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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Sound system equipment – Part 4: Microphones

Équipements pour systèmes électroacoustiques – Partie 4: Microphones

IEC 60268-4:2014-06(en-fr)

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FOREWORD

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International Standard IEC 60268-4 has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

This fifth edition cancels and replaces the fourth edition published in 2010, and constitutes a technical revision.

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

– clarification of Table 5 of classification of characteristics;
– clarification of graphical representation;
– clarification of environmental influences;
– rewritten clause for EMC;
– tolerances and more specific values for noise measurements;

– inclusion of near-field response for sound source-to-microphone distances of the order of 30 cm.

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

CDV	Report on voting
100/2116/CDV	100/2186/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.

A list of all parts of the IEC 60268 series, under the general title *Sound system equipment*, 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- withdrawn,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.

SOUND SYSTEM EQUIPMENT –

Part 4: Microphones

1 Scope

This part of IEC 60268 specifies methods of measurement for the electrical impedance, sensitivity, directional response pattern, dynamic range and external influences of sound system microphones, and also details the characteristics to be specified by the manufacturer.

It applies to sound system microphones for all applications for speech and music. It does not apply to measurement microphones, but it does apply to each audio channel of microphones having more than one channel, for example for stereo or similar use. It is also applicable to flush-mounted microphones and to the analogue characteristics of microphones with digital audio output.

For the purposes of this International Standard, a microphone includes all such devices as transformers, pre-amplifiers, or other elements that form an integral part of the microphone, up to the output terminals specified by the manufacturer.

The major characteristics of a microphone are considered in Clauses 6 to 21. Additional characteristics are considered in Annex A, Annex C and Annex D.

NOTE The characteristics specified in this standard do not completely describe the subjective response of the microphone. Further work is necessary to find new definitions and measurement procedures for a later replacement by objective characteristics of at least some of the subjective descriptions used to describe microphone performance.

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.

CISPR 35:–, *Electromagnetic compatibility of multimedia equipment – Immunity requirements*[1]

IEC 60268-1:1985, *Sound system equipment – Part 1: General*
Amendment 1:1988
Amendment 2:1988

IEC 60268-2:1987, *Sound system equipment – Part 2: Explanation of general terms and calculation methods*
Amendment 1:1991

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

IEC 60268-5:2003, *Sound system equipment – Part 5: Loudspeakers*
Amendment 1:2007
Amendment 1:2007

[1] To be published.

IEC 60268-11:1987, *Sound system equipment – Part 11: Application of connectors for the interconnection of sound system components*
Amendment 1:1989
Amendment 2:1991

IEC 60268-12:1987, *Sound system equipment – Part 12: Application of connectors for broadcast and similar use*
Amendment 1:1991
Amendment 2:1994

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test*
Amendment 1:2007
Amendment 2:2010

IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-6:2008, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-16, *Electromagnetic compatibility (EMC) – Part 4-16: Testing and measurement techniques – Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz*

IEC 61000-4-17:1999, *Electromagnetic compatibility (EMC) – Part 4-17: Testing and measurement techniques - Ripple on d.c. input power port immunity test*
Amendment 1:2001
Amendment 2:2008

IEC 61260-1:2014, *Electroacoustics – Octave-band and fractional-octave-band filters – Part 1: Specifications*

IEC 61938:2013, *Multimedia systems – Guide to the recommended characteristics of analogue interfaces to achieve interoperability*

ITU-T Recommendation P.51:1996, *Artificial mouth*

EN 55103-2:2009, *Electromagnetic compatibility – Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use – Part 2: Immunity*

EN 300 422-2 V1.3.1:2011, *Electromagnetic compatibility and radio spectrum matters (ERM) – Wireless microphones in the 25 MHz to 3 GHz frequency range – Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60268-1 and the following apply.

