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INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Sound system equipment – Part 24: Headphones and earphones – Active acoustic noise cancelling characteristics

Équipements pour systèmes électroacoustiques – Partie 24: Casques et écouteurs – Caractéristiques d'annulation active du bruit acoustique

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The text of this International Standard is based on the following documents:

Draft	Report on voting
100/3880/CDV	100/3981/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 60268 series, published under the general title *Sound system equipment*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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INTRODUCTION

This document specifies both methods of measurement and reporting of data for noise cancelling characteristics on active acoustic noise cancelling headphones and earphones.

Active acoustic noise cancelling headphones and earphones are commonly used to reduce the ambient acoustic noise to which the ear is exposed.

However, to date, there is no International Standard for evaluating the noise cancelling performance of active acoustic noise cancelling headphones and earphones. Manufacturers currently measuring noise cancelling performance only use proprietary methods, and the resulting metrics are neither uniform nor comparable.

This document provides measurement methods and metrics for the noise cancelling performance of active acoustic noise cancelling headphones and earphones. The resulting measured and calculated values enable comparison of performance data obtained in different locations.

SOUND SYSTEM EQUIPMENT –

Part 24: Headphones and earphones – Active acoustic noise cancelling characteristics

1 Scope

This document is applicable to active acoustic noise-cancelling headphones and earphones which have the function of reducing the noise heard by the user by the output sound from the transducer generated by the environment noise detection microphone and the noise reduction signal processing circuit.

This document specifies the terms and definitions of this type of headphones or earphones, the characteristics to be specified, and the measurement and evaluation methods.

The noise detection microphone or microphones are mounted in the body, on the surface, or on an accessory of the headphones or earphones. Signal processing circuits are analogue and digital electronic circuits.

This document does not deal with equipment intended for hearing protection.

The noise cancelling characteristic measurement methods can be applied to headphones and earphones having no active noise cancelling function.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60268-7, *Sound system equipment – Part 7: Headphones and earphones* IEC 61260-1:2014, *Electroacoustics – Octave-band and fractional-octave-band filters – Part 1: Specifications*

IEC 60318-4, *Electroacoustics – Simulators of human head and ear – Part4: Occluded-ear simulator for the measurement of earphones coupled to the ear by means of ear inserts*

IEC 60318-7, *Electroacoustics – Simulators of human head and ear – Part 7: Head and torso simulator for the measurement of air-conduction hearing aids*

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

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

ISO 532-1:2017, *Acoustics – Method for calculating loudness – Part 1: Zwicker method*

ISO 3741:2010, *Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Precision methods for reverberation test rooms*

ANSI/ASA S12.42:2010, *Methods for the Measurement of Insertion Loss of Hearing Protection Devices in Continuous or Impulsive Noise Using Microphone-in-Real-Ear or Acoustic Test Fixture Procedures*

ITU-T Recommendation P.58, *Head and torso simulator for telephonometry*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60268-7, in IEC 60318-4, in IEC 60318-7 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
active noise cancellation
ANC
characteristic of reducing the noise level in the user's ear canal by the output sound from the driver, which is generated by the noise detection microphone and the signal processing circuit

3.2
noise cancelling headphones
ANC headphones
headphones or earphones that have the characteristics of active noise cancelling

3.3
head and torso simulator
HATS
simulator of a median adult human head and part of the torso extending in total from the top of the head to the waist and designed to simulate the sound pick-up characteristics and acoustic diffraction

Note 1 to entry: The head simulator includes two pinna simulators, and at least one occluded-ear simulator.

[SOURCE: IEC 60318-7:2022, 3.1, modified – The abbreviated term "HATS" has been added.]

3.4
acoustic test fixture
ATF
inanimate device that approximates certain physical characteristics and dimensions of a representative human head, pinnae, and ear canal and is used for measuring the insertion loss of ambient noise by a headphone

[SOURCE: ANSI/ASA S12.42, modified – "of a hearing protection device" replaced with "of ambient noise by a headphone"]

3.5
passive insertion loss
insertion loss determined from the difference between the sound pressure levels with and without the ANC headphones attached to the HATS or ATF, measured in the condition of the ANC function turned off

Note 1 to entry: Passive insertion loss is measured in dB.

3.6
active insertion loss
insertion loss determined from the difference between the sound pressure levels with and without the ANC function on, where the ANC headphones are attached to the HATS or ATF

Note 1 to entry: Active insertion loss is measured in dB.

