IEC 60268-5

Edition 3.1 2007-09

CONSOLIDATED VERSION

VERSION CONSOLIDÉE

colour inside

Sound system equipment –
Part 5: Loudspeakers

Equipements pour systèmes électroacoustiques –
Partie 5: Haut-parleurs

IEC 60268-5:2003+A1:2007

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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FOREWORD

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This Consolidated version of IEC 60268-5 bears the edition number 3.1. It consists of the third edition (2003) [documents 100/648/FDIS and 100/674/RVD] and its amendment 1 (2007) [documents 100/1189/CDV and 100/1245/RVC]. The technical content is identical to the base edition and its amendment.

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through. A separate Final version with all changes accepted is available in this publication.

This publication has been prepared for user convenience.

International Standard IEC 60268-5 has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

The bilingual version (2013-08) of this standard corresponds to the monolingual English version, published in 2007-09.

This standard is to be read in conjunction with IEC 60268-1, IEC 60268-2 and ISO 3741.

The French versions of this standard and its amendment 1 have not been voted upon.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of the base publication and its amendments 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- withdrawn;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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SOUND SYSTEM EQUIPMENT –

Part 5: Loudspeakers

1 Scope

This standard applies to sound system loudspeakers, treated entirely as passive elements. Loudspeakers with built-in amplifiers are excluded.

NOTE 1 The term “loudspeaker” used in this standard relates to loudspeaker drive units themselves and also to loudspeaker systems, which comprise one or more loudspeaker drive units provided with a baffle, enclosure or horn and such relevant devices as built-in crossover filters, transformers and any other passive element.

The purpose of this standard is to give the characteristics to be specified and the relevant methods of measurement for loudspeakers using sinusoidal or specified noise or impulsive signals.

NOTE 2 The methods of measurement given in this standard have been chosen for their appropriateness to the characteristics.

NOTE 3 If equivalent results can be obtained using other methods of measurement, details of the methods used should be presented with the results.

NOTE 4 The following items are under consideration:

– loudspeakers with built-in amplifiers;

– measurements under conditions other than free-field, half-space free-field and diffuse field;

– measurements with signals other than sinusoidal or noise or impulsive signals.

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 60050(151), *International Electrotechnical Vocabulary (IEV) – Part 151: Electrical and magnetic devices*

IEC 60263, *Scales and sizes for plotting frequency characteristics and polar diagrams*

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

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

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

IEC 60268-11, *Sound system equipment – Part 11: Application of connectors for the interconnection of sound system components*

IEC 60268-12, *Sound system equipment – Part 12: Application of connectors for broadcast and similar use*

IEC 60268-14, *Part 14: Circular and elliptical loudspeakers; outer frame diameters and mounting dimensions*

IEC 60651, *Sound level meters*

IEC 61260, *Electroacoustics – Octave-band and fractional-octave-band filters*

ISO 3741, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Precision methods for reverberation rooms*

ISO 3744, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Engineering method in an essentially free field over a reflecting plane*

ISO 3745, *Acoustics – Determination of sound power levels of noise sources – Precision methods for anechoic and semi-anechoic rooms*

3 Conditions for measurement

3.1 General conditions

This standard is to be used in conjunction with IEC 60268-1, IEC 60268-2 and ISO 3741.

3.2 Measuring conditions

3.2.1 General

For convenience in specifying how loudspeakers are to be set up for measurement, normal measuring conditions are defined in this standard. To obtain the correct conditions for measurement, some values (known as "rated conditions") shall be taken from the manufacturer's specification. These values themselves are not subject to measurement but they constitute the basis for measuring the other characteristics.

The following values and conditions are of this type, and shall be stated by the manufacturer:

- rated impedance;
- rated sinusoidal voltage or power;
- rated noise voltage or power;
- rated frequency range;
- reference plane;
- reference point;
- reference axis.

NOTE A full explanation of the term "rated" is given in IEC 60268-2. See also term 151-04-03 in IEC 60050(151).

