone handsets that provide inductive coupling to hearing aids is another significant application, where ITU-T Recommendation P370 [1][1] applies.

Transmission of an audio-frequency signal via an induction-loop system can often establish an acceptable signal-to-noise ratio in conditions where a purely acoustical transmission would be significantly degraded by reverberation and background noise.

One form of audio frequency induction-loop system comprises a cable installed in the form of a loop usually around the perimeter of a room or area in which a group of hearing impaired persons wish to listen. The cable is connected via an amplifier to a microphone system or other source of audio signal, such as a radio receiver, CD player etc. The amplifier produces an audio-frequency electric current in the induction loop cable, causing a magnetic field to be produced inside the loop. The design and implementation of the induction loop is determined by the construction of the building in which it is installed, particularly by the presence of large amounts of iron, steel or aluminium in the structure. In addition the layout and position of electrical cables and equipment may generate high levels of background audio frequency magnetic fields that may interfere with the reception of the loop signal.

Another form of induction-loop system employs a small loop, intended for communication with a hearing-aid user in its immediate vicinity. Examples are: neck loops, ticket-counter systems, self-contained 'portable' systems and chairs incorporating induction loops. (See Annex A)

The pick-up device for an audio-frequency induction-loop system is usually a personal hearing aid, of a type fitted with a pick-up coil (telecoil); however, special induction loop receivers may be used in certain applications.

1 Numbers in square brackets refer to the Bibliography.

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1 Scope

This part of IEC 60118 is applicable to audio-frequency induction-loop systems producing an alternating magnetic field at audio frequencies and intended to provide an input signal for hearing aids operating with an induction pick-up coil (telecoil). Throughout this standard, it is assumed that the hearing aids used with it conform to all relevant parts of IEC 60118.

This standard specifies requirements for the field strength in audio-frequency induction loops for hearing aid purposes, which will give adequate signal-to-noise ratio without overloading the hearing aid. The standard also specifies the minimum frequency response requirements for acceptable intelligibility.

Methods for measuring the magnetic field strength are specified, and information is given on appropriate measuring equipment (see Annex B), information that should be provided to the operator and users of the system (see Annex C), and other important considerations.

This standard does not specify requirements for loop driver amplifiers or associated microphone or audio signal sources, which are dealt with in IEC 62489-1, or for the field strength produced by equipment, such as telephone handsets, within the scope of ITU-T P.370.

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 60268-3:2013, *Sound system equipment – Part 3: Amplifiers*

IEC 60268-10:1991, *Sound system equipment – Part 10: Peak programme level meters*

IEC 61672-1:2013, *Electroacoustics – Sound level meters – Part 1: Specifications*

IEC 62489-1:2010, *Electroacoustics – Audio-frequency induction-loop systems for assisted hearing – Part 1: Methods of measuring and specifying the performance of system components*

3 Terms and definitions

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

3.1
reference magnetic field strength level
level of 0 dB referred to a magnetic field strength of 400 mA/m

Note 1 to entry: This is measured as specified in 8.2.

3.2
useful magnetic field volume
volume (of 3-dimensional space) within which the system provides hearing-aid users with a signal of acceptable quality (see 8.4)

Note 1 to entry: In the first edition of this standard, the concept of 'specified magnetic field area' was defined, because that edition did not consider the very important 'height' dimension (the perpendicular distance between the hearing aid pick-up coil and the plane of the loop). See Annex E.

Note 2 to entry: The base area of the useful magnetic field volume is often different from the plan area of the induction loop.

3.3
telecoil
inductor with an open magnetic circuit, intended for detecting the magnetic fields of audio-frequency induction-loop systems

4 General

4.1 Procedure for setting up and commissioning an audio-frequency induction loop system

The flow chart in Figure 1 shows the sequence of operations detailed in this standard.

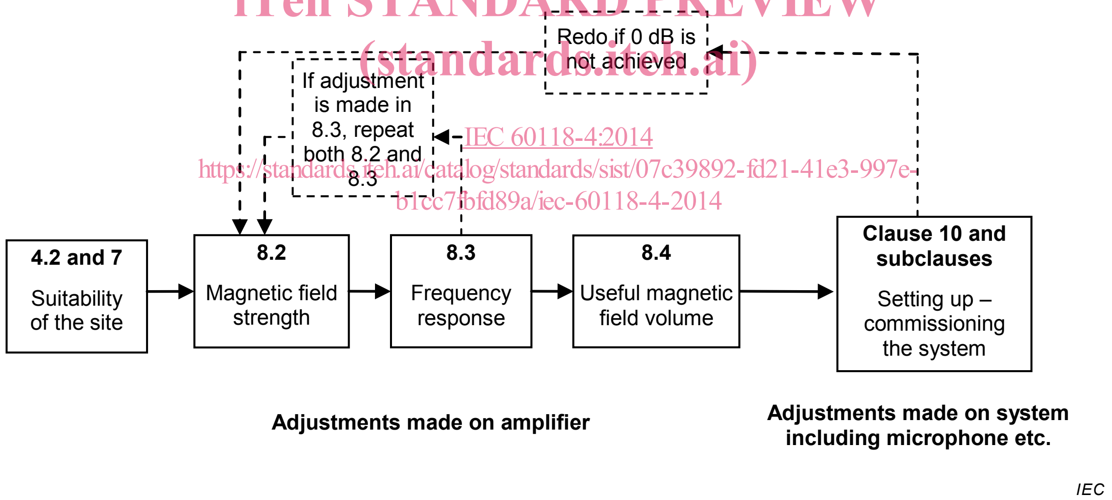

Figure 1 – Flow chart for the operations in this standard

4.2 Suitability of the site for the installation of an audio-frequency induction-loop system

It may not be possible to obtain acceptable conditions for an induction-loop system in all places where it is desirable. It is therefore essential, ***in the planning stage***, to examine a proposed location with respect to the following conditions:

- the magnetic noise level from electric installations, e.g. heating systems in the floor or roof, the electrical control of lighting systems (especially in theatres), (see Clause 7);
- the influence of magnetizable and electrically-conducting materials in the structure in which the loop is intended to be installed;
- the presence of other induction-loop systems in the neighbourhood, the signals of which may interfere with that of the planned loop system.

NOTE Techniques exist to reduce the magnetic field strength outside an induction loop, but previously-installed systems may not be so designed.

4.3 Relation of the magnetic field strength level at the telecoil to the sound pressure level at the microphone.

An acoustic input sound pressure level of 70 dB and a long-term average magnetic field strength level ($L_{eq,60\ s}$) of −12 dB ref. 400 mA/m, i.e. 100 mA/m, at the telecoil in a hearing aid are assumed to give the same acoustic output level.

5 Using components of a sound system in an induction-loop system

5.1 General

It may seem economically attractive to derive signals for an induction-loop system from a sound system serving the same space, but it may not be technically straightforward.

5.2 Microphones

Microphones for a sound system may not be positioned at the optimum places to obtain a signal as free as possible from ambient acoustic noise and reverberation. It is essential to listen to the signal, preferably with high-quality headphones, to assess its suitability. This should be done for all microphone signals that the sound system can produce in different modes or configurations.

5.3 Mixer

The signal for the induction-loop system shall be taken from the mixer at a point where the level of that signal is controlled independently from the signal level in the chain leading to the loudspeakers of the sound system.

5.4 Power amplifier

It is possible that a suitable signal can be obtained from the output of a power amplifier, but such a signal can be satisfactory only if it is applied to an induction-loop amplifier provided with an input of appropriate sensitivity and impedance, and with automatic gain control of a range sufficient to accommodate changes in the signal level in the sound system.

In general, it is not advisable to attempt to derive from a sound system a signal suitable for connection directly to an induction loop. Such an interconnection must be individually designed to suit the electrical characteristics of the sound system and the loop system.

6 Meters and test signals

6.1 Meters

6.1.1 Meters in general

For historical reasons, two types of magnetic field strength meter are in use, and it is not practicable to disallow the use of either of them. The results of measurements with the two types of meters are exactly equal only for sinusoidal signals but in most cases the differences are not so large as to cause serious problems. Indications are given in this standard of differences that may be expected in some cases. In case of doubt, the result of measurement with the meter specified in 6.1.3 shall be definitive.

6.1.2 Requirements common to both types

The meter shall have a frequency response flat within ± 1 dB from 50 Hz to 10 kHz, falling at an ultimate rate of at least 6 dB/octave outside this range. A-weighting shall also be provided. The frequency response in A-weighted mode shall conform, within the frequency band 100 Hz to 5 kHz, to those for a Class 2 meter specified in IEC 61672-1. Other features can also be provided, such as other weighting characteristics.

6.1.3 True-r.m.s. meter

This meter was derived from the IEC sound level meter specified in IEC 61672-1 by replacing the microphone by a magnetic pick-up coil and an amplifier with frequency response correction. This meter has a true-r.m.s. detector and a 125 ms averaging time constant in 'F' mode.

A useful additional feature is a peak-hold indication.

6.1.4 Peak programme meter (PPM)

This meter was derived from the PPM Type II specified in IEC 60268-10 by adding a magnetic pick-up coil, usually together with a modern display (preferably a 'bar' type) in place of the original moving-coil pointer instrument.

It shall have dynamic responses conforming to the relevant requirements of IEC 60268-10, i.e. an attack time-constant of approximately 5 ms and a release time-constant of approximately 1,0 s.

6.2 Test signals in general

It is possible to use several different types of test signal for the setting-up and measurement of the frequency mid-band value (in case of doubt, the average value over the octave band centred on 1 kHz) and the frequency response of the magnetic field strength. However, some signals are not suitable for some purposes, and the suitability depends on the amplitude characteristic of the amplifier in the system (see IEC 62489-1). Table 1 shows the range of applications of the specified test signals. The test signal specified by the amplifier manufacturer shall be used, unless the use of a different signal can be justified.

Table 1 – Application of signals

Clause number and measurement in this standard (unless otherwise specified)	Sine wave	Pink noise	Simulated speech	Reference speech	Combi	Other
IEC 62489-1 Amplitude characteristic	Y	N	N	N	Y	N
7.1 Magnetic noise level	N	N	N	N	N	Y (no signal)
8.2 Magnetic field strength	Y	Y	Y	Y	Y	N
8.3 Frequency response	Y	Y	See Note to 8.3.2	N	Y	N
10.1 Commissioning the system	N	N	N	Y	N	Y (real signals)

The use of a wideband signal and wideband meter to determine the achievement of the reference magnetic field strength requires a special procedure to prevent serious errors. First the magnetic background noise level shall be measured, to ensure sufficient signal to noise ratio, followed by the frequency response of the wanted magnetic field, after making any adjustments to the amplifier controls so as to achieve the flattest possible response. The achievement of the reference magnetic field strength can then be determined.

The frequency-response controls are set to achieve the flattest possible response, otherwise it is possible that the reference magnetic field strength is not achieved at 1 kHz. Particularly in rooms with metal reinforcement, this may cause considerable errors. Also, if the signal-to-noise ratio is not sufficient, particularly if there are strong components in the noise, this method may not be accurate.

6.3 Speech signals

6.3.1 Live speech signals

Live speech is suitable only for use as a test signal for the final verification (commissioning) of the operation of an induction-loop system. However, live speech is an essential element in the subjective assessment of loop systems.

6.3.2 Recorded speech material

Speech that has been recorded under controlled conditions and evaluated both subjectively and objectively may be used for test purposes. See also B.2.1.

6.3.3 Simulated speech material

6.3.3.1 General

Simulated or synthetic speech material contains the features of speech in terms of its amplitude, frequency components and temporal characteristics, but has no recognizable intelligibility.

6.3.3.2 ITU-T P.50

ITU-T P.50 [2] is accompanied by a CD containing a standardized form of synthetic speech. See also B.2.2.

6.3.3.3 Reference speech signal

The ISTS (International Speech Test Signal) [3] is recommended for making objective measurements. It was developed by EHIMA (European Hearing Instrument Manufacturers' Association) is derived from 21 female speakers in six different mother tongues (American English, Arabic, Chinese, French, German and Spanish) and is based on natural recordings but is largely non-intelligible because of segmentation and remixing. This was then analysed and compared to the original recordings in respect of different criteria (involving many time, frequency and amplitude distributions) and found to be entirely representative.

6.4 Pink noise signal

The signal shall be bandwidth limited, with a peak-to-peak voltage (as measured with an oscilloscope) to true r.m.s. voltage ratio of at least 18 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 one-third-order Butterworth high pass and low pass filters giving −3 dB responses at 75 Hz and 6,5 kHz. See also B.2.3.

NOTE 1 This specification is given to ensure that the test signal stimulates the system in a manner similar to normal speech.

NOTE 2 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. This effect is taken into account in the method of measuring frequency response using the pink noise signal.

6.5 Sinusoidal signal

The signal source should provide at least the three frequencies 100 Hz, 1 kHz and 5 kHz (one at a time or simultaneously, or both), with less than 2 % total harmonic distortion in a 20 kHz bandwidth. The output voltage should be capable of being set to the ranges 0 mV to 10 mV