SLOVENSKI STANDARD
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Sound system equipment: Headphones and earphones associated with portable audio equipment - Maximum sound pressure level measurement methodology and limit considerations - Part 1: General method for "one package equipment"

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Elektroakustische Geräte: Kopfhörer und Ohrhörer in Verbindung mit tragbaren Audiogeräten - Verfahren zur Messung des maximalen Schalldruckpegels und Angaben zu Grenzwerten -- Teil 1: Allgemeines Verfahren für Original-Geräte-Sets

Equipement de systèmes acoustiques: Casques et écouteurs associés avec un baladeur - Méthode de mesure de niveau maximal de pression acoustique et prise en compte d'une limite -- Partie 1: Méthode générale pour un équipement complet

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EUROPEAN STANDARD

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English version

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 206, Consumer equipment for entertainment and information and related sub-systems.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50332-1 on 1999-10-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2000-10-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2002-10-01

Annexes designated "informative" are given for information only.
In this standard, annex A is informative.

1 Scope

The scope of this standard is to set up a suitable measuring methodology allowing accurate measurement of the maximum sound pressure level produced by consumer's headphones and earphones when associated with portable audio equipment.

NOTE This standard does not apply to acoustically open or acoustically closed headphones associated with mains operated Hi-Fi home equipement nor does it apply to headphones for medical purposes (hard of hearing etc.) or to headphones or similar parts being part of active hearing protection systems. Wireless headphones are neither included, conditions for them may be derived accordingly. Other requirements for safety, e.g. for noise protection in offices and industry are not affected by this standard.

Requested features:

- The method should be reproducible and easily applicable to every type and shape of headphone or earphone available on the market (good mechanical adaptability).
- As safety and health are addressed, the method should faithfully reflect the pressure level effective at the user's earhig (good correlation with subjective tests).
- And finally, it is desirable to establish a global measuring procedure, including each component in the chain:
  Portable set
  + specific test signal
  + associated headphone or earphone.

The standard is split into two parts:

- Part 1 deals with sets provided as a package equipment by the manufacturer. In this case, "Portable audio equipment" means the association of one set (compact cassette player, CD player, FM radio receiver, with its headphone or earphone.
- Part 2 (under consideration at present time) gives guidelines to associate portable audio sets (compact cassette player, CD player, FM radio receiver, ...) with headphones or earphones coming from a different manufacturer.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 60094-2	Magnetic tape sound recording and reproducing system Part 2: Calibration tapes
EN 60094-7	Magnetic tape sound recording and reproducing system Part 7: Cassette for commercial tape records and domestic use
EN 60268-7	Sound system equipment – Part 7: Headphones and earphones
EN 60315-4	Methods of measurement on radio receivers of various classes of emission Part 4: Receivers for frequency-modulated sound broadcasting emissions
EN 60804	Integrating–averaging sound level meters

IEC 60268-1 Sound system equipment – Part 1: General
(IEC 60268-1:1985 + A1:1988 harmonized as HD 483.1 S2:1989)

IEC 60711 Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts (IEC 60711:1981 harmonized as HD 443 S1)

IEC 60959 Provisional head and torso simulator for acoustic measurements on air conduction hearing aids (Technical Report)

3 Definitions

For the purpose of this standard, the following definitions apply:

3.1
equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$)
the equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$) defined in EN 60804 as follows:

$$L_{Aeq,T} = 10\lg\left\{\left(\frac{1}{T}\int_{t_1}^{t_2} p_A^2(t)dt\right) \Big/ p_0^2\right\} \quad dBA$$

where:

$L_{Aeq,T}$ is the equivalent continuous A-weighted sound pressure level re 20 µPa, determined over a time integration interval $T = t_2 - t_1$

$p_A(t)$ is the instantaneous A-weighted sound pressure of the sound signal

p_0 is the reference sound pressure of 20 µPa

3.2
free field frequency response of a Head And Torso Simulator (HATS)
the free field frequency response of a head and torso simulator defined in IEC 60959 as follows:

The difference, as a function of frequency, between the sound pressure level at the ear simulator microphone with the reference point of the manikin at the test point and the sound pressure level at the test point with the manikin absent.

