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NORME INTERNATIONALE

Quality evaluation method for the sound field of directional loudspeaker array systems

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Méthode d'évaluation de la qualité du champ acoustique des systèmes de haut-parleurs directionnels

IEC 62777:2016

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QUALITY EVALUATION METHOD FOR THE SOUND FIELD OF DIRECTIONAL LOUDSPEAKER ARRAY SYSTEMS

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

FDIS	Report on voting
100/2603/FDIS	100/2637/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 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,
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INTRODUCTION

Directional loudspeaker array systems provide focused sound for a person to listen alone without disturbing others. This system is convenient for consumers who want to listen to sound without earphones or headphones.

This system would be widely used in consumer electronics, for example, smart phone or pad, TV, computer, navigator, and game machine. The applicable area for the system could be fitness club, exhibition room, museum, shopping mall, and etc. A simple and easy concept is needed to evaluate the performance of the directional loudspeaker array system for a consumer. It will provide consumers with personalized audio space criteria in order to compare the audio sound field quality between various electronic products that have a directional loudspeaker array system. It is important to specify the quality evaluation method for the personal audio space and the concept of personal audio space.

This standard provides guidelines for general test methods to evaluate the quality of directional loudspeaker array systems.

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QUALITY EVALUATION METHOD FOR THE SOUND FIELD OF DIRECTIONAL LOUDSPEAKER ARRAY SYSTEMS

1 Scope

This International Standard applies to directional loudspeaker array systems of any kind, and to the parts of which they are composed or which are used as auxiliaries in such systems.

This standard deals with the determination of the performance of directional loudspeaker array systems, the comparison of these system types, and the determination of their proper practical application, by listing the characteristics which are useful for their specification. It specifies uniform measurement methods for these characteristics.

This standard is restricted to a description of the audio space around a person and the relevant method of measurement. It does not consider characteristics of loudspeakers, which are specified in IEC 60268-5.

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 60268-1, *Sound system equipment – Part 1: General*
<https://standards.iec.ch/catalog/standards/sist/51610638-b8f9-41ec-a3de-47471fcff0d9/iec-62777-2016>

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

IEC 60268-5, *Sound system equipment – Part 5: Loudspeakers*

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

3 Terms and definitions

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

3.1

personal acoustic zone

PAZ

acoustic space occupied by a person

3.2

personal distance

distance between listeners and a directional loudspeaker array system

3.3

sound pressure level at a personal acoustic zone

P_{ij}

sound pressure level measured at the center of the surface j of the personal acoustic zone i

3.4 average sound pressure level at a personal acoustic zone

P_i

mean value of the sound pressure levels measured at the centers of the surfaces of the personal acoustic zone i

3.5 personal acoustic zone index PAZI

ratio of the average sound pressure level of the personal acoustic zone for a listener, to the total average sound pressure levels for listeners around the directional loudspeaker array system located at a specified personal distance

3.6 personal acoustic zone index-x PAZI-x

ratio of the average sound pressure level of the personal acoustic zone of a listener in front of the directional loudspeaker array system to the sum of the average sound pressure levels of listeners at the front, the front-right, and the front-left of the system

3.7 personal acoustic zone index-y PAZI-y

ratio of the average sound pressure level of the personal acoustic zone of a listener located in front of the directional loudspeaker array system to the sum of the average sound pressure levels of listeners at the front and the rear of the system

3.8 personal acoustic zone index-xy PAZI-xy

ratio of the average sound pressure level of the personal acoustic zone of a listener located in front of the directional loudspeaker array system to the sum of the average sound pressure levels of listeners at the front, the front-right, the front-left and the rear of the system

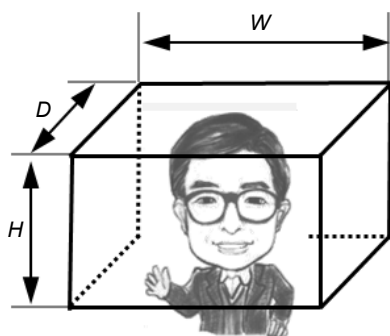
3.9 personal acoustic zone index-xyz PAZI-xyz

ratio of the average sound pressure level of the personal acoustic zone of a listener located in front of the directional loudspeaker array system to the sum of the average sound pressure levels of persons at the front, the front-right, the front-left, and the rear, and the front-upper, and the front-lower of the system