3.2.2 Normal measuring conditions

A loudspeaker shall be understood to be working under normal measuring conditions when all the following conditions are fulfilled:

a) the loudspeaker to be measured is mounted in accordance with Clause 10;

b) the acoustical environment is specified and is selected from those specified in Clause 5;

c) the loudspeaker is positioned with respect to the measuring microphone and the walls in accordance with Clause 7;

d) the loudspeaker is supplied with a specified test signal, in accordance with Clause 4, of a stated voltage U, within the rated frequency range in accordance with 19.1. If required, the input power P can be calculated from the equation: $P = U^2/R$, where R is the rated impedance in accordance with 16.1;

e) attenuators, if any, are set to their "normal" position as stated by the manufacturer. If other positions are chosen, for example those providing a maximally flat frequency response or maximum attenuation, these shall be specified;

f) measuring equipment suitable for determining the wanted characteristics is connected in accordance with Clause 8.

4 Test signals

4.1 General

Acoustical measurements shall be made under one of the following measuring signal conditions, and the choice shall be indicated with the results.

4.2 Sinusoidal signal

The sinusoidal test signal shall not exceed the rated sinusoidal voltage (as defined in 17.4) at any frequency. The voltage across the input terminals of the loudspeaker under test shall be kept constant for all frequencies unless otherwise stated.

4.3 Broadband noise signal

NOTE This term is explained in IEC 60268-2.

The crest factor of a noise source should fall between 3 and 4 to avoid clipping of amplifiers.

A true r.m.s. voltmeter with a time constant at least as long as the “slow” constant of the sound level meter, specified in IEC 60651, shall be used to measure the amplitude of the signal.

4.4 Narrow-band noise signal

NOTE This term is explained in IEC 60268-2.

For measurement using narrow-band noise, constant relative bandwidth filters in accordance with IEC 61260 shall be used with a pink-noise generator, the relative bandwidth being usually 1/3 octave.

4.5 Impulsive signal

A short-duration pulse shall have constant spectral power per unit bandwidth over at least the bandwidth of interest in the measurement. Such a signal has low energy content relative to its peak amplitude.

NOTE To minimize the influence of acoustical and electrical noise on the measurement, the peak amplitude of the pulse should be as high as possible within the capability of the driving amplifier and consistent with linear operation of the loudspeaker.

5 Acoustical environment

5.1 General

Acoustical measurements shall be made under one of the acoustical field conditions specified in 5.2 to 5.6, and the choice shall be indicated with the results.

5.2 Free-field conditions

If acoustical conditions approach those of free-field space, an environment (for example an anechoic room) in which the sound pressure decreases with the distance (r) from a point source according to a $1/r$ law, with an accuracy of ±10 %, in the region that will be occupied by the sound field between the loudspeaker system and the microphone during the measurements shall be used. The minimum conditions shall be deemed to exist if this requirement is met along the axis joining the measuring microphone and the reference point on the loudspeaker.

Free-field conditions shall exist over the whole frequency range of measurement.

5.3 Half-space free-field conditions

If acoustical conditions are used in which the free-field exists in a half space, these conditions shall be met with a reflecting plane of sufficient size so that the sound pressure from a point source mounted in the surface of that plane decreases in the manner specified in 5.2.

5.4 Diffuse sound field conditions

NOTE 1 These conditions are normally used for band noise measurements only.

If diffuse sound field conditions are used for measurements with 1/3 octave band limited noise, as defined and specified in ISO 3741, the lower limiting frequency shall be determined as specified in ISO 3741, Appendix A.

NOTE 2 While ISO 3741 provides details of measuring instruments, it should be clearly understood that both space averaging and time averaging are required in loudspeaker power determination. This may be achieved as stated in the standard or alternatively by using continuous space and time averaging techniques.

NOTE 3 The precision of the measurement depends on a number of factors including the room volume, the room reverberation time, and the degree of diffusion.

