

Standards for Safe Listening – how they align and how some differ

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The ‘Make Listening Safe workgroup’ is an initiative of The World Health Organization (WHO) in the framework of the World Hearing Forum and is committed to creating a world where nobody’s hearing is put in danger due to unsafe listening. In this article, the authors focus on standards for safe listening in the industry, for personal music players and for personal amplifiers.

Noise exposure in the industry

In 1971, the first ISO standard ISO 1999 ‘Acoustics — Assessment of occupational noise exposure for hearing conservation purposes’ was published [1]. Noise exposure level over time is the main criterium used in this standard and the studies used as reference in the standard have evaluated the impact of exposure level of time on the pure tone audiogram of the participants. The risk of noise induced hearing loss significantly increases from an exposure of 85 dBA Lex8h/day and higher.

In 1972, the first NIOSH (National Institute for Occupational Safety and Health) guidelines were published [2]. In the NIOSH guidelines, the concept of daily dose was introduced and a table for ‘Combinations of noise exposure levels and durations that no worker exposure shall equal or exceed’ is displayed, exposure level 85dBA – eight hours or equivalent. This concept is based on the energy equivalence principle.

In 2003, the European Commission published the EU Noise at Work Regulations (Directive 2003/10/EC), which set three action levels:

- Lower exposure action values - at 80dB(A) LEX,8h the employer shall make individual hearing protectors available to workers.
- Upper exposure action values - at 85dB(A) LEX,8h individual hearing protectors shall be used - the individual hearing protectors shall be so selected as to eliminate the risk to hearing or to reduce the risk to a minimum.



- Exposure limit values - at 87dB(A) LEX,8h under no circumstances shall the exposure of the worker exceed the exposure limit values.

Safe Listening with personal audio systems

In 2010 the International Electrotechnical Commission published the first standard IEC 62368-1 on Audio/video, information and communication technology equipment Part 1: Safety requirements [3]. The LAeq,T acoustic output shall be lower or equal to the relevant RS2 sound output value of 100dBA.

In the new ITU and WHO standard H.870, ‘Guidelines for safe listening devices/ systems’ (2018), the weekly sound dose should be limited to the equivalent of

80dBA for 80 hours/week or 1.6 Pa²h as a standard safety level [4]. Personal audio systems need to be equipped with a monitoring function that sets the above exposure as a one-week sound allowance. Some companies are already implementing this monitoring feature this year.

In 2018, IEC 62368-1 was reviewed and the concept that weekly sound dose should be limited to the equivalent of 80dBA for 80 hours/week or 1.6 Pa²h as a standard safety level was also added to this standard.

Safe Listening with personal amplifiers

In 2015, the joined associations EFHOH (European Federation of Hard of Hearing People) and AEA (European Association of Hearing Aid Professionals) published

dB(A) SPL	Weekly (1,6 Pa ² h)
107	4.5 minutes
104	9.5 minutes
101	18,8 minutes
98	37,5 minutes
95	75 minutes
92	2,5 hours
89	5 hours
86	10 hours
83	20 hours
80	40 hours

Table 1 - ITU-WHO Weekly safe listening time - energy equivalence principle

'Paper on the potential risk of using "Personal Sound Amplification Products" PSAPs' in which 27 personal amplifiers were analysed. All devices had a maximum output level of more than 120dB SPL, 23 exceeded 125dB SPL and eight even 130dB SPL. None of the products had a limiter of the maximum power. This alarming report initiated the ITU standard on personal amplifiers.

In 2017 the Consumer Technology Association, published the ANSI/CTA standard 2051 on 'Personal Sound Amplification Performance Criteria' [5]. The safety aspects in this standard state that "the maximum OSPL₉₀ output level shall not exceed 120dB SPL measured in a 2cc coupler". This standard exceeds the safety level set by IEC 62368-1 with more than 15dB.

In 2019, ITU published ITU-T H.871, which can be considered a companion standard to H.870, which describes safety requirements for personal sound amplifiers (PSA) [6].

For PSAs with the capacity to measure weekly dose, it is required that weekly maximum sound dose needs to be less than 1.6 Pa²h, which corresponds to 80dBA for 40 hours.

When PSA's do not have the capacity to measure weekly sound dose, the maximum output of the device needs to be permanently limited to 95dBA; a user then

is unlikely to use the device at a level higher than 80dBA since the dynamic range of speech has a crest factor of 12 to 17dB and PSA's need to provide adequate warnings.

Conclusions

In all the standards, there is a clear consensus that 85dBA average exposure for eight hours/day leads to irreversible noise induced hearing loss. For the availability of hearing protection at work, for personal music players and personal amplifiers the exposure should be less than 1.6 Pa²h, which corresponds to 80dBA for 40 hours.

Although only setting a maximum output level is not advisable, since this can result in higher compression in the source music file or in the amplification, for personal sound amplifiers that don't have the capacity to measure weekly dose needs to be permanently limited to 95dBA.

References

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3. IEC 62368-1 on Audio/video, information and communication technology equipment Part 1: Safety requirements. IEC (International Electrotechnical Commission) - <https://webstore.iec.ch/publication/27412>.
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