4 Personal acoustic zone and sound pressure level

4.1 Personal acoustic zone

The personal acoustic zone (PAZ) is defined as an acoustic space occupied by a person as shown in Figure 1. The dimensions of the personal acoustic zone are defined as W (width), D (depth), and H (height). Considering the standard size of a person, the dimensions of the personal acoustic zone shall be stated.

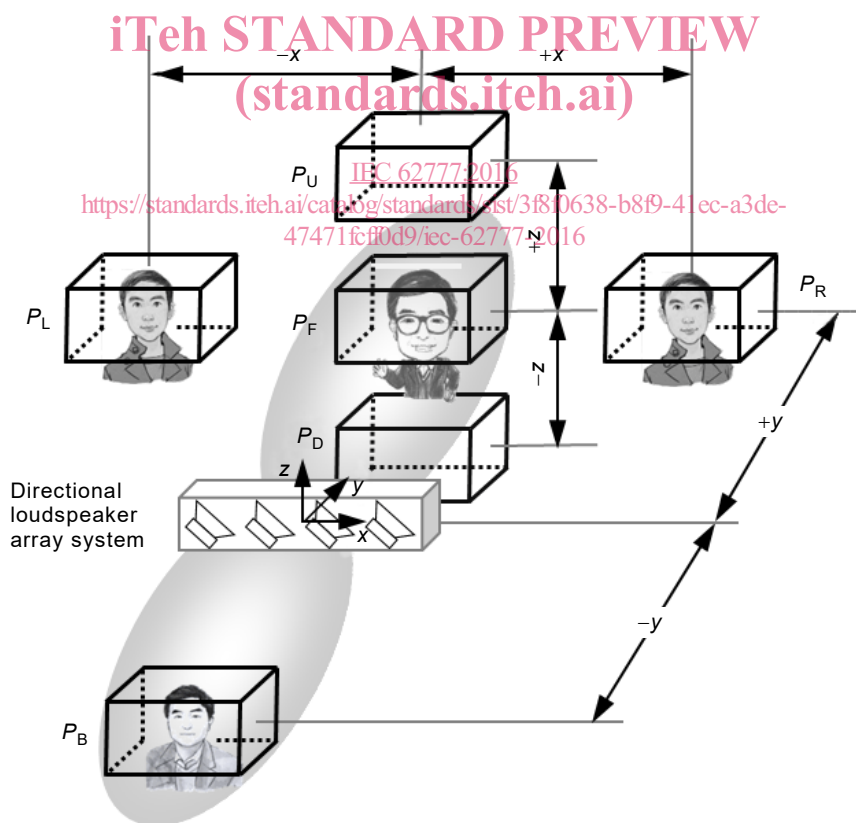


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Figure 1 – Personal acoustic zone

4.2 Personal distance between listeners

The personal distance between separate listeners, x and z , shall be defined as the distance between the centres of their personal acoustic zones, see Figure 2. Considering the standard size of a person, the dimension of the personal distance between listeners shall be stated.



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Figure 2 – Personal acoustic zone and sound pressure level

4.3 Personal distance between a directional loudspeaker array system and a listener

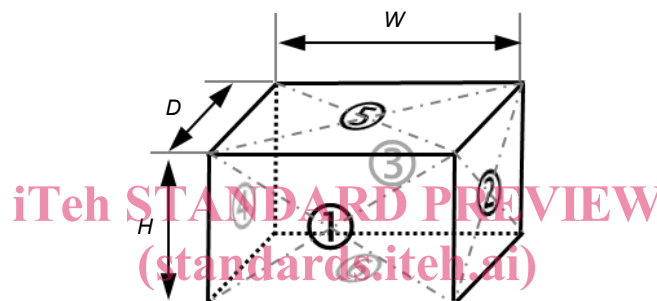
The personal distance between a directional loudspeaker array system and a listener, y , shall be defined as a distance from the centre of the directional loudspeaker array system to the

listener in front of the system, as shown in Figure 2. The personal distance shall be specified by the target application area of the directional loudspeaker array system.

