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Varovala sluha - Preskušanje - 3. del: Dodatna akustična preskusna metoda

Hearing protectors - Testing - Part 3: Supplementary acoustic test method

Gehörschützer - Prüfung - Teil 3: Zusätzliche akustische Prüfverfahren

Protecteurs individuels contre le bruit - Essais - Partie 3 : Méthodes d'essais acoustiques supplémentaires

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Hearing protectors - Testing - Part 3: Supplementary acoustic test method

Protecteurs individuels contre le bruit - Essais - Partie 3 : Méthodes d'essais acoustiques supplémentaires

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 13819-3:2016) has been prepared by Technical Committee CEN/TC 159 “Hearing protectors”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

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This document is a draft under development by CEN/TC 159/WG 2 *Electronic and amplitude sensitive hearing protectors*.

Introduction

This standard is part of a set of standards for personal hearing protectors.

The EN 13819 series consists of three parts and deals with testing plans of hearing protectors.

— *Part 1: Physical test methods*

— *Part 2: Acoustic test methods*

— *Part 3: Supplementary acoustic test methods*

EN 13819-1 and EN 13819-2 deal with testing common to all types of hearing protectors. An overview of the supplementary test methods of this standard and the relative hearing protector they are used for is reported in Annex A.

The EN 352 series addresses product requirements. EN 352-1 deals with requirements for earmuffs, EN 352-2 for earplugs and EN 352-3 for earmuffs attached to industrial safety helmets. Safety requirements for level-dependent earmuffs are contained in EN 352-4, for earmuffs with active noise reduction in EN 352-5, for earmuffs with electrical audio input facility in EN 352-6, for level-dependent earplugs in EN 352-7, for entertainment audio earmuffs in EN 352-8, for earplugs with electrical audio input in prEN 352-9 and for earplugs with entertainment audio input in prEN 352-10.

An associated standard, EN 458, covers selection, use, care and maintenance of hearing protectors.

1 Scope

This European Standard specifies supplementary acoustic test methods for hearing protectors. The purpose of these tests is to enable assessment of the hearing protector performance as specified in the appropriate product standards.

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.

EN 24869-1:1992, *Acoustics - Hearing protectors - Subjective method for the measurement of sound attenuation (ISO 4869-1:1990)*

EN 60318-4:2010, *Electroacoustics - Simulators of human head and ear - Part 4: Occluded-ear simulator for the measurement of earphones coupled to the ear by means of ear inserts (IEC 60318-4:2010)*

EN ISO 4869-2:1995, *Acoustics - Hearing protectors - Part 2: Estimation of effective A-weighted sound pressure levels when hearing protectors are worn (ISO 4869-2:1994)*

EN ISO 11904-1:2002, *Acoustics - Determination of sound immission from sound sources placed close to the ear - Part 1: Technique using a microphone in a real ear (MIRE technique) (ISO 11904-1:2002)*

EN ISO 11904-2:2004, *Acoustics - Determination of sound immission from sound sources placed close to the ear - Part 2: Technique using a manikin (ISO 11904-2:2004)*

ITU-T P.50:1998, *SERIES P: TELEPHONE TRANSMISSION QUALITY, TELEPHONE INSTALLATIONS, LOCAL LINE NETWORKS, Objective measuring apparatus, Artificial voices. Appendix I: Test signals*

3 Terms and definitions

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

3.1
hearing protector
device that can be an earmuff or an earplug

3.2
ear simulator
device for measuring the acoustic output of sound sources where the sound pressure is measured by a calibrated microphone coupled to the source so that the overall acoustic impedance of the device approximates that of the normal human ear at a given location and in a given frequency band

[SOURCE: EN 60318-4:2010, 3.4]

3.3
occluded-ear simulator
ear simulator which approximates the acoustic transfer impedance of the inner part of the ear canal, from the tip of an ear insert to the eardrum

[SOURCE: EN 60318-4:2010, 3.5]

Note 1 to entry: The standard EN 60318-4 replaced IEC 60711.