3.7
total insertion loss
insertion loss determined from the difference between the sound pressure levels with and without the ANC headphones attached to the HATS or ATF, measured in the condition of the ANC function turned on

Note 1 to entry: Total insertion loss is measured in dB.

3.8
perceptual passive noise attenuation ratio
single ratio value of loudness with the ANC headphones attached to the HATS or ATF, to that without the ANC headphones attached to the HATS or ATF, measured in the condition of the ANC function turned off

3.9
perceptual active noise cancellation ratio
single ratio value of loudness when the ANC function is on to that when the ANC function is off, where the ANC headphones are attached to the HATS or ATF

3.10
perceptual total noise suppression ratio
single ratio value of loudness with the ANC headphones attached to the HATS or ATF to that without the ANC headphones attached to the HATS or ATF, measured in the condition of the ANC function turned on

4 Measurement method for noise cancelling characteristics

4.1 Characteristics to be specified

The noise cancelling characteristics are specified by measuring:

- the sound pressure level for the open ear of the HATS or ATF, without the headphones fitted, $L_{\mathrm{OPEN}}(f)$ (dB);
- the sound pressure level of the HATS or ATF ear simulator with the headphones fitted to the HATS or ATF, but with the ANC turned OFF, $L_{\mathrm{ANC\text{-}OFF}}(f)$ (dB); and
- the sound pressure level of the HATS or ATF ear simulator with the headphones fitted to the HATS or ATF, but with the ANC turned ON, $L_{\mathrm{ANC\text{-}ON}}(f)$ (dB).

All three quantities are measured in the same sound field at the same specified sound pressure level.

The noise cancelling characteristics are also specified by measuring:

- the loudness for the open ear of the HATS or ATF, without the headphones fitted, N_{OPEN} (sone);
- the loudness of the HATS or ATF ear simulator with the headphones fitted to the HATS or ATF, but with the ANC turned OFF, $N_{\mathrm{ANC\text{-}OFF}}$ (sone); and
- the loudness of the HATS or ATF ear simulator with the headphones fitted to the HATS or ATF, but with the ANC turned ON, $N_{\mathrm{ANC\text{-}ON}}$ (sone).

The loudness of each of the three aforementioned quantities is calculated using the method described in ISO 532-1.

4.2 Test signals

4.2.1 Pink noise

Noise whose power spectral density is inversely proportional to frequency (see IEC 60050-801:1994, 801-21-11).

The noise is used to measure $L_{OPEN}(f)$, $L_{ANC\text{-}OFF}(f)$, and $L_{ANC\text{-}ON}(f)$.

4.2.2 Simulated ambient noise

a) simulated aircraft cabin noise

b) simulated train compartment noise

c) simulated cafeteria noise

The power spectra of these signals shall comply with Table 1, Table 2, Table 3, Figure 1, Figure 2 and Figure 3 when measured using 1/3 octave band analyser specified in IEC 61260-1.

Either of the above simulated ambient noises or the pink noise shall be used to measure N_{OPEN}, $N_{ANC\text{-}OFF}$ and $N_{ANC\text{-}ON}$.

Annex C gives examples of how the simulated aircraft cabin noise and the simulated train compartment noise are obtained from filtered pink noise sources by the filter circuits shown in Figure C.1 and Figure C.2, respectively.

Table 1 – Power spectrum of simulated aircraft cabin noise

Frequency	Relative level	Tolerance limit (dB)		Frequency	Relative level	Tolerance limit (dB)	
Hz	dB	+	−	Hz	dB	+	−
20	0,0	0,5	0,5	800	−15,3	1,0	1,0
25	−0,1	0,5	0,5	1 000	−17,1	1,0	1,0
31,5	−0,1	0,5	0,5	1 250	−19,1	1,0	1,0
40	−0,2	0,5	0,5	1 600	−21,1	1,0	1,0
50	−0,4	1,0	1,0	2 000	−23,1	1,0	1,0
63	−0,7	1,0	1,0	2 500	−25,1	1,0	1,0
80	−1,1	1,0	1,0	3 150	−27,1	1,0	1,0
100	−1,7	1,0	1,0	4 000	−29,1	1,0	1,0
125	−2,5	1,0	1,0	5 000	−31,1	1,0	1,0
160	−3,6	1,0	1,0	6 300	−33,1	1,0	1,0
200	−4,8	1,0	1,0	8 000	−35,1	1,0	1,0
250	−6,2	1,0	1,0	10 000	−37,1	1,0	1,0
315	−7,8	1,0	1,0	12 500	−39,1	1,5	1,5
400	−9,6	1,0	1,0	16 000	−41,1	2,0	2,0
500	−11,4	1,0	1,0	20 000	−43,1	3,0	3,0
630	−13,3	1,0	1,0				

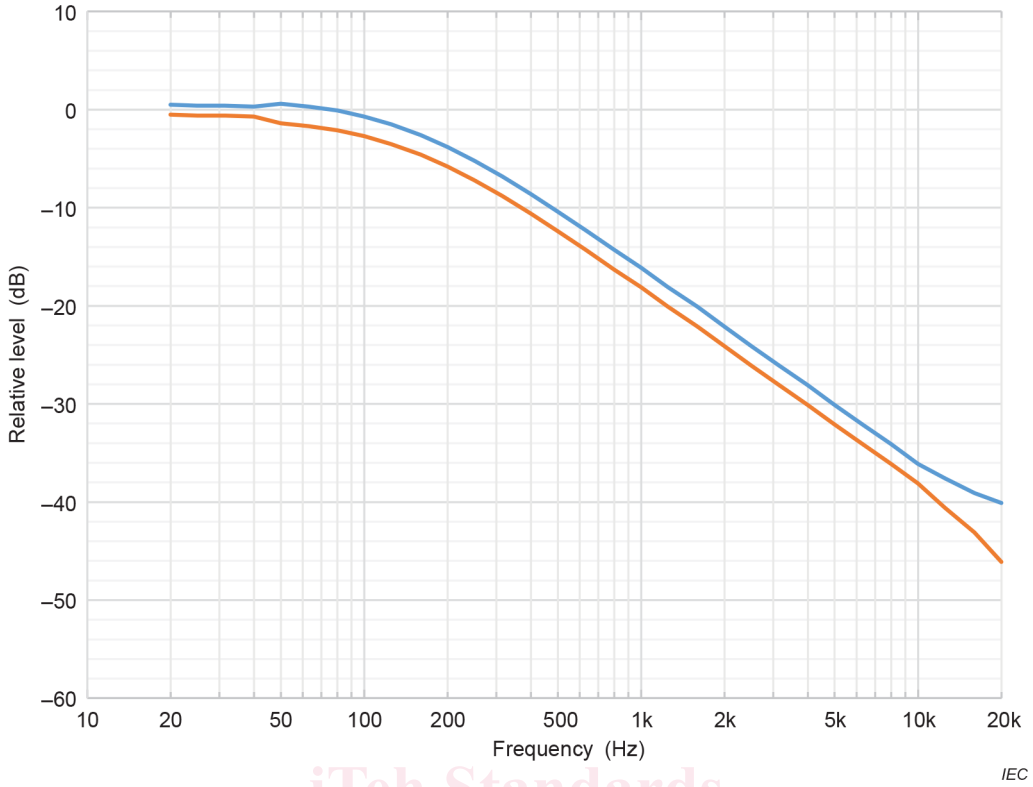

Figure 1 – Tolerance limit of power spectrum of simulated aircraft cabin noise

Table 2 – Power spectrum of simulated train compartment noise

Frequency	Relative level	Tolerance limit (dB)		Frequency	Relative level	Tolerance limit (dB)	
Hz	dB	+	−	Hz	dB	+	−
20	−1,0	2,0	2,0	800	−11,6	2,0	2,0
25	−0,4	1,0	1,0	1 000	−13,3	1,0	1,0
31,5	0,0	0,5	0,5	1 250	−16,4	1,0	1,0
40	−0,8	1,0	1,0	1 600	−19,8	1,0	1,0
50	−2,2	1,0	1,0	2 000	−23,3	1,0	1,0
63	−4,1	1,0	1,0	2 500	−26,9	1,0	1,0
80	−5,4	1,0	1,0	3 150	−30,3	1,0	1,0
100	−7,4	1,0	1,0	4 000	−33,5	1,0	1,0
125	−9,9	1,0	1,0	5 000	−36,5	1,0	1,0
160	−12,2	1,0	1,0	6 300	−39,4	1,0	1,0
200	−14,6	1,0	1,0	8 000	−42,1	1,0	1,0
250	−17,2	2,0	2,0	10 000	−44,6	1,0	1,0
315	−17,3	2,0	2,0	12 500	−46,9	1,5	1,5
400	−15,5	1,0	1,0	16 000	−49,2	2,0	2,0
500	−13,1	1,0	1,0	20 000	−51,3	3,0	3,0
630	−11,5	2,0	2,0				

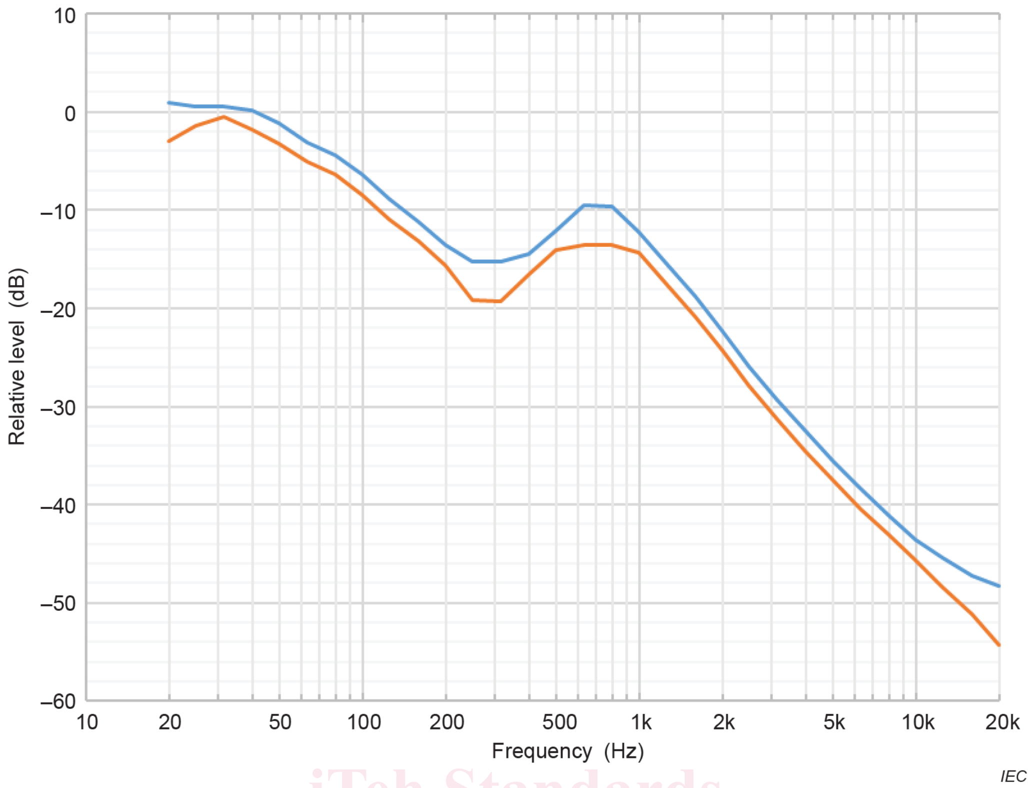

Figure 2 – Tolerance limit of power spectrum of simulated train compartment noise

Table 3 – Power spectrum of simulated cafeteria noise

Frequency Hz	Relative level dB	Tolerance limit (dB) +	−	Frequency Hz	Relative level dB	Tolerance limit (dB) +	−
20	−28,1	1,0	1,0	800	−1,3	1,0	1,0
25	−26,4	1,0	1,0	1 000	−2,6	1,0	1,0
31,5	−24,3	1,0	1,0	1 250	−3,9	1,0	1,0
40	−21,9	1,0	1,0	1 600	−5,2	1,0	1,0
50	−19,1	1,0	1,0	2 000	−6,5	1,0	1,0
63	−16,0	1,0	1,0	2 500	−7,8	1,0	1,0
80	−12,8	1,0	1,0	3 150	−9,1	1,0	1,0
100	−9,5	1,0	1,0	4 000	−11,0	1,0	1,0
125	−6,3	1,0	1,0	5 000	−14,0	1,0	1,0
160	−3,7	1,0	1,0	6 300	−17,5	1,0	1,0
200	−1,8	1,0	1,0	8 000	−20,3	1,0	1,0
250	−0,8	1,0	1,0	10 000	−23,4	1,0	1,0
315	−0,5	1,0	1,0	12 500	−27,0	1,0	1,0
400	0,0	1,0	1,0	16 000	−31,0	1,0	1,0
500	0,0	1,0	1,0	20 000	−34,0	1,0	1,0
630	0,0	1,0	1,0				