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Microphones and earphones for speech communications

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

MICROPHONES AND EARPHONES FOR SPEECH COMMUNICATIONS

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 61842 has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

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

FDIS	Report on voting
100/450/FDIS	100/479/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.

The committee has decided that the contents of this publication will remain unchanged until 2005. At this date, the publication will be

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- withdrawn;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

MICROPHONES AND EARPHONES FOR SPEECH COMMUNICATIONS

1 Scope

This standard applies to the microphone part and earphone part of handsets, headsets or earsets for speech communications, and also to the microphone units and earphone units of built-in handsets, headsets or earsets. The object of this standard is to establish definitions relating to these electroacoustic transducers, and to standardize the characteristics to be specified and the relevant methods of measurement. This does not exclude the use of other methods of measurement which can be shown to give the same or more reliable results.

2 Normative references

The following reference 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 60268-1:1985, *Sound system equipment – Part 1: General*

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

IEC 60268-7, *Sound system equipment – Part 7: Headphones and earphones*

IEC 60318-1, *Electroacoustics – Simulators of human head and ear – Part 1: Ear simulator for the calibration of supra-aural earphones*

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IEC 60603-11:1992, *Connectors for frequencies below 3 MHz for use with printed boards – Part 11: Detail specification for concentric connectors (dimensions for free connectors and fixed connectors)*

IEC 60711, *Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts*

IEC 61094-1, *Measurement microphones – Part 1: Specifications for laboratory standard microphones*

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

ITU-T P.51, *Artificial mouth*

ITU-T P.370, *Coupling hearing aids to telephone sets*

3 Terms and definitions

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

3.1 Classification

3.1.1

handset

assembly for speech communications, which is a handle including a microphone part and an earphone part suitable to be held by the talker's hand

3.1.2

headset

assembly for speech communications, which consists of a holder to put on the talker's head, one or two earphone parts and a microphone part, so as to keep the talker's hands free

3.1.3

earset

assembly for speech communications, which consists of an earphone part and a microphone part, so as to keep the talker's hands free, without a holder to put on the talker's head

NOTE The distinction between an earset and a headset is as complicated as it is between an earphone and a headphone. Table 1 explains the definitions of earphone, headphone, earset and headset used in this standard.

3.1.4

microphone for speech communications:

- a) part of a handset, an earset or a headset, which functions as a microphone (an acousto-electrical transducer)
- b) assembly of a microphone unit for speech communications and a case for measurement purposes, including acoustical circuit elements so as to obtain practical frequency characteristics

NOTE 1 A microphone for speech communications is understood to include devices, if any, such as amplifiers or impedance matching transformers up to the output terminals.

NOTE 2 A microphone for speech communications is called merely "microphone", or "microphone part" of a handset, of an earset or of a headset, in Clause 4 of this standard and beyond.

3.1.5

earphone for speech communications

- a) part of a handset, an earset or a headset, which functions as an earphone (an electro-acoustic transducer)
- b) assembly of an earphone unit for speech communications and a case for measurement purposes, including acoustical circuit elements so as to obtain practical frequency characteristics

NOTE 1 Any component which is intended by the manufacturer as an integral part of the earphone is included during measurements.

NOTE 2 An earphone for speech communications is called merely "earphone", or "earphone part" of a handset, of an earset or of a headset, in Clause 4 of this standard and beyond.

3.1.6

microphone unit for speech communications

acousto-electrical transducer installed in a handset, in an earset or in a headset to pick up the talker's speech in the vicinity of his/her mouth

NOTE The microphone unit for speech communications is called merely a "microphone unit" in Clause 4 of this standard and beyond.

3.1.7

earphone unit for speech communications

electroacoustic transducer installed in a handset, in an earset or in a headset to radiate sound signal in the vicinity of the listener's ear

NOTE The earphone unit for speech communications is called merely an "earphone unit" in Clause 4 of this standard and beyond.

3.1.8

case for unit measurement

case in which a microphone unit or an earphone unit for speech communications is installed for measurement. It includes additional acoustic circuit elements so as to obtain practical frequency characteristics, if necessary

3.2 Devices for measurement

3.2.1

mouthpiece holes

holes bored into the front of the enclosure of a microphone unit for speech communications, to receive the input sound

3.2.2

earcap holes

holes bored into the front of the enclosure of an earphone for speech communications, to radiate the output sound

3.2.3

artificial mouth

sound source for microphone measurement, which can produce the sound field similar to that around an ordinary human mouth

3.2.4

artificial ear

acoustic load for earphone measurement, whose acoustic impedance is similar to that of an ordinary human ear. It includes a microphone for measurement