3.4
insertion loss
algebraic difference in decibels between the one-third octave band sound pressure level, measured by the microphone of the acoustic test fixture with the hearing protector absent, and the sound pressure level with the hearing protector present

[SOURCE: EN ISO 4869-3:2007, 3.7]

3.5
sound attenuation
difference, in decibels, between the threshold of hearing with and without the hearing protector in place for a test subjects, for a given test signal

[SOURCE: EN 24869-1:1992, 3.8]

3.6
reference point
fixed spatial location within the test chamber at which the midpoint of a line connecting the test subject's or ATF's ear canal openings is located for MIRE or ATF measurements, and likewise the point to which all objective measurements of the sound field characteristics are referenced

3.7
acoustic test fixture
ATF
device that approximates certain dimensions of an average adult human head

[SOURCE: EN ISO 4869-3:2007, 3.4]

3.8
head simulator
acoustic test fixture with an occluded ear simulator

3.9
level-dependent hearing protector

hearing protector designed to provide restoration of external sounds, while providing attenuation of sounds at high levels

3.10
active noise reduction hearing protectors
hearing protectors designed to provide additional attenuation of external sounds by means of a noise cancellation circuit

3.11
hearing protector with electrical audio input
hearing protector designed to provide speech information and warning signals, while providing attenuation of sounds in excess of limit levels

3.12
entertainment audio hearing protector
hearing protector designed to provide not only sound attenuation to ambient sound but also to provide entertainment audio via built-in loudspeakers

3.13
crest factor
peak amplitude of the signal divided by its rms value in linear scale

3.14
decibel full scale
decibel with respect to digital full scale

Note 1 to entry: The full scale amplitude (0 dB FS) is the rms value of a sine wave whose positive peak just reaches positive full scale.

4 Symbols and abbreviations

ANR	Active Noise Reduction
ATF	Acoustic Test Fixture
APV	Assumed Protection Value
DUT	Device Under Test
MIRE	Microphone In Real Ear
rms	root mean square
SNR	Single Number Rating
SPL	Sound Pressure Level
dB FS	decibel Full Scale

5 Acoustic Test Method

5.1 Conditioning and testing atmosphere

All specimens shall be conditioned for 4 hours and tested in an atmosphere having a temperature of 22 °C ± 5 °C and a relative humidity of not more than 85 %.

5.2 Occluded-ear simulator

The occluded-ear simulator shall be used together with an ear canal extension and a pinna simulator, when necessary. Different ear canal extensions and pinna simulators may be used. When earplugs with electronic level-dependent feature are tested (7.1.2) the individual diffuse-field related transfer function for the specific equipment shall be determined and used. When other earplugs are tested the earplug end shall be positioned at the reference plane according to EN 60318-4:2010, Figure 1 and the diffuse-field frequency response of EN ISO 11904-2:2004, Table 1 shall be used as diffuse-field related transfer function.

5.3 Occluded-ear simulator built into an acoustic test fixture

The occluded-ear simulator built into an acoustic test fixture (ATF) shall be used to achieve sufficient attenuation of the test fixture. Different ear canal extensions and pinna simulators may be used and the diffuse-field related transfer function shall be measured.

5.4 Microphone in Real Ear (MIRE)

The MIRE-technique as described in EN ISO 11904-1 shall be used with the following exception: in the area of the concha the microphone, including supporting elements and electrical leads, shall occupy an area not exceeding 25 mm^2 in the plane perpendicular towards the centre axis of the ear canal. The

microphone position, as shown in EN ISO 11904-1:2002, Figure 1 a) shall be used, i.e. with an open ear canal and the port of the microphone showing towards the ear drum and positioned in between the ear canal entrance and the ear drum, preferably at a distance of a few mm from the ear canal entrance.

Test subject noise exposure shall be monitored. The microphone, its mounting and electrical leads shall not introduce leakage between the head or earphone and the ear.

Alternatively, for safety reason, the occluded ear canal can be used as reported in EN ISO 11904-1:2002, Figure 1 c).

The measurement and calculation of the diffuse-field correction shall be carried out according to EN ISO 11904-1 for each test subject.

6 Test signals

Test signals can be realized acoustically as sound or transmitted by other means, for example electrically.

