World Health Organization

Safe Listening

Devices and Systems

A WHO-ITU standard

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Safe listening devices and systems: a WHO-ITU standard

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Abbreviations and acronyms

CSD	calculated sound dose
DAC	digital to analogue conversion
dBA	decibels of sound pressure level measured using the a-weighting network
dBFS	decibel full scale
dBHL	decibels of hearing level
dBSPL	decibel sound pressure level
DRP	eardrum reference point
LAEQ	equivalent continuous average sound level
LEX	equivalent continuous average sound level normalized
NIHL	noise-induced hearing loss
PAD	personal audio device
PAS	personal audio system
PMP	personal media player
RMS	root mean squared
SIHL	sound-induced hearing loss
SLD	safe listening device
SPL	sound pressure level

Glossary

dBA: Decibels of sound pressure level measured using the A-weighting network; a level intended to measure low-intensity noise (around 40 phon loudness level) but has become commonly used also for measuring occupational and environmental noise exposures.

dBHL: Decibels of hearing level at a certain frequency; a level used to measure audiometric hearing threshold relative to the level defined as normal.
NOTE – It is the ear's sensitivity in a human with normal hearing, at different frequencies, that is the reference. ISO 226 is a mapping of phon against dB SPL, and the two scales meet at 1 kHz. dB SPL, which is by definition referenced at the threshold of hearing at 1 kHz, i.e. 0 phon (and 0 dB SPL).

Sound dose: The total quantity of sound received by the human during a specified period. In the context of the WHO-ITU Global standard, it is the same as sound exposure. The unit of (sound) dose is Pa2h.

Dosimetry: The calculation and assessment of the sound dose received by a human.

Equal energy principle: The assumption that equal amounts of sound energy will cause equal amounts of sound-induced permanent threshold shift, regardless of the distribution of the energy across time.

Equivalent continuous A-weighted sound pressure level: A continuous sound pressure level (SPL) in dBA which is considered to pose the same risk as a time-varying SPL, calculated using a 3 dB exchange rate between level and time. Mathematically, it is represented as:

$$L(Aeq,T)=10\lg\{[1/T\int_{t_1}^{t_2} p_A^2(t)dt]/p_0^2\}\text{dBA}$$

where
LAeq,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 (t) is the reference sound pressure of 20 µPa

Equivalent continuous average sound level normalized: A continuous SPL in dBA which is considered to pose the same risk as a certain time-varying SPL pattern measured using a 3 dB exchange rate, and normalized to an *n*-hour exposure period. Examples of the values for *n* is 8, in which case this may also be referred to as an L_{A8hn} or L_{EX8h}", or *n*=40, L_{EX40h}.

Exchange rate: The change in average noise level (in dB) that corresponds to a doubling or halving of allowable exposure time.

Frequency response: In this context, frequency response is short for "sensitivity vs. frequency response", sometimes referred to as the "tone curve" of an audio device, such as a headphone, loudspeaker, microphone, amplifier etc.

Listening device: A device used to transmit sound to the ear. Consists of a transducer and fitting to accommodate in the ear, on the ear or over the ear listening. Examples are headphones and earphones.

Media: Audio or audiovisual content for entertainment, whereby long term exposure may result in hearing loss. Examples are music, gaming and podcasts.

Personal audio device: A portable device designed to be worn on the body or in a pocket. It is designed to allow the user to listen to various forms of media.

Personal audio system: A system comprising a personal audio device and a listening device.

Safe listening device: A personal audio device/system that meets requirements and criteria to minimize users' risk of acquiring hearing loss, (as a consequence of its use) can possibly be termed a "safe listening device". It could include music players (MP3 players, smartphones and personal music players), which together with a transducer can convert an electric signal into audio (e.g. earphones and headphones).

Sound allowance: A dose estimate of sound exposure over a certain rolling period of time (e.g., daily or weekly), commonly expressed in percentage of the maximum regarded as safe. A weekly sound allowance is equivalent to 100% cumulative sound dose.

Sound-induced: Refers to a state or a quality resulting from exposure to sound. The sound may be (part of) music or "noise", which implies the sound is not desirable.

Transducer: An electronic device that converts energy from one form to another.