4 Measuring principle

The sound pressure level produced by headphones or earphones can be measured by subjective methods or by objective methods.

The reference method for evaluating the sound pressure level emitted by earphones is a psycho acoustic method known as "equal loudness" (EN 60268-7). It consists in using human test subjects to compare the level of sound emitted by a speaker to that emitted by an earphone.

Nevertheless this subjective method becomes inadequate – and hazardous – when high levels are to be evaluated.

The solution is to use an objective measurement method, giving both a good reproducibility and a good correlation with subjective tests.

This standard is based on the use of a Head and Torso Simulator (HATS) in accordance with IEC 60959. This manikin is fitted with an occluded ear simulator (as described in IEC 60711) and an ear canal extension (8,8 mm length and diameter 7,5 mm ±- 0,02 mm).

NOTE Industrial realisations of this simulator use pinnae of different material properties leading to different results. Thus, the type of pinnae has to be stated in the measurement protocol.

The sound pressure level measured by the ear simulator microphone represents the pressure found at eardrum level and differs from that of the free field pressure by the HATS transfer function. In order to keep good correlation with noise measurements and epidemiological studies on hearing impairment, raw measurement data will be converted into free field values (0° frontal incidence). This will be done by subtracting the free field frequency response of the HATS expressed in third octave frequency bands.

Free field response shall be used in order to conform to European current regulations and standards, and for the better availability of calibrating data for existing devices.

Weighting curve A shall be used in order to conform to current regulations and standards.

The results are given as "free field related A-weighted equivalent continuous sound pressure levels (L_{Aeq}).

5 Test signal

5.1 General

Actual musical signals are continuously fluctuating in both amplitude and spectral contents and thus cannot be used as test signals.

As the frequency response curve of earphones may show considerable fluctuations, accurate measurements cannot be performed using a sinusoidal signal at a determined frequency (e.g. 1 kHz).

The test signal must therefore be a stationary wide-band signal, the spectral content of which is representative of the musical signals.

The test signal used to determine the maximum sound pressure level of headphones shall be programme simulation noise, as defined in IEC 60268-1.

NOTE 1 IEC 60268-1 defines a test signal called "programme simulation noise" described as: "A signal whose mean power spectral density closely resembles the average of the mean power spectral densities of a wide range of programme material, including both speech and music of several kinds". This signal is a weighted stationary Gaussian noise and can be obtained from pink noise with a suitable filter network.

NOTE 2 This noise is used in particular for determining the nominal power rating of loudspeakers.

This programme simulation noise must have a crest factor ranging between 1,8 and 2,2. Thus, this signal will be easy to record on various media (compact cassette, CD audio, ...)

Since portable cassette and CD players are playback only devices, it is necessary to define a reference cassette and a reference CD for test.

Test signal recording level is a major issue, as the whole measuring process will depend on this setting.

5.2 Recording level on compact cassette

With analogue tape recording on compact cassette, "0 dB" level recording corresponds by definition to a flux value of 250 nWb/m at a frequency of 315 Hz (EN 60094-2).

The recording level of the test cassette must be set considering both the frequency spectrum and the crest factor of programme simulation noise:

- the test recording tape shall be type 1 magnetic tape according to EN 60094-7;
- the test signal shall be recorded at an RMS value of –6 dB (ref 250 nWb/m at 315 Hz);
- the noise reduction system shall be switched off.

5.3 Recording level on CD, mini-disc and other digital audio media

For digital recording media, 0 dB reference level is defined as being the maximum amplitude of a sinusoidal signal corresponding to the full scale of the A/D converter (0 dB full scale):

- the test signal shall be recorded at an RMS value of –10dB (ref 0 dB full scale).

5.4 Test signal level for FM radio

Measurements on receivers for frequency modulated sound broadcasting emissions are defined in EN 60315-4.