6.1 HML test sounds

The test signal at the reference point of the sound field shall be a broadband random noise with three different spectra in the frequency range 100 Hz to 10 kHz and a defined $L_C - L_A$ value:

— H-oriented noise $L_C - L_A$ = −1,2 dB (−0,2 dB, +0,1 dB)

— M-noise $L_C - L_A$ = 2 dB (−0,2 dB, +0,2 dB)

— L-oriented noise $L_C - L_A$ = 6 dB (−0,2 dB, +0,4 dB)

NOTE 1 The spectrum of the H-oriented noise has a rising output (+3 dB/octave) between 100 Hz and 10 kHz. The spectrum of the M-noise has a flat output up to 2 kHz and a falling characteristic above. The spectrum of the L-oriented noise has a falling output (−3 dB/octave) from 100 Hz to 10 kHz.

The crest factor shall be 5 + 1.

Annex B gives the SPLs in one-third octave bands for the three test sounds with L_A = 100 dB with permissible tolerances in dB.

NOTE 2 In EN ISO 4869-2, H-noise is defined as having an L_C-L_A-value of −2 dB and L-noise is defined as having an L_C-L_A-value of 10 dB. It has been found that the generation of H and L test noises is not straightforward and for the purposes of this standard, alternative noises of slightly different spectral shape are stated.

6.2 Broadband noise (pink noise) test sound

A broadband noise spectrum shall be used as test signal for ANR hearing protectors and for determining the diffuse-field related SPLs. The crest factor shall be 5 ± 1. An adequate signal to noise ratio shall be present across the range of tested frequencies. Some minor equalization of the test signal may be necessary to achieve this.

Annex B gives the SPL in one-third octave bands for pink noise test sound with L_A = 100 dB with permissible tolerances in dB.

6.3 Speech signal

The speech test signal according to ITU-T P50_F (Female speech test signal) shall be used for testing communication facilities.

6.4 Entertainment audio test signal

The test input signal should be broadband noise having the overall spectrum shape of long-term speech and music as referenced in IEC 60268-1. The crest factor shall be of 5 ± 1.

7 Test procedures

7.1 Level dependent hearing protectors

The A-weighted equivalent diffuse field related SPL is measured with the sound transmission systems switched on and operating at full volume for three different external noise spectra. The measurements are conducted in a range of sound level settings. The HML test sounds according to 6.1 shall be used.

7.1.1 Earmuff with electronic level dependent feature

7.1.1.1 Test method

The effective attenuation of the earmuff, comprising the passive attenuation and the sound output of the level-dependent function shall be measured using the MIRE technique described in 5.4. The measured sound levels shall be corrected for the diffuse-field frequency response of the test subject to give the equivalent diffuse-field SPL produced by the level-dependent earmuff as a function of the external SPL. If the DUT is fitted with a volume control, it shall be set to maximum audio output.

Four earmuffs and eight test subjects shall be used. Each of the four earmuff samples shall be worn by two subjects. Measurements shall be taken on both ears.

Determine the A-weighted equivalent diffuse field related SPL as a function of the external noise level for each ear and for each type of test sound specified in 6.1. The measurement shall start at an external SPL of 65 dB(A) and shall increase in steps of 5 dB, ensuring that data points lower and higher than 85 dB(A) are encompassed.

The measurement shall start 10 s after the activation of the test signal or a period specified by the manufacturer. The measurement time shall be 20 s.

If the DUT is battery powered a specified fresh battery shall be fitted. Systems with external power source (e.g. hearing protector connected to a radio system) shall be operating as specified by the manufacturer).

7.1.1.2 Calculation procedure

Calculate, for each of the sixteen ears tested, the external noise level for which the A-weighted equivalent diffuse field related SPL equals 85 dB(A). Use linear interpolation between adjacent values of the external noise SPL on either side of the 85 dB(A) criterion value.

Calculate the mean value and the standard deviation of the interpolated values of the external noise SPL for the sixteen ears tested.

Subtract one standard deviation from the mean value of external noise level to obtain the criterion level for each type of external noise spectrum.

Obtain the criterion levels for H-noise with $L_C - L_A = -2$ dB and L-noise with $L_C - L_A = 10$ dB by extrapolation from the M-value to the H-oriented resp. the L-oriented values. Assume a linear relation for the change in external SPL with $(L_C\text{-}L_A)$-value on either side of the M-value of $L_C - L_A = 2$ dB.

A detailed calculation example is reported in C.1.