4.4 Average sound pressure level at a personal acoustic zone

The sound pressure level, P_{ij} , shall be defined as the sound pressure level measured at the center of the surface j of the personal acoustic zone i . The average sound pressure level of the personal acoustic zone, P_i , shall be the mean value of the sound pressure levels measured at the center of the surfaces of the personal acoustic zone, as shown in Figure 3.

$$P_i = \frac{\sum_{j=1}^6 P_{ij}}{6}$$



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Figure 3 – Measuring points of the personal acoustic zone

The average sound pressure level of the personal acoustic zone, P_i , at the position of listener, as shown in Figure 2, is defined as follows:

- P_F is the average sound pressure level of the personal acoustic zone in front of the directional loudspeaker array system;
- P_L is the average sound pressure level of the personal acoustic zone at the front-left of the directional loudspeaker array system;
- P_R is the average sound pressure level of the personal acoustic zone at the front-right of the directional loudspeaker array system;
- P_B is the average sound pressure level of the personal acoustic zone at the rear of the directional loudspeaker array system;
- P_U is the average sound pressure level of the personal acoustic zone at the front-upper of the directional loudspeaker array system;
- P_D is the average sound pressure level of the personal acoustic zone at the front-lower of the directional loudspeaker array system.

5 Personal acoustic zone index

5.1 General

The personal acoustic zone index provides the ratio of the average sound pressure level of the personal acoustic zone of one listener, to the average sound pressure level of another listener at a specified personal distance.

5.2 PAZI-x

PAZI-x is defined as the ratio of the average sound pressure level of the personal acoustic zone of a listener in front of the directional loudspeaker array system to the sum of the average sound pressure levels of listeners at the front, the front-right, and the front-left of the system. This index means a relative ratio of the average sound pressure level of the listener in front of the directional loudspeaker array system to those of the persons who are at the left side and right side of the listener.

$$PAZI-x = P_F / (P_F + P_R + P_L)$$

5.3 PAZI-y

PAZI-y is the ratio of the average sound pressure level of the personal acoustic zone of a listener located in front of the directional loudspeaker array system to the sum of the average sound pressure levels of listeners at the front and the rear of the system. This index means a relative ratio of the average sound pressure level of a listener in front of the directional loudspeaker array system to that of the person who is at the rear side of the system.

$$PAZI-y = P_F / (P_F + P_B)$$

5.4 PAZI-xy

PAZI-xy is the ratio of the average sound pressure level of the personal acoustic zone of a listener located in front of the directional loudspeaker array system to the sum of the average sound pressure levels of listeners at the front, the front-right, the front-left and the rear of the system. This index means a relative ratio of the average sound pressure level of a listener located in front of the directional loudspeaker array system to the sum of those of the persons who are neighboring the listener in a 2-dimensional plane, as shown in Figure 2.

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$$PAZI-xy = P_F / (P_F + P_R + P_L + P_B)$$

5.5 PAZI-xyz

PAZI-xyz is the ratio of the average sound pressure level of the personal acoustic zone of a listener located in front of the directional loudspeaker array system to the sum of the average sound pressure levels of persons at the front, the front-right, the front-left, and the rear, and the front-upper, and the front-lower sides of the system. This index means a relative ratio of the average sound pressure level of a listener located in front of the directional loudspeaker array system to the sum of the average sound pressure levels of the persons who are neighboring the listener in 3-dimensional space.

$$PAZI-xyz = P_F / (P_F + P_R + P_L + P_B + P_U + P_D)$$

6 Measurement of the sound pressure level for a personal acoustic zone

6.1 General

This standard shall be used in conjunction with IEC 60268-1, IEC 60268-2, IEC 60268-5 and IEC 61672-1.

6.2 Characteristics to be specified

The sound pressure level shall be specified as a function of frequency measured under free field condition at a specified constant voltage with sinusoidal signal.