NOTE Signal peak to peak level at a receiver's output is directly proportional to the peak frequency deviation of the RF carrier.

In order to comply with the definition of maximum peak frequency deviation (determined with a sinusoidal modulating waveform), and to take into account pre-emphasis influence, the test signal applied at the input of the RF generator shall be set at an RMS value of –6 dB related to the amplitude of a sinusoidal waveform at 250 Hz, producing a peak to peak deviation of ± 75 kHz.

6 Measuring arrangement and test protocol

6.1 General

The device under test plays the recorded test signal (for operating conditions see 6.3). Earphones or headphones shall be correctly positioned on the HATS. The sound pressure level emitted by the earphones or headphones of the portable audio equipment is measured, for both right and left ear, by a third octave analyser connected to the microphone of the HATS ear simulator.

For each third octave band, the free field response of HATS is subtracted from the value of the pressure level delivered by HATS.

The A-weighting curve is applied. (Type of pinnae has to be stated in the measurement protocol, see note in clause 4).

Figure 1 shows a possible measuring arrangement.

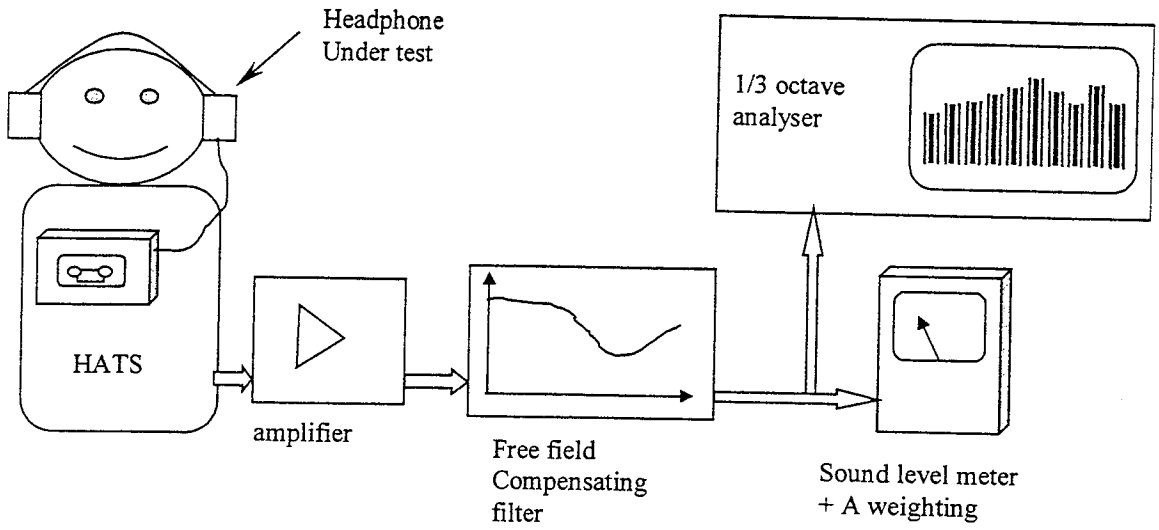

Figure 1 — Measuring arrangement

6.2 Headphone fit

Various types and shapes of headphones or earphones (as described in EN 60268-7) can be supplied with portable audio sets, depending on manufacturers and models.

Main types can be considered according to the following principles:

- supra-aural,
- circumaural,
- supra-concha,
- intra-concha.

Supra-concha and intra-concha earphones shall be positioned on the manikin in order to fit normally, taking into account the manufacturer's instructions for use.

Supra-aural and circumaural headphones shall be positioned on the HATS so that the measured sound pressure level is maximised.

NOTE This position can be found more easily by monitoring the output during fitting, e.g. by a real time analyser.

6.3 Operating conditions

Devices under test shall be powered by a stabilised power supply, at their nominal supply voltage, with a tolerance of ± 3%.

When testing devices, all measurements shall be taken at the following settings:

- noise reduction system : OFF
- volume control : maximum
- tone control : adjusted in order to maximise the sound pressure level.