NOTE 4 For measurement below 125 Hz, a room volume greater than 200 m^3 is desirable.

5.5 Simulated free-field conditions

If acoustical conditions are used in which the simulated free-field conditions that are equivalent to those of free space for the period of time required for a measurement, these conditions shall be used.

The conditions shall be met in any environment (for example large, unobstructed rooms) in which sound emitted by a loudspeaker in response to an impulsive signal reflected from any surface or object in the environment does not reach the measuring microphone before measurement of the direct path sound at the microphone has been completed.

Any such reflection reaching the microphone shall be excluded from the measurement by gating or other means.

NOTE 1 These conditions are normally used only for measurements with impulsive signals.

NOTE 2 Under such conditions, successive measurements are separated by time intervals sufficient for the sound pressure level due to reverberation within the space to decrease to a negligible value.

5.6 Half-space simulated free-field conditions

If acoustical conditions are used in which the simulated free-field exists in a half-space, these conditions shall be used when a reflecting plane, forming one boundary of a simulated free-field environment, is of sufficient size that no reflections from its edge reach the measuring microphone within the measurement time.

NOTE 1 These conditions are normally used only for measurements with impulsive signals.

NOTE 2 Under such conditions, successive measurements are separated by time intervals sufficient for the sound pressure level due to reverberation within the space to decrease to a negligible value.

6 Unwanted acoustical and electrical noise

Unwanted acoustical and electrical noise shall be kept at the lowest possible level as its presence may obscure low-level signals.

Data related to signals which are less than 10 dB above the noise level in the frequency band considered shall be discarded.

7 Positioning of loudspeaker and measuring microphone

7.1 Measuring distance under free-field and half-space free-field conditions

7.1.1 General

Measurements under free-field and half-space free-field conditions should ideally be carried out in the far field of the loudspeaker, in order to obtain consistent results. However, in practice, imperfections of the measuring environment room and the effects of background noise set an upper limit to the distance that can be used. Therefore, the measuring distance should be 0,5 m or an integral number of m, and that result should be referred to a standard distance of 1 m.

7.1.2 Single drive unit loudspeaker

For this type of loudspeaker, a measuring distance of 1 m from the reference point shall be used unless special conditions dictate another value, which shall be stated.

7.1.3 Multi-unit loudspeaker systems

Loudspeaker systems in which two or more loudspeaker units reproduce the same frequency band create problems of acoustical interference at the measuring point due to the interaction of the sounds radiated by the units. This situation exists whether all units operate over the entire frequency band under test or whether some units operate over parts of this band (for example cross-over regions). In such cases, the measuring distance should be chosen so as to minimize the errors due to this phenomenon.

7.2 Positioning of loudspeaker in diffuse field conditions

The loudspeaker position and orientation with respect to the walls shall be described by means of a diagram appended to the measurement results.

An arrangement for the simultaneous movement of the loudspeaker and the microphone is permitted for the evaluation of the power delivered by the loudspeaker in accordance with the method prescribed in 22.1.2.2. The microphone system and the nearest microphone position shall meet the requirements of ISO 3741.

7.3 Positioning of loudspeaker and microphone in simulated free-field conditions

The measuring distance shall be chosen with reference to 7.1 for free-field conditions.

The position of the loudspeaker and microphone within the measuring environment shall be such so as to maximize the time available for measurement before the first unwanted reflection reaches the microphone.

If the measurement space is an anechoic chamber, attention shall be paid to reflections from wedge tips, personnel floor, and supports for the loudspeaker and microphone. Errors from these sources shall not exceed 0,5 dB over the frequency range of measurement.

The microphone distance and the maximum signal capture time available in the environment shall be stated.

It is necessary to ignore all the output of the microphone from the time of arrival of the first reflection onwards. Truncation errors are therefore introduced into the transfer function measurement unless the loudspeaker response to the impulsive test signal is negligible