3.2.5

lip ring

circular ring placed in front of the sound outlet of an artificial mouth for localizing the equivalent lip position

3.2.6

lip plane

outer plane of the lip ring, giving the reference point for finding the measuring position

3.2.7

external d.c. power supply

d.c. power supply for a microphone for speech communications including an amplifier or an electrical impedance converter circuit

3.2.8

additional resistance

electrical resistance for the earphone for speech communications which requires an external resistance for necessary adjustment of characteristics of the device

3.2.9

probe coil

coil for measurement of the external magnetic field of an earphone for speech communications

3.3 Characteristics and performance

3.3.1

sensitivity (V/Pa)

absolute value of the ratio between the open-circuit output voltage from a microphone for speech communications placed at a specified point in the sound field produced by the artificial mouth and the sound pressure in the undisturbed free field at a specified calibration point, the signal frequency being the reference frequency

NOTE Though the specified point for the microphone and the sound pressure calibration point should be identical in general, these points may be different according to this Standard.

3.3.2**sensitivity level (dB)**

twenty times the logarithm to base ten of the sensitivity divided by the reference sensitivity (1 V/Pa)

3.3.3**sensitivity to voltage (Pa/V)**

absolute value of the ratio between the sound pressure produced by an earphone for speech communications in the artificial ear and the voltage supplied to the earphone, the signal frequency being the reference frequency

3.3.4**sensitivity level to voltage (dB)**

twenty times the logarithm with a base of ten of the sensitivity divided by the reference sensitivity (20 μ Pa/V)

3.3.5**sensitivity to power (Pa²/W)**

absolute value of the ratio between mean square of the sound pressure produced by an earphone for speech communications in the artificial ear and the electrical power supplied to the earphone, the signal frequency being the reference frequency

3.3.6**sensitivity level to power (dB)**

ten times the logarithm with a base of ten of the sensitivity to power divided by the reference sensitivity (4×10^{-10} Pa²/W)

3.3.7**electrical impedance (Ω)**

absolute value of the internal impedance measured at the output terminals of a microphone for speech communications or the input terminals of an earphone for speech communications

NOTE The word "electrical" is added in this Standard to distinguish the electrical impedance from the acoustical or the mechanical impedance.

3.3.8**capacitance (nF)**

capacitance measured at the input terminal of the earphone for speech communications

NOTE The capacitance is relevant only to earphones including a piezoelectric transducer because an ordinary piezoelectric microphone includes an amplifier.

3.3.9**plane of magnetic field strength measurement**

a plane parallel to the earcap reference plane at a distance of 10 mm (see 4.2.7)

4 Characteristics and measuring procedures**4.1 General conditions**

IEC 60268-1 applies for the following items:

- 1) Units and system for measurement: IEC 60268-1, Clause 2.
- 2) Climatic conditions: IEC 60268-1, Clause 8.
- 3) Graphical presentation of data: IEC 60268-1, Clause 10.

4.2 Rated conditions

In order to perform measurements correctly and reproducibly, certain basic data, to be specified by manufacturer, are essential, and these are termed 'rated conditions'. For a full explanation of rated conditions, see IEC 60268-2.

4.2.1 Rated d.c. power supply voltage (V)

The d.c. power supply voltage for the microphone for speech communications.

4.2.2 Rated sinusoidal voltage (V)

The sinusoidal input voltage over the specified frequency range, under which the earphone for speech communications can operate in a linear mode continuously without any thermal or mechanical damage for a long time.

4.2.3 Rated sinusoidal power (W)

Electric power given by,

$$(U_s)^2 / Z_r$$

where

U_s is the rated sinusoidal voltage;

Z_r is the rated impedance.

4.2.4 Rated noise voltage (V)

The pink noise input voltage over the specified frequency range, under which the earphone for speech communications can operate in a linear mode continuously without permanent damage for a long time.

4.2.5 Rated noise power (W)

Electric power given by,

$$(U_n)^2 / Z_r$$

where

U_n is the rated noise voltage;

Z_r is the rated impedance.

4.2.6 Rated frequency range

Frequency range of a continuous input signal for a normal operation of a microphone or an earphone for speech communications.

4.2.7 Earcap reference plane

Plane formed by the contacting points of a flat surface against the earcap of a handset, an earset or a headset, or by the front plane of the case for earphone unit measurement.

NOTE Partly similar to the definition in ITU-T P.10 (see Bibliography).

4.2.8 Earcap reference point

Point in the earcap reference plane, used as a reference parameter.

NOTE See the note to 4.2.7.

4.2.9 Rated impedance (Ω)

Absolute value of the electrical impedance of a microphone or earphone for speech communications.

For an earphone with an electrodynamic transducer, it is recommended that the value is chosen so that the lowest value of the modulus of the actual impedance within the rated frequency range is not less than 80 % of the chosen value. Alternatively, it may be given as the value at the reference frequency or the value at the frequency specified by the manufacturer.

4.2.10 Rated capacitance (nF)

The capacitance of an earphone for speech communications at the frequency specified by the manufacturer, or at 120 Hz, if not specified.

4.3 Measuring conditions

4.3.1 Environmental interference

The level of disturbances due to environmental noise, reverberation, wind noise, electro-magnetically induced noise, vibration noise and other interference shall be at least 10 dB below the measured quantity.

4.3.2 Reference sound pressure

The reference sound pressure for a microphone shall be 1 Pa and that for an earphone shall be 20 μ Pa.

4.3.3 Signal for measurement

IEC 61842:2002

A sinusoidal signal shall be used for measurement unless otherwise specified.

Results may also be gained from measurements using noise signals, quasi-random sequence signals or impulsive signals. If signals other than sinusoidal signals are used, it is the responsibility of the test house to show that the results are equivalent or have fewer artefacts than those obtained with sinusoidal signals.

4.3.4 Reference frequency and frequency range

The reference frequency shall be 1 kHz. The frequency range shall be from 150 Hz to 5 kHz unless otherwise specified. The frequency values for measurement at discrete frequency points shall be specified by the manufacturer.

4.3.5 Apparatus for acoustic measurement

The following apparatus shall be used.

a) Microphone for measurement

A condenser microphone conforming to IEC 61094-1 or IEC 61094-4 shall be used. Type LS2P or equivalent, or smaller than LS2P, is recommended. A pressure microphone whose sensitivity was calibrated by using the standard condenser microphone is acceptable.

b) Artificial mouth

The artificial mouth defined by ITU-T Recommendation P.51 shall be used.

c) Artificial ear

The artificial ear defined in IEC 60318-1 or IEC 60711 shall be used. Additional components shall be used, if necessary.

The type of artificial ear to be used, and conditions relating to shape, dimension or other characteristics of the additional components shall be specified by the manufacturer. In particular, the following items shall be specified clearly.

- 1) Position of the earcap reference plane,
- 2) Position of the earcap reference point, and,
- 3) Direction of axis of the microphone part.

The artificial ear specified in IEC 60318-1, or an artificial ear with a construction as shown in Figure 1, is recommended for measurement of the supra-aural earphone, defined in the Clause 1 of IEC 60268-7: with minimized leakage, mainly for measurements at less than 3.4 kHz.

NOTE 1 The positions of the earcap reference plane and the earcap reference point may be different for a different handset, headset or earset to be measured, even if the same artificial ear is used.

NOTE 2 Only the P type microphone is suitable for use in the artificial ear.

NOTE 3 Recent developments in ITU-T describe the use of head and torso simulator (HATS) for the measurement of communication devices. The relevant Recommendations are ITU-T P.58, ITU-T P.57 and ITU-T P.64. A measurement equipment according to these recommendations can be used alternatively. The chosen test configuration shall be described unambiguously in the test report as well as the exact positioning of the device under test.

4.3.6 Apparatus for electrical measurement

The following instruments shall be used.

- a) Automatic frequency response recorder

Interruption of the signal frequency trace at any instant during the measurement shall affect the indicated response by less than 1 dB.

- b) Sinusoidal signal generator and amplifier

The amplifier associated with the sinusoidal signal generator shall conform to the following requirements:

- 1) The total harmonic distortion of the signal applied to the artificial mouth for radiation of the output sound pressure of 1 Pa under the calibration condition (see 4.3) shall be less than 0,1 %.
- 2) Earphone to be measured, or the earphone with the necessary additional resistance, shall be less than 0,1 %.
- 3) The output level across the rated pure resistance load of the amplifier shall not differ by more than 1 dB from the output level across a load of ten times the rated resistance.

4.3.7 Cases for unit measurement

The acoustical performance of a microphone or earphone unit is often strongly dependent on the mechanical and acoustical properties of the housing in which it is to be operated. Therefore, the microphone/earphone unit to be measured shall be installed in a case for unit measurement unless otherwise specified. An example of a case for microphone unit measurement is shown in Figure 2, and a case for earphone unit measurement in Figure 3.

NOTE The case for unit measurement should be specified for measurement with sufficient reproducibility under conditions similar to actual use. The manufacturer is recommended to specify clearly the following conditions relating to the shape, dimensions or other characteristics which may affect the measuring result:

- a) mouthpiece holes or earcap holes,
- b) front cavity,
- c) front construction of the case,
- d) rear construction of the case, and,
- e) rear cavity.