3.1
far-field microphone
microphone for use at a distance of more than 1 m from the source of sound

3.2
near-field microphone
microphone for use by an individual performer at a distance of approximately 30 cm

3.3
close-talking microphone
microphone for use at a distance of approximately 25 mm from the source of sound

4 General conditions

4.1 General

Special reference is made to IEC 60268-1, concerning:

- units and system of measurement;
- frequencies of measurement;
- quantities to be specified and their accuracy (see also 5.7);
- marking (see also 7.1);
- ambient conditions;
- filters, networks and measuring instruments for noise specification and measurement;
- individual specifications and type specifications;
- graphical presentation of characteristics;
- scales for graphical presentation;
- personal safety and prevention of spread of fire;
- method of producing a uniform alternating magnetic field;
- search coils for measuring the magnetic field strength,

and to IEC 61938 concerning powering of microphones.

4.2 Measurement conditions

4.2.1 General

For convenience in specifying how microphones shall be set up for measurement, three sets of conditions have been defined in this standard, under the title of "rated conditions".

Microphones should be measured in conditions approximating those in which they are intended to be used. Three sets of measurement conditions are specified in this standard: free-field, near-field and close-talking. The differences between these sets of conditions are in the distance to the sound source and the sound pressure level of the measurement. Measurements shall be reported using at least one of these sets of conditions. Additional data may be included, provided that the measurement conditions are specified.

Three ratings are basic to the formulation of these concepts:

– rated power supply (see 9.1);
– rated impedance (see 10.2);
– rated sensitivity (see 11.3).

To obtain the correct conditions for measurement, the above mentioned ratings shall be taken from the specifications supplied by the manufacturer of the equipment.

The term "rated" applied to other characteristics relates to the specification or measurement of the particular characteristic under rated conditions or under conditions unambiguously connected to them. This applies, for example, to the following two characteristics:

– rated output voltage;
– rated equivalent sound pressure level due to inherent noise.

Methods of measurement are given in this standard for electrical impedance, sensitivity, directional pattern, dynamic range and external influences. Where alternative methods are given, the chosen method shall be specified.

4.2.2 Rated conditions

The microphone is understood to be working under rated conditions when the following conditions are fulfilled:

– the microphone is connected to the resistive load specified in 5.4, or as specified by the manufacturer;
– if the microphone needs a power supply, this is the rated power supply;
– the microphone (except a close-talking or near-field microphone) is placed in a sound field meeting the free-field conditions in 5.5.2, the waves having zero degree incidence with respect to the reference direction;
– the undisturbed sound pressure (in the absence of the microphone) in the sound field at the reference point of the microphone is sinusoidal and set at a level of 1 Pa (94 dB SPL);
– for close-talking microphones, the microphone is placed at a stated distance, no more than 25 mm from the artificial mouth complying with ITU-T Recommendation P.51, and the undisturbed sound pressure in the sound field at the reference point of microphone is sinusoidal and set at a level of 3 Pa (104 dB SPL);
– for near-field microphones, the microphone is placed at 30 cm from the artificial mouth complying with ITU-T Recommendation P.51, and the undisturbed sound pressure in the sound field at the reference point of microphone is sinusoidal and set at a level of 1 Pa (94 dB SPL);
– if a special microphone needs a different measurement level, it shall be stated in the technical data together with the reason for this. Levels related to the normal reference level of 94 dB by multiples of 10 dB are preferred;
– controls, if any, are set to the position recommended by the manufacturer;
– in the absence of a clear reason to the contrary, the measurement frequency is 1 000 Hz (see IEC 60268-1);
– the ambient pressure, relative humidity and ambient temperature are within the limits given in IEC 60268-1, and shall be stated.

Measurements may be made at a sound pressure of 0,3 Pa if this is necessary due to limitations of the performance of the loudspeaker or other measurement equipment, and only if any change in performance between the level used and the reference level is known with the necessary accuracy for the relevant characteristics.

5 Particular conditions

5.1 Pre-conditioning

A microphone with preamplifier shall be switched on for the period of time specified by the manufacturer, before measurements are made, to allow the components to reach the stationary temperature for rated conditions. If the manufacturer specifies no period, a period

of 10 s shall be allowed for stabilization. If the microphone contains a vacuum tube or other heating device the time shall be 10 min.

5.2 Sound source

The sound source shall be capable of producing at the microphone position the sound pressure level as defined for rated conditions. The amplitude non-linearity of the sound source shall be held to such a value that the effect on the measured response does not exceed 0,5 dB. If the conditions of measurement preclude the possibility of securing sufficiently low distortion, a narrow-band filter may be used at the microphone output terminals, which allows the response at the fundamental frequency to be measured.

For free-field calibration and calibration of near-field microphones, the sound source shall be contained in an enclosure which radiates sound from one well-defined opening only, and such an opening shall be radially symmetrical with respect to the axis of the reference direction of the microphone.

5.3 Measurement of sound pressure

A calibrated reference pressure microphone shall be used to measure the sound pressure. The reference microphone shall be calibrated with an accuracy of ±1 dB or better.

5.4 Voltage measuring system

The voltage generated by the microphone, when in a sound field, shall be determined by using a voltmeter with an input resistance of five times the rated impedance of the microphone, unless otherwise stated by the manufacturer. If external equipment, such as a power supply, applies an impedance in parallel with the microphone, its impedance shall be taken into account.

NOTE Microphones having a rated impedance of 200 Ω often have an actual internal impedance in the order of 50 Ω, and perform best with a minimum load impedance around 1 000 Ω.

5.5 Acoustical environment

5.5.1 General

The microphone can be measured in different acoustical environments:

a) in a free field or similar with negligible boundary effects, e.g. by using special computer-generated sound source signals:
   - spherical waves, or
   - plane waves, or
   - waves produced by a specific sound source (artificial mouth or artificial head);

b) in a diffuse field;

c) coupled to a sound source by means of a small cavity (coupler).

5.5.2 Free-field conditions

5.5.2.1 General

A free-field sound wave is normally divergent in character. In certain circumstances it can approximate an ideal plane wave. Free-field conditions can be obtained:

– in open air, ambient noise and wind permitting, or

– in an anechoic room, or

– in a duct.

A sound source of small dimensions with respect to the wavelength produces a spherical wave in these environments. The spherical wave can be approximated to a plane wave in a region of measurement located at a sufficient distance from the source. Spherical waves can be used to measure pressure microphones but it is necessary to use almost perfect plane waves in the low-frequency range for the measurement of pressure gradient microphones.

For microphones responding both to pressure and to pressure gradient, having a sufficiently flat frequency response in a plane-wave free sound field (i.e. at a sufficient distance from the source), the response as a function of frequency f of distance r from a centre of spherical diverging waves and of angle of incidence θ of the waves at the microphone, can be given in a complex form:

$$(1-B)+B\left(1+\frac{1}{\mathrm{j}kr}\right)\cos\theta$$

where

$1 - B$ is the contribution of the pressure component;

B is the contribution of the pressure gradient component;

k = $2\pi/\lambda$ or $2\pi f/v$;

B = 0 for the omnidirectional pressure type;

B = 0,5 for the cardioid type;

B = 1 for the bidirectional pressure gradient type.

At low frequencies, it becomes difficult to realize plane wave conditions in an anechoic room. A plane wave at low frequencies, below the cut-off frequency of the anechoic room, can therefore be better produced under other conditions.

Free-field conditions are considered to be sufficiently realized in the region around the microphone if the following conditions are met:

– within a distance of 200 mm in front, behind, right, left, above and below the position of the microphone the sound pressure level is measured at every measuring frequency by means of a pressure transducer;

– the axis of the transducer shall point towards the reference point of the loudspeaker (see IEC 60268-5);

– the corresponding sound pressure levels on axis positioned at different distances from the loudspeaker shall not differ by more than 0,5 dB from the calculated levels in the ideal sound field;

– the values at a nearly constant distance to the sound source, right, left, above and below the microphone shall not differ by more than 1 dB from the level at the reference point of the microphone.

5.5.2.2 Spherical waves

The sound pressure generated in a free field by an omnidirectional sound source varies inversely with the distance from the acoustic centre of the sources.

The output voltage of the microphone varies inversely with the distance between the source and the microphone when the relevant dimensions of both are small compared with the wavelength, allowing the results from the measurements made at a certain distance r to be converted by calculation to results which would be obtained at the reference distance.

When either the circumference of the radiating surface of the source or the circumference of the principal acoustic entry of the microphone exceeds the wavelength, this computation applies only when the measuring distance conforms to: