Global standard for safe listening video gameplay and esports

World Health Organization

ITU

Global standard for safe listening video gameplay and esports

Global standard for safe listening video gameplay and esports

ISBN (WHO) 978-92-4-010802-8 (electronic version)
ISBN (WHO) 978-92-4-010803-5 (print version)
ISBN (ITU) 978-92-61-40601-1 (electronic version)
ISBN (ITU) 978-92-61-40611-0 (print version)

Suggested citation. Global standard for safe listening video gameplay and esports. Geneva: World Health Organization and International Telecommunication Union, 2025. Licence: CC BY-NC-SA 3.0 IGO.

Cataloguing-in-Publication (CIP) data. CIP data are available at https://iris.who.int/.

Design and layout by Inis Communication

Cover photo: A young teenage girl, wearing over the ear video game headphones, playing a video game on a PC device. @ International Telecommunication Union

Contents

Acknowledgements

The Global standard for safe listening video gameplay and esports is the outcome of a consultative process led by the World Health Organization (WHO) and the International Telecommunication Union (ITU). It was drafted by Shelly Chadha, WHO Headquarters, Noncommunicable Diseases department (WHO HQ/NCD); Peter Mulas (WHO HQ/NCD); Masahito Kawamori (ITU); and Simao Campos de Nato (ITU-T), under the guidance of Alarcos Cieza (WHO HQ/NCD); Guy Fones (WHO HQ/NCD); and Bilel Jamoussi (ITU).

Invited experts who contributed to the standard include: Brian Schmidt (President of Game Audio Network Guild, United States of America), Nicola Diviani (Senior Research Fellow, Swiss Paraplegic Research, Lecturer, University of Lucerne, Switzerland); Mark Laureyns (Audiologist, Lecturer, Thomas More University College, Belgium, and President of the European Association of Hearing Aid Professionals); Sara Rubinelli (Professor, Health Communication, University of Lucerne and Swiss Paraplegic Research, Switzerland); Dorte Hammershøi (Professor, Department of Electronic Systems, Aalborg University, Denmark), Patrik Žúdel (representative of user group) and members of the ITU Study group (Q28/16 Multimedia framework for e-health applications).

The document also benefitted from contributions by the following WHO staff: Carolina Der (WHO HQ/NCD), Lauren Dillard (WHO HQ/NCD) and Chitra Chander (WHO HQ/NCD). Financial support for this work was provided by the International Society of Audiology and Michael Chowen CBE HL (Help for Hearing).

Abbreviations and acronyms

dB	decibel
dBA	A-weighted decibel
ITU	International Telecommunication Union
LU	loudness unit
LUFS	loudness unit full scale
Pa²h	pascal squared hour (unit of sound dose)
PC	personal computer
SPL	sound pressure level
VGD	video gameplay device
WHO	World Health Organization

Glossary

audio peripheral: An external device that either captures or outputs sound and connects to a computer system for the purpose of enabling or contributing to video game audio. In the context of video gameplay, audio peripherals typically include (but are not limited to) earphones, headphones and headsets.

close fitting audio devices: such as headphones, earphones, ear buds, in ear monitors (IEMs); wireless and wired, which often feature both sound producing components (for e.g., drivers, speakers, etc) as well as sound capturing components (for e.g., microphones).

dBA: decibels of sound pressure level measured using the A-weighting network; a level intended to measure low-intensity noise (around the 40 phon loudness level), which is now also commonly used to measure occupational and environmental noise exposures.

dBHL: decibels of hearing level at a certain frequency; a level used to measure the audiometric hearing threshold relative to the level defined as normal.

Note: The reference is the human ear's sensitivity with normal hearing, at different frequencies. ISO 226 is a mapping of Phon against decibel sound pressure level (dB SPL), and the two scales meet at 1 kilohertz (kHz) dB SPL, which is by definition referenced at the threshold of hearing at 1 kHz, i.e. 0 phon (and 0 dB SPL).

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:

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

where:

LAeq,T	is the equivalent continuous A-weighted sound pressure level re 20 μPa, determined over a time integration interval T = t2 – t1
pA (t)	is the instantaneous A-weighted sound pressure of the sound signal
p0	is the reference sound pressure of 20 μPa.

equivalent continuous average sound level normalized: a continuous sound pressure level (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. An example of the values for *n* is 8, in which case this may also be referred to as an LA8hn or LEX8h, or *n*=40, LEX40h.

esports: competitive and organized computer and video gameplay, in which two or more parties (individuals or teams) face each other under regulated and balanced conditions.

esports live event: an event held around competitive video gameplay, involving video game tournaments and related content. These events are conducted in a live format, sometimes in designated venues, where esports enthusiasts gather to witness the gameplay, competition, and associated entertainment. Esports live events may feature sound reinforcement audio systems, multimedia displays (such as large screens) and stages to showcase the gameplay, commentary, and highlights to the audience.

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

free-field audio devices: devices capable of propagating sound from a connected source, such as speakers, soundbars and sound systems

frequency response: in this context, a term that is short for “sensitivity vs frequency response”, sometimes referred to as the “tone curve” of an audio device, such as a headphone, loudspeaker, microphone or amplifier.

headphone safety mode: A hearing protection feature used within a video gameplay device or software that activates when a game player switches from free-field loudspeaker to headphone or headset audio peripheral.

listening device: a device used to transmit sound to the ear, consisting of a transducer and a fitting to accommodate in-the-ear, on-the-ear or over-the-ear listening. Examples include headphones and earphones.

loudness K-weighted full scale (LKFS): the LKFS unit is equivalent to a decibel in that an increase in the level of a signal by 1 dB will cause the loudness reading to increase by 1 LKFS. *ITU-R BS.1770*.

loudness unit (LU): the unit of measurement used in the process of quantifying a digital recording's perceived loudness by analysing the average level over time.

loudness Unit Full Scale (LUFS): LUFS' is equivalent to 'LKFS'. The European Broadcast Union (EBU) uses 'LUFS' which is compliant with international naming conventions. *EBU R 128–2023*.

media: audio or audiovisual content for entertainment, whereby long-term exposure may result in hearing loss. Examples include music, video games and podcasts.

personal audio device: a portable device designed to be worn on the body or carried in a pocket which allows the user to listen to various forms of media.

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

personal computers (PCs): Computers (including laptops) with capabilities to run and play video games.

safe listening device: a personal audio device/system that meets requirements and criteria to minimize its users' risk of acquiring hearing loss (as a consequence of its use). It can include music players (MP3 players, smartphones and personal music players) that 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 as a percentage of the maximum regarded as safe. A weekly sound allowance is equivalent to a 100% cumulative sound dose.

sound dose: the total quantity of sound received by the human during a specified period. In the context of the World Health Organization–International Telecommunication Union (WHO–ITU) global standard, it is the same as sound exposure. The unit of (sound) dose is Pa^2h.

sound-induced: 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.

video game: an electronic game that involves interaction with a user interface or input device (such as a joystick, controller, keyboard or motion sensing device) to generate visual and/or audio feedback for a player. These games encompass a wide variety of genres and formats, ranging from simple arcade games to complex, immersive simulations. They can be played on various platforms, including personal computers, video game consoles, handheld devices and mobile phones.

video game console: a purposed game playing system designed to connect to televisions or monitors, providing a platform to run video games.

video gameplay device: a device designed to execute the software instructions that constitute a video game. It comprises a combination of hardware, firmware and an operating system that facilitate the playing, processing, rendering and production of immersive video and audio gameplay content. A video gameplay device can be designed to be stationary, such as a video game console or arcade game device, or portable. In the context of this safe listening standard, examples include video game consoles, handheld or mobile devices and personal computers.

video gameplay peripheral: an additional video game hardware connected to a VGD that provides some sort of additional functionality relevant to a particular video game being executed. Whilst peripherals can provide a range of functions, those most relevant to this standard are peripheral devices capable of reproducing or capturing audio, such as:

video gameplay software: refers to computer programs and applications specifically crafted to facilitate interactive engagement with video gameplay content.

video gameplay software title: name or title given to a specific video game software program or application used to distinguish one video game from another.

virtual reality (VR) and augmented reality (AR) devices: Hardware systems that enable players to experience games in immersive virtual or augmented environments.

Executive summary

The World Health Organization (WHO) and the International Telecommunication Union (ITU) have developed a global standard to promote safe listening practices in video gameplay and esports. This initiative addresses the growing concern over the risk of hearing loss due to prolonged exposure to loud sounds during recreational activities, including video gameplay.

This document outlines the key features and requirements that video gameplay devices and/or video gameplay software titles must have in order to facilitate safe listening practices among users, as set out in the *ITU-T H.872 Safe listening for video gameplay and esports*.

The recommendations in this document are based on the best available knowledge and evidence on principles of hearing loss prevention and criteria for hearing damage caused by sound. They also address the need for, and methods of, communication to facilitate behaviour change in users of video gameplay devices, video gameplay software titles, and those who participate in esports activities.

Objectives of the standard

This standard is intended for implementation by manufacturers of video gameplay devices, video game titles (software) and audio peripherals used for the purposes of video gameplay, either in home entertainment or esports contexts. Through its application, the standard aims to:

- inform and educate video game players about their sound exposure and the associated risks;
- increase awareness of safe listening practices through information and warnings; and
- ensure the availability of safe listening features in video gameplay devices and software.

Safe listening features recommended in the standard

Features for video gameplay devices

1. **Sound allowance tracking (dosimetry):** Devices must measure and track the user's sound exposure, providing feedback on safe listening limits.
2. **Safe listening messages:** Devices should deliver timely messages about sound usage and warnings when safe limits are exceeded.
3. **Volume control system:** Devices should include a user-friendly system that is easy to adjust and limits volume, as well as parental controls for children's devices.
4. **Inclusion of a headphone safety mode:** Devices must include an automatic volume reduction mechanism when switching from loudspeakers to headphones.

Features for video gameplay software titles

1. **Safe listening warnings and messages:** Software must include warnings about auditory risks and provide notifications at appropriate times.
2. **Sound category and master volume controls:** Software must include independent volume controls for different sound categories to help manage exposure.
3. **Software title specific inclusions:** Software titles should include features tailored to the game's sound design, such as dynamic range set-up, tinnitus sound removal and passive gameplay audio reduction.
4. **Inclusion of a headphone safety mode:** Software titles should provide a default headphone safety mode to automatically reduce the volume of the audio output should a switch between loudspeakers and headphones be detected.

Textual warnings and information

1. **Provision of appropriate safe listening information:** This standard specifies that video gameplay devices and video gameplay software titles must include appropriate, textual information in user guides, electronic resources or related websites.
2. **Safe listening feature information:** VGDs and video gameplay software titles must include information that explains the purpose and/or rationale of any included safe listening features that are available to the game player.

Implementation and usage

- Manufacturers and developers are encouraged to voluntarily adopt these features to ensure safe listening practices.
- Governments can incorporate these standards into regulations to protect the hearing of their citizens.
- Civil society groups and consumer associations can advocate for the inclusion of safe listening features in video gameplay devices.

Conclusion

The Global standard for safe listening video gameplay and esports aims to reduce the risk of hearing loss in video game players by promoting safe listening practices without compromising the experience of video gameplay. By implementing this guidance, stakeholders can contribute to a healthier and safer video gameplay environment for all.

Standard Feature Summary

Video gameplay devices

Feature 1: Sound allowance tracking (dosimetry)

Video gameplay devices shall measure the video gameplayer's sound exposure, based on a choice of two modes of reference exposure.

Feature 2: Safe listening messages

A video gameplay device must provide players with messages regarding general sound usage, including time spent, sound consumption, and predictions of when their sound limit will be reached.

Feature 3: Volume control system

A video gameplay device must include a user-friendly volume control system that can be easily adjusted according to the selected operational mode.

Feature 4: Inclusion of a "headphone safety mode"

Video gameplay devices which shares an audio output connection between headphone and loudspeakers must have an automatic mechanism available to reduce the volume when a gameplayer changes the connection.

Video gameplay software titles

Feature 1: Safe listening warnings and messages

Video gameplay software must include a message or warning for players about the auditory risks associated with loud sounds and prolonged exposure during gameplay activities.

Feature 2: Sound category and master volume controls

The video game software must include independent volume controls for different sound categories, allowing players to adjust levels and selectively mute various sounds within the game. These options could be found under the game's audio menu.

Feature 3: Software title dependent safe listening features

The standard promotes safe listening features adapted to the soundtrack, genre, and sound design of each game. It provides examples and encourages developers to create game-specific solutions for listening safety.

Feature 4: Inclusion of a “headphone safety mode”

Video gameplay software capable of detecting a switch between a shared audio output connection between headphone and loudspeakers should have an automatic mechanism available to reduce the volume by at least 3 dB, when a gameplayer changes the connection.

This feature is not required where an equivalent feature is available on the VGD on which the software title is being played.

Textual warnings and information

Feature 1: Provision of appropriate safe listening information

Video gameplay devices and video game software must include appropriate, textual safe listening information in user guides, electronic resources or related websites.

Feature 2: Safe listening feature information

Video gameplay devices and video gameplay software titles must include information that explains the purpose and/or rationale of any included safe listening features that are available to the game player.

1. Introduction

Why was this standard developed?

How was this standard developed?

What are the aims and scope of this standard?

How can this standard be used?

1. Introduction

Why was this standard developed?

Concern is rising about the increasing exposure to loud sounds in leisure settings and activities, such as video gameplay, nightclubs, music festivals, pubs, bars, cinemas, concerts, sporting events and even fitness classes. With the popularization of technology, devices like smartphones, personal computers (PCs) and personal audio systems are listened to for longer periods of time and can be heard at unsafe volumes. Regular participation in such activities poses the serious threat of irreversible hearing loss.

Recent WHO and ITU estimates *(1, 2)* reveal the following:

- Globally, over 1 billion people are at risk of hearing loss due to unsafe listening in recreational settings *(3)*. To address this exposure, WHO launched the Make Listening Safe initiative to promote safe listening and reduce hearing loss.
- Over 1.5 billion people globally live with hearing loss of varying degrees, resulting from a range of causes. This number is projected to rise to over 2.5 billion by 2050, unless action is taken to mitigate the risk factors for hearing loss.
- Among teenagers and young adults aged 12–35 years in middle- and high-income countries, nearly 25% listen to unsafe levels of sound through personal audio devices, such as MP3 players and smartphones; approximately 50% are exposed to potentially damaging sound levels in nightclubs, discotheques and bars.

To address this risk, WHO launched the Make Listening Safe initiative in 2015 with the vision of a world where people of all ages can enjoy sound while fully protecting their hearing. The initiative seeks to reduce the risk of hearing loss from unsafe sound exposure in recreational settings.

As part of this effort, in 2018 WHO partnered with the ITU to develop *the Global standard for safe listening video gameplay and esports*, which sets guidelines for regulating exposure to loud sounds through

personal audio devices and systems, helping to mitigate hearing loss risks associated with their use.

In 2022, WHO introduced the *WHO Global standard for safe listening venues & events*, developed in collaboration with live music industry experts and stakeholders. This standard enables audiences worldwide to enjoy amplified music while protecting their hearing, without compromising the integrity of the artistic experience.

Despite the success of these two standards, a key gap remained: video gameplay and esports activities were not specifically covered. *The Global standard for safe listening video gameplay and esports* now fills this gap, promoting hearing health in the rapidly expanding world of video gameplay and esports.

Video gameplay, esports and risks to hearing

Video gameplay and esports are rapidly becoming one of the largest entertainment industries worldwide, reaching over 3 billion people, with approximately 1.7 billion gameplayers participating in video gameplay via a PC or a video game console (that are most likely to be playing with sound on or using headphones).

When these sounds are heard at high levels for long durations, they can permanently injure the delicate workings of the inner ear (refer Annex 1 for details of how sound affects ears).

A background study *(4)* undertaken by WHO reveals:

- **video gameplay as a source of risk:** examining recreational sound exposure from personal listening devices shows that 24% of young adults are at risk from unsafe listening practices; if similar trends exist within video game activities and the combined total of 1.7 billion PC and console players, then hundreds of millions of game players are potentially at risk of hearing damage from video game activities. Scientific literature further reveals that video gameplayers are more than twice as likely to have measurable high-frequency hearing loss compared to non-gameplayers;
- **the vulnerability of children:** children are especially vulnerable due to their lower tolerance for sound exposure and the increasing prevalence of video gameplay among young users;
- **a low-risk perception among players:** despite the risks, gameplayers often underestimate their susceptibility to hearing damage, contributing to a lack of proactive safe listening behaviours; and
- **the absence of existing standards:** no specific safe listening guidelines or standards previously existed for video gameplay devices (VGDs) or software.

To mitigate this risk, WHO and ITU have developed a universal standard for safe listening in video gameplay and esports whose implementation can mitigate the risk of hearing damage in players. This standard includes the standardization of sound levels, the measurement of sound exposure and the provision of information and warnings.

How was this standard developed?

Development process

The *Global Standard for Safe Listening in Video Gameplay and Esports* was informed by a foundational background paper *(4)* prepared prior to the development of this standard. This background paper included:

- a systematic scoping review of available literature on the topic of risks to hearing from video gameplay and esports activities (*5*);
- outcomes of an international video game player survey that aimed to gain insights into gameplayer perspectives on safe listening *(6);*
- a summary of stakeholder discussions reflecting the views of industry, civil society representatives and players of video games.; and
- stakeholder and expert group meetings.

The standard was developed collaboratively with the International Telecommunications Union (ITU) that contributed by bringing knowledge and expertise on standardization processes for technology and devices. Several stakeholder and expert group meetings were jointly hosted by WHO and ITU. Experts from the fields of technology, video gameplay hardware, gameplay software development, gameplay sound, esports, audiology and acoustics supported this effort.

The existing literature was extensively reviewed to guide the development of the WHO–ITU global standard. Users of technology were involved through online surveys, focus group discussions and in-depth interviews to understand their needs and preferences.

Inferences made from these contributions were shared with the expert group and considered during the drafting of the features in this standard. A sister publication, the *ITU-T H.872 Safe listening for video gameplay and esports*, is available on the ITU website at https://www.itu.int/rec/T-REC-H.872/en.

Management of conflict of interest

All invited experts completed and submitted a WHO Declaration of Interests form prior to the development of this standard.

The WHO department for Noncommunicable diseases reviewed and assessed the submitted declarations of interest and performed an internet search to identify any obvious public controversies or interests that may lead to compromising situations.

If additional guidance on management of any declaration or conflicts of interest had been required, the department would have consulted with colleagues in the Office of Compliance, Risk Management and Ethics.

If deemed necessary, individuals found to have conflicts of interest, financial or non-financial, would have been excluded from participation in any topic where interests were conflicting.

No conflict of interest was identified.

What are the aims and scope of this standard?

Aim

The aim of *the Global standard for safe listening video gameplay and esports* is to reduce the risk of and prevent the hearing loss of gameplayers by:

- informing video game players of their sound exposure when taking part in video gameplay activities;
- increasing awareness of the risk to hearing from loud video gameplay activities through the provision of information and warnings; and
- ensuring the availability of safe listening features that can be used by gameplayers to protect their hearing.

> **Note:** Importantly, the standard promotes safe listening without compromising the enjoyment, immersion or entertainment that video gameplay provides participants, or the artistic content produced by the game developer.

Scope

The features found in *the Global standard for safe listening video gameplay and esports* apply to VGDs, video game software titles and audio peripherals used for the purposes of video gameplay, either in home entertainment or esport contexts.

The standard recommends features for:

- VGDs (such as video game consoles, handheld or mobile devices and PCs, headphones and headsets); and
- Video game software titles.

The features proposed are designed to protect the hearing of all video game players, across a wide range of gameplay scenarios and equipment. Their implementation will allow game developers to create a safe listening experience, independent of the system on which the game is played.

How can this standard be used?

It is proposed that the features included in this WHO–ITU global standard be:

- implemented voluntarily by manufacturers of VGDs and/or developers of video gameplay software to ensure that their customers can practise safe listening;
- adopted by governments as regulations/legislation to ensure that their populations can benefit from using VGDs that incorporate safe listening features, as a means for hearing-loss prevention; and
- used by civil society groups and consumer associations to advocate for the development of VGDs that include safe listening features.

2. Safe listening features for video gameplay devices

Feature 1: Sound allowance tracking (dosimetry)

Feature 2: Safe listening messages

Feature 3: Volume control system

Feature 4: Inclusion of a headphone safety mode

2. Safe listening features for video gameplay devices

Feature 1:
Sound allowance tracking (dosimetry)

A VGD must measure the video game player's sound exposure, based on a choice of two modes of reference exposure.

Each VGD must include a measurement system (also referred to as a dosimeter) that tracks the user's sound exposure time and loudness level, estimating the percentage of a user's sound allowance. This must take account of all media played back through the VGD (including signals created by other apps installed on the VGD, for example music, video streaming and social media).

It is also proposed that the device allow the user to select their reference exposure as one of two operational modes:

Mode 1: WHO standard level for adults: this will apply the sound dose of 1.6 Pa^2h per 7 days as the reference exposure (derived from 80 dBA for 40 hours a week) *(7)*.

Mode 2: WHO standard level for sensitive users (e.g. children): this will apply 0.51 Pa^2h per 7 days as the reference exposure (derived from 75 dBA for 40 hours a week).

The user should be allowed to select either of the two modes when using the player for the first time (or when the device is reset to factory settings) and to change the mode choice at a later time, for example via the device settings menu.

The practical relevance of sound allowance is described below.

An example of how a dosimeter can be implemented in a personal audio system, when measuring the digital media signal and considering known or assumed properties of headphones, can be found in Appendix II of the *ITU-T H.870 Guidelines for safe listening devices/systems (8)*; more information regarding reference exposure can also be found in Annex 3.

Practical relevance of sound allowance

The total (100%) weekly sound allowance is equivalent to the weekly reference exposure, based on the mode selected. The time required to use 100% of the sound allowance depends on the average sound intensity. Tables 1 and 2 set out examples of weekly listening time durations based on the sound allowance for the modes above.

Table 1. Example of weekly listening time for Mode 1

dBA SPL	Weekly (1.6 Pa^2h)
107	4.5 minutes
104	9 minutes
101	18.75 minutes
98	37.5 minutes
95	1.25 hours
92	2.5 hours
89	5 hours
86	10 hours
83	20 hours
80	40 hours

Table 2. Example of weekly listening time for Mode 2

dBA SPL	Weekly (0.51 Pa^2h)
107	1.5 minutes
104	3 minutes
101	6 minutes
98	12 minutes
95	24 minutes
92	48 minutes
89	1.57 hours
86	3.1 hours
83	6.3 hours
80	12.6 hours
77	25.2 hours
75	40 hours

Rationale for this feature

Dosimetry is the measurement the total sound energy received by the human ear over a specified period, offering a clear and precise assessment of sound exposure.

In the context of video games, dosimetry provides a reasonable estimate of the sound dose a player experiences during gameplay. This functionality allows players to monitor their sound exposure and compare it to established safety standards, such as the current limit of 80 dB SPL (A-weighted) for 40 hours per week, or equivalent energy levels at varying intensities.

When integrated into VGDs that support other media applications, dosimetry can also measure sound exposure from audio generated by those applications. Additionally, it could aggregate data from personal audio devices tracking sound dosage across multiple sources, offering a comprehensive view of the user's global sound exposure.

Notably, dosimetry is already a foundational feature in the *WHO–ITU H.870 Guidelines for safe listening devices/ systems*. By ensuring safe listening practices on devices like smartphones, tablets and headphones, it demonstrates its value in safeguarding users' hearing and can similarly contribute to protecting players in video gameplay environments.

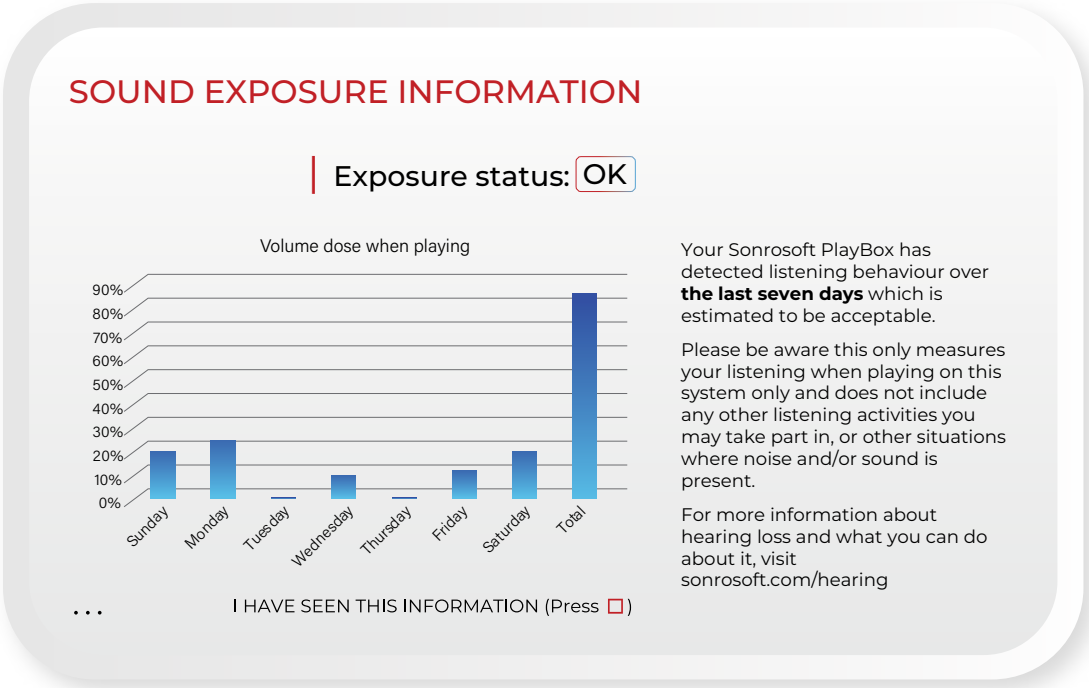
Feature 2:
Safe listening messages

A VGD must provide players with messages about general sound usage, including time spent and sound consumption, and predictions of when their sound limit will be reached.

Safe listening messages (Fig. 1) should be delivered at appropriate moments that do not disrupt gameplay immersion. Possible delivery methods include:

- at the initial bootup of the VGD before a video game software title has loaded;
- at the end of a gameplay session on the exit screen; or
- through real-time notifications via in-game notification systems (with delivery of these in-game notifications overriding any do-not-disturb modes the VGD may provide).

Fig. 1. Dosimetry information: Safe/OK status when voluntarily accessed from a sound menu

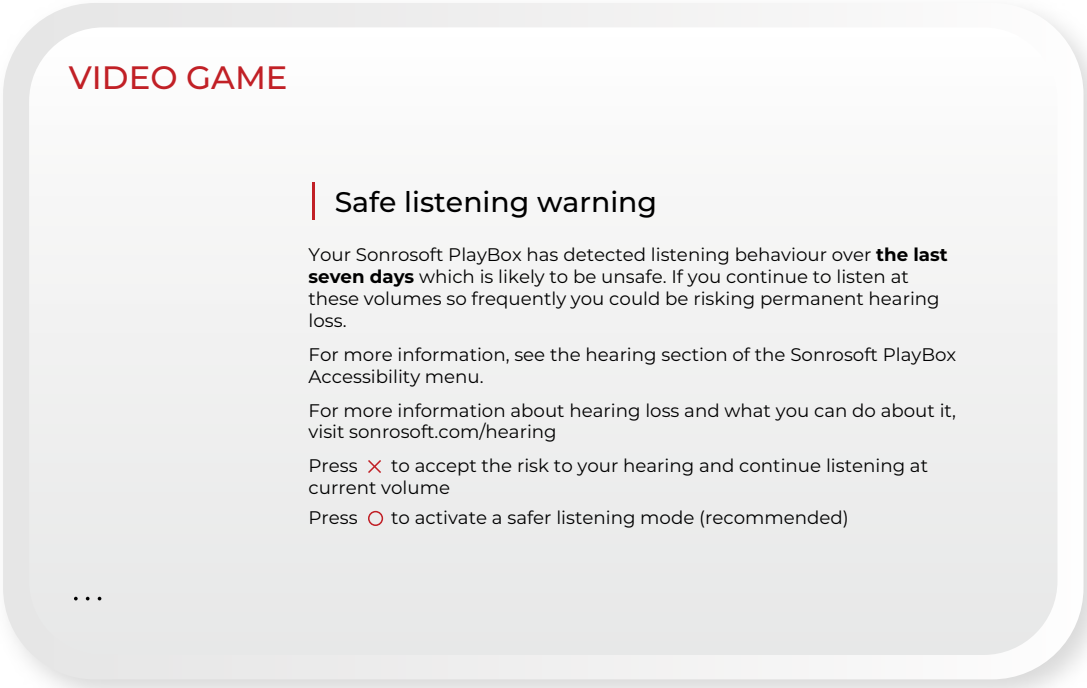


Cue for action messages

When a video game player exceeds 100% of their weekly sound allowance, the VGD must display a message (Fig. 2) that:

- warns the player that their weekly sound allowance has been exceeded and that continuing to listen at the same volume may pose a risk to their hearing; and
- requires the player to choose an option that will either lower the volume level to protect their hearing using a volume limiting option (see Feature 3: Volume control system) or accept the risk of hearing damage and continue at the current volume level.

Fig. 2. Dosimetry information: Warning message shown upon exceeding 100% of sound dosage. More examples can be found in Annex 4.



Rationale for this feature

To provide effective use of dosimetry installed on VGDs, the standard requires the appearance of messages at convenient, non-immersion breaking times that indicate sound dosage information to the gameplayer, requiring them to lower or accept their risk if unsafe dosage is detected or predicted.

Literature reviewing health-related warnings in video games suggests warning messages can be used to raise awareness of the potentially harmful consequences of excessive video gameplay *(9)*. However, studies also show that video game disruption negatively impacts task performance *(10)*.

For these reasons, the standard requires notifications related to sound dosage:

- be provided at convenient, non-immersion breaking times; and
- only require action by the gameplayer should unsafe behaviour be predicted and/or detected by the dosimetry system.

Predictions of exceedance and/or notification of general dosimetry status, even if at safe levels, is also encouraged, as it can enable the delivery of safe listening warnings at non-immersion breaking times.

Feature 3:
Volume control system

A VGD must include a user-friendly volume control system that can be easily adjusted. It should include safeguards to ensure appropriate usage for all gameplayers.

Volume control behaviour

The VGD must offer a suitable method to control and limit the volume when headphones or earphones are detected. This volume control will not only allow players to adjust their volume easily but will also integrate the sound dose tracking and messaging system mentioned earlier.

- When the device detects that the player has reached 100% of their safe listening dosage, it will display a message indicating that the sound dose limit has been reached. Players will then have the option to lower the volume to a safer level or to continue at their current volume, risking potential hearing damage.
- If the player ignores the message and does not respond, the device will automatically reduce the volume to a safe level based on the selected operational mode.

Parental control integration

If the VGD features a user account system with separate options for children and parents (also known as parental controls), it must include a setting that allows parents to set and lock the maximum sound output, potentially using a password. This feature enables parents or guardians to restrict the maximum sound output of the child's device in a way that the child cannot modify.

Rationale for this feature

A volume control system is essential to mitigate the risk of hearing damage and promote responsible video gameplay practices. Allowing users to adjust audio levels directly from the VGD empowers players to maintain a safe and comfortable listening environment tailored to their individual preferences.

This feature protects against hearing loss caused by prolonged exposure to high volume levels and enhances the video gameplay experience by minimizing discomfort or distraction from excessively loud sounds. Furthermore, it promotes inclusivity by accommodating players with diverse auditory needs, ensuring accessibility and enjoyment for all.

Volume control limiting

This feature specifically addresses the use of headphones and earphones, where sound dosage can be most accurately measured. The default behaviour of compliant devices prioritizes hearing protection.

- If a player does not respond to a warning message about unsafe sound dosage, the device will automatically reduce the volume to safe levels.
- This proactive approach ensures that hearing preservation remains the primary focus, even in the absence of user intervention.

Password-protected sound output control

Password-protected sound output controls provide parents or caregivers with the ability to lock the audio output at safe levels for children using the VGD.

Since children may lack the awareness or ability to monitor their sound exposure effectively, this functionality is logically integrated into the parental control system. These controls align with other parental oversight features, such as managing screen time or setting gameplay schedules, to ensure a comprehensive approach to safe and responsible video gameplay.

Feature 4:
Inclusion of a headphone safety mode

A VGD that shares an audio output connection between headphones and loudspeakers must have an automatic mechanism to reduce the volume when a gameplayer changes the connection.

Some VGDs feature an onboard output connector that can be used for both headphones and loudspeakers. For these devices, the standard mandates that a default headphone safety mode be activated upon detection that a user is transitioning from loudspeaker audio to headphone use on the same output *and* the VGD is unable to store volume settings for each audio output. In these cases, the device shall reduce the volume by at least 3 dB.

Rationale for this feature

The headphone safety mode feature ensures safer listening experiences by automatically adjusting the volume when a gameplay device switches between loudspeakers and headphones, particularly in devices that cannot store separate volume settings for each configuration. This feature addresses multiple safety concerns.

- **Audio mastering differences**
  Many video game titles are optimized for small, underpowered onboard loudspeakers, which require higher volume levels to deliver clear sound. When the same settings are applied to headphones – often capable of much louder output – the result can be excessive and potentially harmful volume levels. By limiting audio output during the switch, the headphone safety mode mitigates the risk of overamplifying the game soundtrack, ensuring a safer listening experience.
- **Protection for vulnerable users**
  This feature is especially important for safeguarding children and users under the care of a parent or caregiver. Young players may not be able to assess or adjust volume levels appropriately when switching between loudspeakers and headphones. Similarly, caregivers may not immediately notice excessive volumes if the sound playback shifts to headphones. The headphone safety mode automatically reduces volume during these transitions, protecting users' hearing and ensuring safer listening, even in environments where the audio output is not actively monitored.

By addressing audio mastering disparities and providing protection for vulnerable users, the headphone safety mode enhances hearing safety while preserving an enjoyable and inclusive gameplay experience.

3. Safe listening features for video gameplay software titles

3. Safe listening features for video gameplay software titles

The Global standard for safe listening video gameplay and esports has been designed to enable video game developers to achieve compliance independently of the VGD it runs on. This enhances inclusivity and broadens its reach, particularly on platforms where a VGD consists of diverse components.

If equivalent features are available on the VGD (on which it is intended to be played), it is not mandatory to include them in the video gameplay software and may be omitted.

Feature 1: Safe listening warnings and messages

Video gameplay software must include a message or warning for players about the auditory risks associated with loud sounds and prolonged exposure during gameplay activities.

The video gameplay software title is required to deliver a warning to gameplayers (Fig. 3 and 4) at two separate times during a gameplay session, specifically:

1. **upon the initial load of the game**, which should include:
    - a description of sound level allowance and safe listening; and
    - examples of auditory symptoms to be aware of in case of hearing damage (for example ringing in the ears, fullness in the ear, loss of sensitivity to other sounds, etc.).

    The message should also specify that the absence of these symptoms does not necessarily indicate an absence of hearing damage.

2. **during convenient moments in the game**.

   "Convenient moments" may include the end of a round of gameplay, after completing a level, after losing a life, when pausing the game, at the end of two-hours of continuous gameplay, upon exit, etc. To be effective, the notifications and messages should not compromise the gameplay experience.

> **Note:** These warnings and messages are designed to provide general hearing health information, which complements the personalized sound dose information required by this standard for VGDs. See Annex 4 for more examples.

Fig. 3. Initial load screen warning example

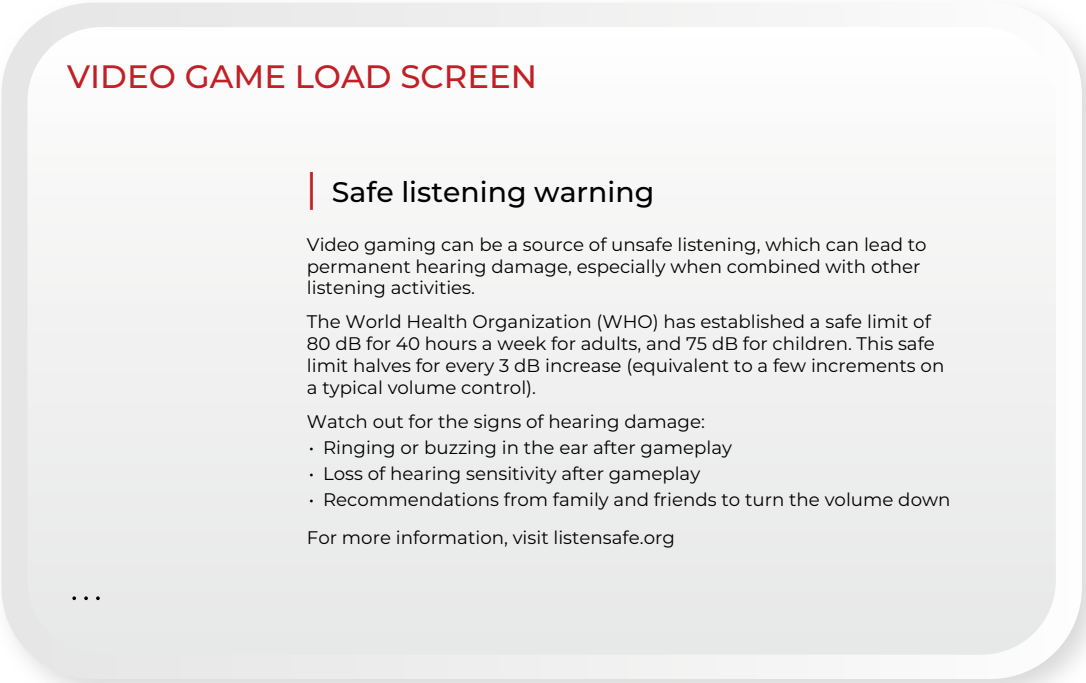
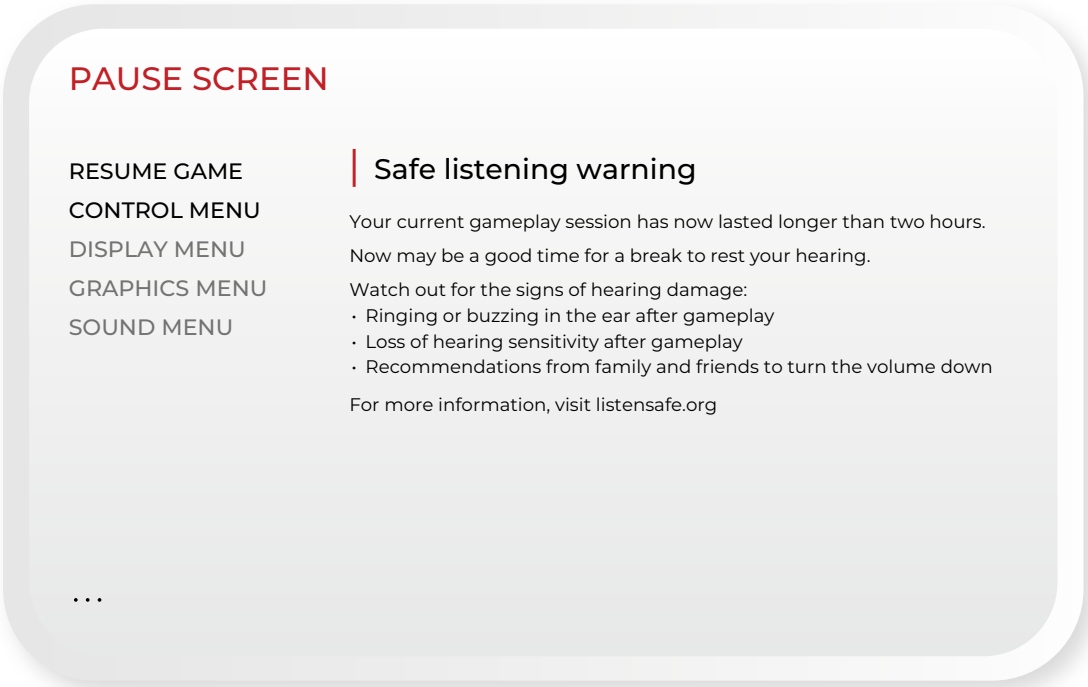


Fig. 4. Example of a safe listening warning shown in the pause menu



Rationale for this feature

Research suggests warning messages can be used to raise awareness of the potentially harmful consequences of excessive video gameplay *(9)*. The recommendation builds upon existing software practices, where health warnings are routinely shown to gameplayers (for example photosensitivity or epilepsy warnings, which commonly feature in games today).

Considering the available literature, the standard proposes warning messages at various points within the gameplay experience to ensure safe listening messages are received and can be conveniently placed to respect the game's narrative. This is based on studies showing that video game disruption negatively impacts task performance *(10)*.

The implementation of these features can:

- allow video gameplay software titles to reach compliance separate to that of the video game hardware they may be running on; and
- allow warning messages to adequately reach the gameplayer at various times when their attention may be more focused on the screen.

Feature 2:
Sound category and master volume controls

The video game software must include independent volume controls for different sound categories, allowing players to adjust levels and selectively mute various sounds within the game.

Sound category volume controls should be easily accessible and must enable players to efficiently reduce or mute:

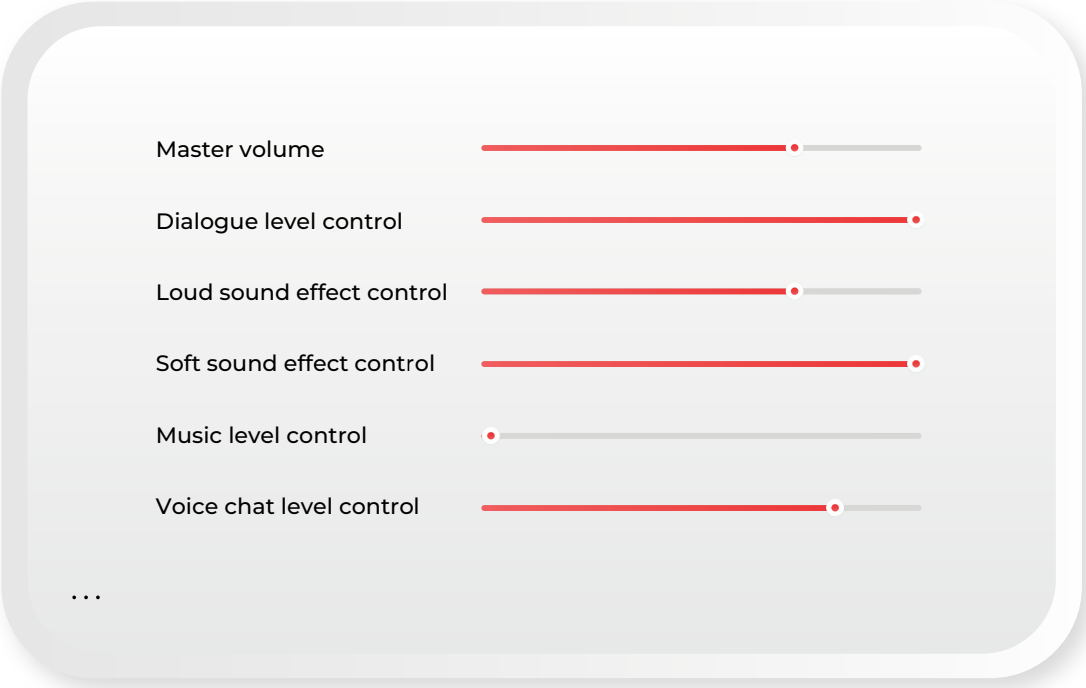
- the overall master volume level; and
- specific sounds they deem unnecessary based on their gameplay style.

Examples of these controls (Fig. 5) may include:

- game dialogue level
- sound effects level
- music level
- voice chat level.

Note: These options are mostly found under the game's audio menu.

Fig. 5. Example of an in-game sound category control menu



Rationale for this feature

The original rationale for this feature's inclusion came from the feedback of users and gameplayers who contributed to WHO's background study on safe listening in video gaming and esports *(4)*.

Players who cannot adjust the volume of lower priority sounds in a game often raise the overall volume to focus on critical audio cues. This increases the risk of prolonged exposure to excessive noise and potential hearing damage. For instance, in many first-person shooter games, important sounds like enemy footsteps may be masked by music or other in-game noises. Without the ability to lower competing sounds, players typically increase the master volume to hear these cues more clearly.

While immersion and the original artistic vision of game soundtracks are important considerations, WHO's background study *(4)* revealed that:

- volume channel controls are already commonly available in many modern games and typically offer broad control over a number of categories of sounds; and
- competitive players, both amateur and professional, often adjust these controls to remove audio cues they deem unnecessary.

Volume channel controls allow players to efficiently reduce:

- specific sounds they consider non-essential, distracting or not useful for their specific style of gameplay; and/or
- the overall in-game volume.

In either case, sound exposure is reduced, benefiting players' hearing health.

Feature 3:
Software title specific inclusions

Video gameplay software titles should include safe listening features that are appropriate considering the soundtrack, genre and sound design of each game.

The Global standard for safe listening video gameplay and esports encourages game developers to include safe listening features that promote healthier listening habits in gameplayers and reduce the risk of hearing damage during gameplay. These features are particularly important in cases where the VGD itself does not offer built-in protections.

However, the Global standard for safe listening video gameplay and esports also recognizes that:

- video games have a wide range of soundtracks and sound design structures, which can vary significantly between video gameplay software titles;
- a video game's soundtrack serves different purposes depending on the game. For example, some games integrate it as a key gameplay element, while others use it primarily to enhance immersion; and
- listening preferences differ greatly depending on the genre of the game and the individual player.

Therefore, enforcing a list of specific features for video gameplay software titles is impractical, and instead, *the Global standard for safe listening video gameplay and esports* provides a set of features as examples that, when implemented, can enhance the listening experience, minimize sound exposure and reduce the risk of hearing damage for players. These examples are not mandatory but are offered as practical guidance.

Example 1: Game audio output scaling

Video game soundtracks, like other forms of audio media, are mastered to create a rich and dynamic experience for players, and/or to ensure the video game audio level is comparable to other media played back on the gameplayer's entertainment system. To achieve this, video game developers often follow similar mastering standards used in TV broadcasting, measured in loudness units relative to full scale (LUFS).

This standard recommends that game developers adhere to these common practices to ensure that the volume levels of video game soundtracks are consistent with other media displayed on television or PCs.

Specifically, the output of a video game should be set so that the average loudness over a 30-minute period does not exceed -23 LKFS/LUFS, allowing for a variation of ±2 LUs. Additionally, the highest peak level should not exceed -1 decibel true peak.

Example 2: Player dynamic range set-up

Video gameplay software should include an initial dynamic range test, which can establish what sounds are “loud” to the gameplayer, and what sounds are at lowest levels of audibility based on the gameplayer’s own audio system.

This information is to be used to set the initial volume of the game title (avoiding starting the game at an uncomfortably loud volume) and/or to calibrate a dynamic range compression mechanism that can be used to limit loud sounds throughout gameplay. The usefulness and implementation of dynamic range compression require further study.

Example 3: Tinnitus sound removal

Tinnitus sounds refer to sound effects that provide a simulation of tinnitus (ringing or buzzing in their ears). These sound effects are used in response to a particular gameplay event, such as when a player is overwhelmed by an enemy during a fight or directly exposed to an explosion or flashbang.

When these sound effects exist in a particular game, an option should be provided to remove them when first running the game. Once selected, the setting should be maintained unless the player opts to change the setting in the game’s audio menu.

To better assess whether this feature is suitable, the gameplayer could be asked if they have troublesome tinnitus that is made worse by certain in-game audio sounds.

Example 4: Passive gameplay audio reduction

The video game software should include the automated attenuation by at least 3 loudness units of the game’s audio components during periods of passive, non-interactive gameplay (for example audio between rounds of a first-person shooter game).

The most common intended application of this definition will be towards sections of gameplay in between rounds of a multiplayer game, where a gameplayer has been excluded from participating in the game until a new round begins.

Example 5: Subtitles

Video gameplay software should enable subtitles by default, which can facilitate gameplay at lower volumes.

Example 6: Equalization presets

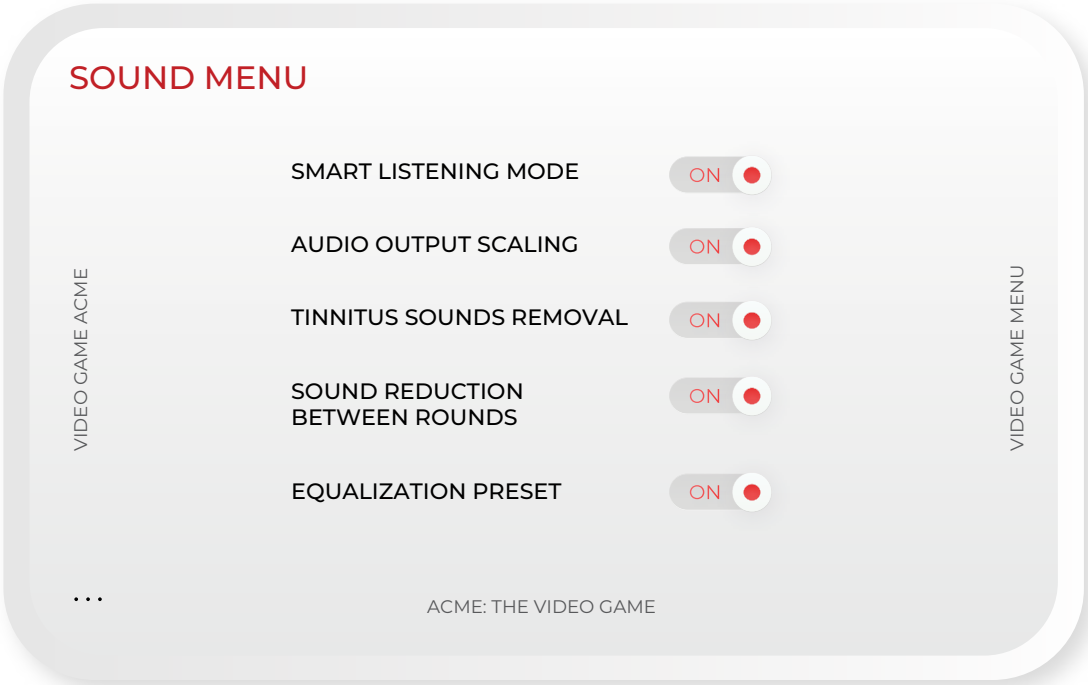
The video gameplay should include adjustable equalization presets that apply filters to reduce the mid- and high-frequency range. Reducing this particular frequency range can reduce harshness, spikes in intensity and ear fatigue.

Example 7: Smart listening mode preset

In a similar way to how modern game menus manage graphic quality, the video game should by default combine and enable the relevant safe listening features available in that software title under one, easy-to-enable settings preset (Fig. 6).

A smart listening mode preset should be aimed at reducing the total sound dosage a gameplayer will receive during a gameplay session, while minimally affecting the gameplay experience.

Fig. 6. Example of title-dependent features, including smart listening mode, in an in-game sound control menu



Example 8: Audio behaviour telemetry

Game software developers should consider adding audio behaviour telemetry to their games to help determine player listening behaviours, such as if/when the user changes app/system volume during gameplay, end user settings for category volume sliders, time spent in gameplay sessions, etc.

Rationale for these features

Given the variability and diversity of video game soundtracks, it was deemed inappropriate to mandate a specific set of safe listening features that all video games must include for compliance.

This position was reached following extensive consultation with industry experts, who highlighted key considerations in video game design:

- Some games are inherently low-volume in nature.
- Sound is often used differently across games to achieve specific impacts.
- Certain games may even be entirely silent.

As a result, this feature of the standard was designed to:

- inform game developers about features that may be suitable for promoting safe listening in their video games;
- encourage the adoption of these features where appropriate; and
- inspire the creation of new safe listening solutions tailored to the unique needs of individual games.

This flexible approach ensures that the standard remains practical and adaptable across a wide range of video game genres and designs.

Feature 4:
Inclusion of a headphone safety mode

Video gameplay software titles should provide a default headphone safety mode where the audio output of the VGD for headphones is also intended for use with a speaker, and the audio output level is not stored separately for each type of audio peripheral.

The mode should automatically reduce the volume of the audio output should a switch between loudspeakers and headphones be detected.

The default headphone safety mode should be implemented when the video gameplay software title can detect that users are switching from free field to headphones on the same audio output. The applied volume reduction should be at least 3 dB.

This feature is not required when the device on which the video gameplay software title is released provides an equivalent feature.

Rationale for this feature

This feature is equivalent to a feature previously described for VGDs. It aims to ensure safer listening experiences by automatically adjusting the volume should a video gameplay software title be capable of detecting when a gameplayer switches between loudspeakers and headphones operating from a shared audio output.

4. Textual warnings and information

Feature 1: Provision of appropriate safe listening information

Feature 2: Safe listening feature information

4. Textual warnings and information

Feature 1:
Provision of appropriate safe listening information

VGDs and video game software must include appropriate, textual safe listening information in user guides, electronic resources or related websites. This information should go beyond basic instructions and actively promote safe listening behaviours.

User guides and other written information

This standard also specifies requirements for compliant VGDs and video gameplay software titles regarding what written information is provided with the device or software (Fig. 7).

The required information should include:

- a clear statement: loud sounds during gameplay can lead to unsafe listening due to high volume levels and extended play duration;
- auditory symptom awareness details: a list of common symptoms of unsafe listening, such as tinnitus and reduced hearing sensitivity; and
- safe listening guidance: simple instructions for incorporating safe listening habits into gameplay, including references to onboard features and where to find more information.

To ensure accessibility, the information should avoid technical jargon or complex terminology and be easy for laypersons to understand. Further information and examples regarding textual information can be found in Annex 5.

Fig. 7. Excerpt of a VGD user guide outlining safe listening information

PlayBox User guide

Warning: protect your hearing while gaming!

Playing video games can be really fun, but loud sounds can hurt your hearing if you play for too long. Follow these tips to keep your ears healthy.

Watch for signs of hearing damage:

- **Ringing or buzzing:** if you hear ringing or buzzing in your ears during or after gameplay, it could mean your hearing is being damaged.
- **Hard to hear:** if you struggle to hear quiet sounds or conversations, take action to protect your hearing.

Safe listening tips:

- **Keep the volume down:** Set your game volume at a comfortable level. If you can't hear external noises, it might be probably too loud.
- **Take breaks:** give your ears a rest by taking 5-10 minute breaks every hour. This helps prevent ear strain.
- **Choose headphones carefully:** use over-ear headphones that block out noise. These can help you play at lower volumes.
- **Use volume limits:** check your device settings to limit the maximum volume.
- **Listen to your body:** if your ears hurt or you notice hearing problems, take a break and let your ears rest. Get more info:
- **Check the manual:** if using other audio devices such as headphones or earphones, check the manual or the manufacturer's website for safe listening tips.
- **Visit trusted sources:** find more information from places like the World Health Organization (WHO) and other hearing health organizations.

Remember: playing safely means protecting your ears. By following these tips, you can enjoy gaming without damaging your hearing.

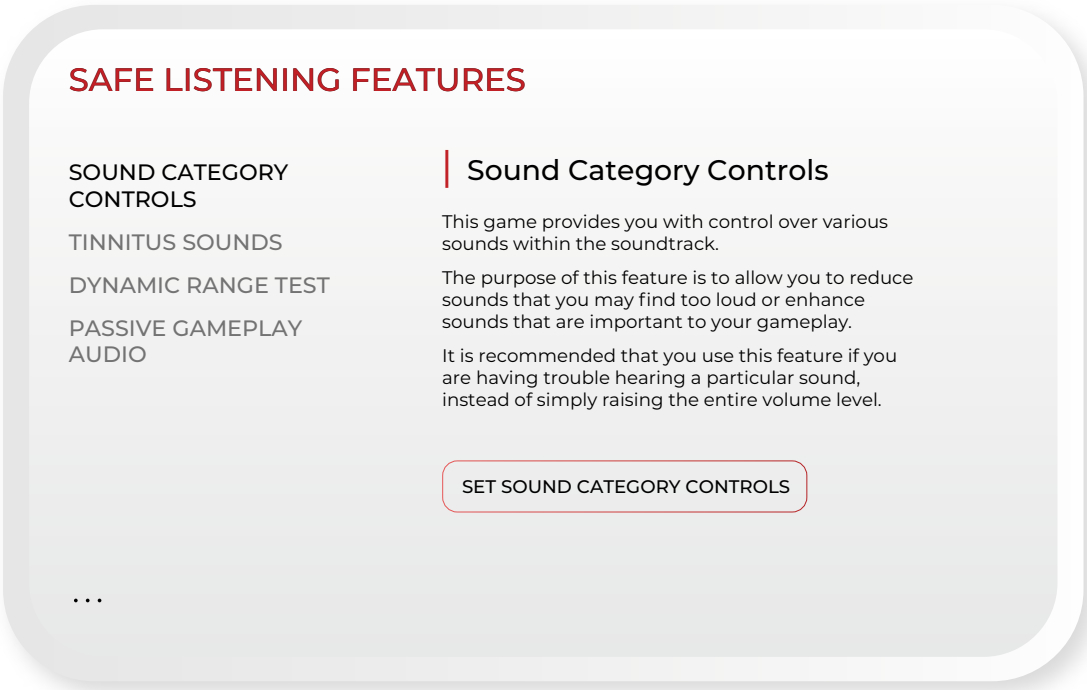
Feature 2:
Safe listening feature information

VGDs and video gameplay software titles must include information that explains the purpose and/or rationale of any included safe listening features that are available to the game player.

Safe listening feature information

To encourage and ensure the effective use of all available safe listening features to a game player, VGDs and video gameplay software titles should include helpful information pertaining to the purpose and/or rationale of the safe listening features in their systems.

Fig. 8. Example of a safe listening feature menu explaining the role of a specific feature titled "Sound Category Control". *Additional examples can be found in Annex 5.*



Rationale for this feature

Textual warnings and information within user guides for VGDs and software titles serve to educate gameplayers about the risks associated with unsafe listening practices. By going beyond basic instructions, these warnings confirm the link between high volume levels and prolonged gameplay duration with potential auditory health issues like tinnitus and hearing sensitivity loss.

Simple instructions on implementing safe listening practices, provided in parallel with guidance on what safe listening features are available on a VGD or video gameplay software title and how to use them optimally, empower the gameplayer to protect their hearing. This approach fosters a culture of responsible video gameplay and promotes auditory well-being among video gameplayers.

5. Safe listening for live esports events

Structure of live esports events

Types of live esports events

Safe listening considerations for live esports events

Main features for live esports events

Limitations on these features for esports events

5. Safe listening for live esports events

While most esports gameplay takes place online, recent years have seen an upsurge in large-scale tournaments held in front of live audiences. These events feature immersive audiovisual experiences, including high-intensity sound driven through high powered public address (PA) systems, amplified commentary, and enthusiastic audience engagement.

Structure of live esports events

Live esports events are organized to display competitive matches in front of a live audience, and typically involve:

- The participation of professional and/or amateur players and teams competing in a tournament or match.
- The utilization of video game consoles, PCs, or other gameplay devices as the primary platform for gameplay.
- The incorporation of a stage and visual display system to present live gameplay and related content to the audience.
- The deployment of a high-powered PA system that delivers in-game sound effects, commentator narration, crowd reactions, and event announcements at significant volumes.
- The provision of seating or standing areas for the live audience to watch the matches in person.

Types of live esports events

Live esports events vary in scale and format, including:

- International esports tournaments featuring top-tier professional teams.
- Local competitive events organized at smaller venues for amateur and semi-professional players.
- Exhibition matches that bring together professional and amateur players.

These events showcase a variety of esports genres, such as multiplayer online battle arena (MOBA), first-person shooter (FPS), real-time strategy (RTS), and more.

Safe listening considerations for live esports events

While the audio elements of live esports events enhance the atmosphere, prolonged exposure to high sound levels can pose hearing health risks for audience members.

The Global standard for safe listening video gameplay and esports outlines safe listening features for VGDs and software titles that are used in esports events by competitors, however these features only mitigate hearing risks for esports gameplayers; amplified sound for audience participants at esport live events is beyond the scope of this standard.

Accordingly it is therefore suggested that esport live events that provide amplified sound incorporate features and principles outlined in the *WHO Global standard for safe listening venues & events (11).*

Main features for live esports events

WHO Global standard for safe listening venues & events presents a systematic and comprehensive approach to achieving safe listening when holding live events at venues with audiences. It methodically balances auditory safety with entertainment value and artistic expression live performances provide and therefore provides a useful framework for providing safe listening experiences for audience members attending live esports events.

Safe listening features for esport live events

Feature 1: Sound level limit

An upper limit of 100 dB $L_{Aeq,\ 15\ min}$ shall be imposed for the venue, keeping sound safe and enjoyable for the audience.

Feature 2: Sound level monitoring

Live monitoring of sound levels shall be performed by a designated staff member using calibrated equipment.

Feature 3: Venue acoustics and sound systems

Sound system and venue acoustics shall be optimized ensuring safe listening and improved sound quality.

Feature 4: Personal hearing protection

Hearing protection, such as earplugs, along with appropriate instructions should be available to audience members.

Feature 5: Quiet zones

Events shall include quiet rooms for competitors and audience members. In addition, adequate breaks shall be taken between the competitive rounds when sound levels shall be kept below 80 dBA, in order to provide a break from sound exposure.

Feature 6: Appropriate training and information

Esports players, audience members and venue staff shall be provided information to make them aware of practical steps they can take to ensure safe listening.

Limitations on these features for esports events

These recommended features do not apply to:

- recreational video gameplay sessions or casual gatherings;
- non-competitive video gameplay events conducted in an unstructured way;
- competitive esports events without live in-person component, e.g. streamed online only.

References

1. Hearing loss due to recreational exposure to loud sounds: A review. Geneva: World Health Organization; 2015.
2. ITU-T H.870 Guidelines for safe listening devices/systems. Geneva: International Telecommunication Union; 2022 (https://www.itu.int/rec/recommendation.asp?lang=en&parent=T-REC-H.870-202203-I, accessed 28 January 2025).
3. Dillard LK, Arunda MO, Lopez-Perez L, Martinez RX, Jiménez L, Chadha S. Prevalence and global estimates of unsafe listening practices in adolescents and young adults: a systematic review and meta-analysis. BMJ Global Health. 2022;7(11):e010501 (https://gh.bmj.com/content/7/11/e010501, accessed 28 January 2025).
4. Safe listening in video gaming & esports: A World Health Organization background study. Geneva: World Health Organization; 2023 (https://cdn.who.int/media/docs/default-source/ncds/sdr/deafness-and-hearing-loss/safe-listening-in-video-gaming-and-esports.pdf?sfvrsn=cccd86e2_4, accessed 28 January 2025).
5. Dillard LK, Mulas P, Der C, Fu X, Chadha S. Risk of sound-induced hearing loss from exposure to video gaming or esports: a systematic scoping review. BMJ Public Health. 2024;2(1):e000253. doi:10.1136/ bmjph-2023–000253 (https://bmjpublichealth.bmj.com/content/2/1/e000253, accessed 28 January 2025).
6. Diviani N, Chadha S, Mulas P, Rubinelli S. Safe Listening Beliefs, Attitudes, and Practices Among Gamers and Esports Participants: An International Online Survey. JMIR Formative Research. 28/10/2024:60476 (forthcoming/in press). https://preprints.jmir.org/preprint/60476
7. Based on the WHO Environmental noise guidelines for the European Region, section 3.5, Recommendation for leisure noise exposure. Copenhagen: World Health Organization; 2018 (https://www.who.int/europe/publications/i/item/9789289053563, accessed 12th December, 2024).
8. ITU-T H.870 Guidelines for safe listening devices/systems (V2). Geneva: International Telecommunication Union; 2022 (https://www.itu.int/rec/T-REC-H.870-202203-I/en, accessed 28 January 2025).
9. Wang Q, Ren H, Long J, Liu Y, Liu T. Research progress and debates on gaming disorder. Gen Psychiatr. 2019; 32(3):e100071. doi:10.1136/gpsych-2019–100071 (https://gpsych.bmj.com/content/32/3/e100071, accessed 29 January 2025).
10. Bailey BP, Konstan JA. On the need for attention-aware systems: Measuring effects of interruption on task performance, error rate, and affective state. Comput Human Behav. 2006;22(4): 685–708. doi:10.1016/j.chb.2005.12.009 (https://www.sciencedirect.com/science/article/abs/pii/S074756320500107X?via%3Dihub, accessed 29 January 2025).
11. WHO global standard for safe listening venues and events; World Health Organization. 2022

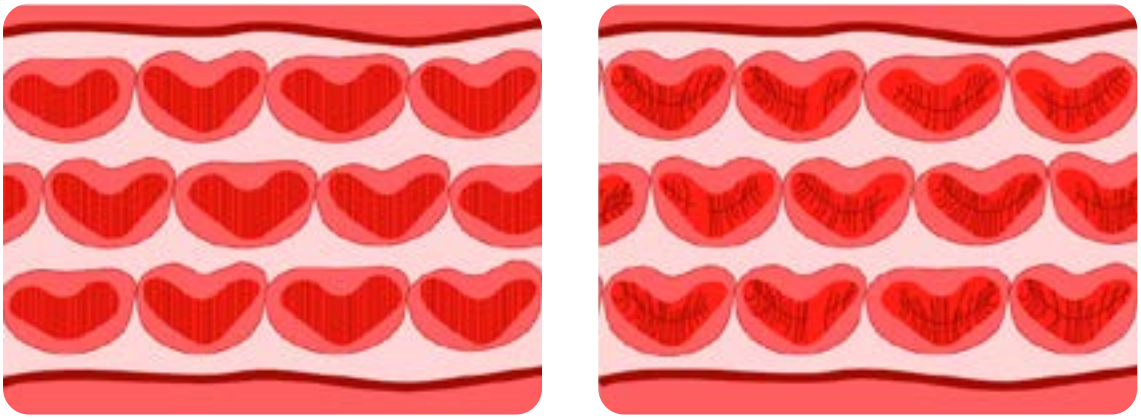
Annexes

Annex 1

How does sound affect our ears?

Repeated exposure to sound at high levels, for long durations, permanently injures the delicate workings of the inner ear (as illustrated in Figure A1.1). The most vulnerable parts of the ear include the cochlear outer hair cells, which make faint sounds audible by amplifying the ear's response to them, and the synaptic connections between inner hair cells and the auditory nerve fibres which carry sound information to the brain *(1)*.

Figure A1.1 Damage to the sensory cells in the ear from repeated exposure to high sound levels



Normal sensory cells | Damaged sensory cells

Injuries to the inner ear result in a variety of symptoms, which, if unaddressed, can significantly worsen a person's quality of life and have long-term consequences for their mental health and well-being. Over-exposure to sound may result in hearing loss, tinnitus (ringing or humming in the ears), or both. Hearing loss due to excessive sound exposure may range from mild to profound *(2)*, and lead to:

- difficulty understanding speech, especially in background noise
- degraded hearing quality, e.g. distortion of sounds, lack of clarity
- difficulty telling sounds apart, such as the different instruments in a mix.

Any type of sound can cause permanent hearing loss if listened to at a sufficiently high level and length of time. Although this is usually referred to as noise-induced hearing loss, it can occur from listening to deeply enjoyable music as much as it can from exposure to industrial noise (hence the commonly used alternatives, "sound-induced hearing loss" or "music-induced hearing loss").

Symptoms may appear short-lived, for example, a temporary hearing loss or tinnitus that resolves in a matter of hours or days. However, even when short-term symptoms fully resolve, progressive and irreversible injury to the inner ear may continue for months afterwards *(3)*. Evidence also suggests that over-exposed ears age more quickly than non-exposed ears *(4–6)*.

Exposure to loud sounds, even for short periods, can fatigue the ear's sensory cells, leading to temporary hearing loss or tinnitus – a ringing or buzzing sensation in the ear. After attending a loud concert, listening to music or playing video games at elevated levels, for example, a person might experience "muffled" hearing or tinnitus, which typically improves as the sensory cells recover.

However, when exposure is particularly loud, frequent, or prolonged, it can permanently damage these sensory cells and other ear structures, resulting in irreversible hearing loss. Initially, the ability to hear high-pitched sounds is affected, though this may go unnoticed. Continued exposure can lead to progressive hearing loss, eventually impairing speech comprehension and negatively impacting the individual's quality of life.

What is "safe listening"?

Safe listening refers to a set of practices and behaviours that promote the enjoyment of amplified sound while reducing the risk of permanent hearing injury. Adopting safe listening practices during video gameplay can support players in being able to enjoy the sound of video games today and into the future.

The risk to hearing is dictated by a combination of sound level and cumulative duration of exposure. In a recreational context, such as video gameplay, listening can be made safer by:

i) reducing the sound level; and/or

ii) reducing the duration of exposure; and/or

iii) reducing the frequency of exposure (i.e. being exposed less often).

The equal energy principle

The equal energy principle *(7,8)* states that the total effect of sound is proportional to the total amount of sound energy received by the ear, irrespective of the distribution of that energy over time – i.e. equal amounts of sound energy are expected to cause equal amounts of hearing loss, regardless of how and when the exposure occurs. The amount of energy doubles for every 3 dB increase in sound intensity. Hence, a person may receive the same "sound dose" listening to music at 80 dB for 8 hours a day as listening to 100 dB for 5 minutes.

The recommended safe level for leisure noise is below 80 dB for a maximum of 40 hours duration in a week – equal to LAeq,24h = 70 dB(A) *(9,10)*. This represents the acceptable level of sound energy that an individual can receive without putting their hearing at risk and is described as a "sound allowance" or "calculated sound dose". In order to stay within this level it is important to:

- keep the volume as low as possible while listening to media, including music (live or recorded) and video gameplay audio;
- limit the time engaged in noisy activities – including activities at work, home and leisure;
- monitor safe listening levels over personal audio systems, VGDs and in noisy spaces;
- heed the warning signs of hearing loss, including tinnitus (ringing or buzzing sounds in your ear) and/or loss of hearing sensitivity.

Safe listening also includes regular hearing tests, or audiograms, to monitor hearing health. These tests are especially important for individuals frequently exposed to loud sounds or prolonged noise. Early identification of hearing loss allows for timely and effective interventions if needed.

References

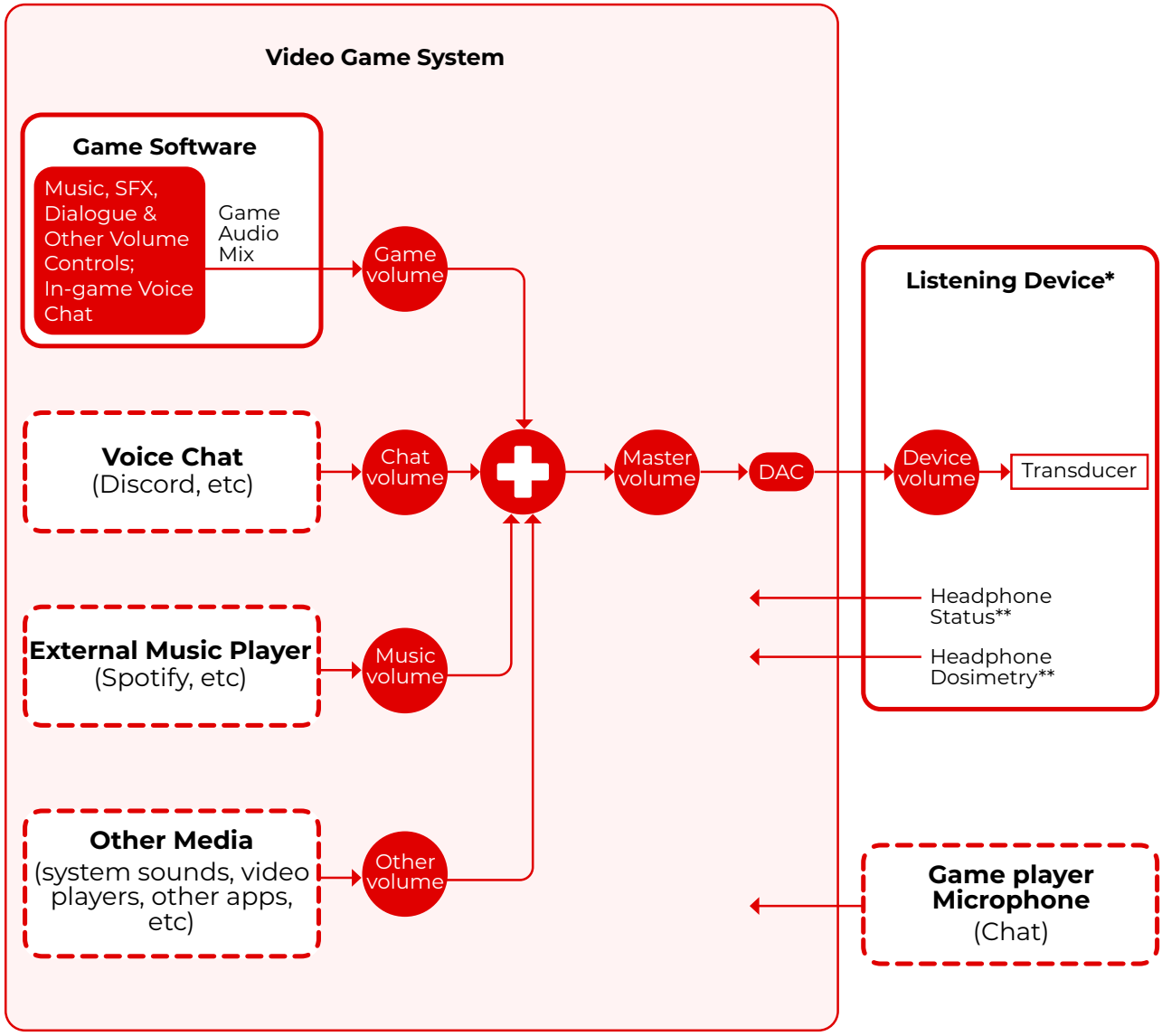
1. Kujawa SG, Liberman MC. Adding insult to injury: cochlear nerve degeneration after “temporary” noise-induced hearing loss. J Neurosci. 2009; 29(45):14077–14085.
2. World report on hearing. Geneva: World Health Organization; 2021 (https://apps.who.int/iris/handle/10665/339913, accessed 5 February 2022).
3. Bohne BA, Kimlinger M, Harding GW. Time course of organ of Corti degeneration after noise exposure. Hear Res. 2017; 344:158–169.
4. Fernandez KA, Jeffers PW, Lall K, Liberman MC, Kujawa SG. Aging after noise exposure: acceleration of cochlear synaptopathy in “recovered” ears. J Neurosci. 2015; 35(19):7509–7520.
5. LePage EL, Murray NM. Latent cochlear damage in personal stereo users: a study based on click-evoked otoacoustic emissions. Med J Aust. 1998; 169(11–12):588–592.
6. Liberman MC, Kujawa SG. Cochlear synaptopathy in acquired sensorineural hearing loss: manifestations and mechanisms. Hear Res. 2017; 349:138–147.
7. Environmental noise guidelines for the European Region. World Health Organization; 2018 (https://www.who.int/europe/publications/i/item/9789289053563, accessed 12th December, 2024).
8. WHO-ITU global standard for safe listening devices and systems. World Health Organization (2019).
9. Environmental noise guidelines for the European Region. Geneva: World Health Organization; 2018 (http://www.euro.who.int/__data/assets/pdf_file/0008/383921/noise-guidelines-eng.pdf?ua=1, accessed 11 January 2019).
10. Neitzel R, Filgor B. Determinination of risk of noise-induced hearing loss due to recreational sound:Review. Geneva: World Health Organization; 2017 https://cdn.who.int/media/docs/default-source/documents/health-topics/deafness-and-hearing-loss/monograph_on_determination_of_risk_of_hl_due_to_exposure_to_recreational_sounds.pdf?sfvrsn=9e55778e_5, accessed 11 January 2019).

Annex 2

Architecture of video gameplay devices and software

A video gameplay experience is provided by a system that combines hardware, operating system software, and video gameplay software to create an immersive video gameplay experience. This system integrates multiple layers of functionality, including sound management, user input, and visual display, while accommodating additional elements like external media and communication platforms.

Figure A2.1: Architecture of a video gameplay device



**Listening devices may include linear processing, such as gain or frequency shaping and non-linear processing, such as compression or dynamic range equalization. Any of these can be dynamic.*

***Headset Status and/or dosimetry may or may not be available. In some cases, the make/model of headset may be known which may help map digital audio level to dB SPL. Dosimetry may also be included, but generally the listening hardware is unknown.*

Reproduced with kind permission from ITU-T H.872.

Features for safe listening video gameplay devices

Traditional VGDs were designed to provide sound content solely generated by the video game software. However, modern VGDs and PCs offer significantly enhanced functionality, multitasking capabilities, and diverse sound source options. The architecture of these devices now supports various media-generating applications that can be accessed during a gameplay session, such as:

- **Voice Communication**: Players can engage in voice chat using a microphone connected to the gameplay device. This communication may be integrated into the video game software or facilitated through a separate application installed on the device.
- **Music Streaming Applications**: Platforms like Spotify, YouTube Music, Amazon Music, and Apple Music allow players to listen to their preferred music during gameplay sessions.
- **Social Media Applications**: Social media apps can run in the background or simultaneously with video gameplay, generating additional sound content.

These additional sound sources contribute to the overall sound exposure experienced by players. It is important to consider them as part of the total sound dosage that game players using modern PCs and VGDs are exposed to.

Annex 3

Sound allowance and calculating the reference exposure

Sound allowance refers to a dose estimate of sound exposure over a certain rolling period of time (e.g., daily or weekly), commonly expressed in percentage of the reference exposure, which is based on the equal energy principle *(1,2)* and recommends the use of two possible operational modes to estimate the reference exposure, catering for both adults and sensitive populations such as children *(3)*.

Reference exposure can be calculated by using the equal energy principle, which assumes that the total effect of sound on ear and hearing is proportional to the total amount of sound energy received by the ear, irrespective of the distribution of that energy in time.

The Equal energy principle is the assumption that the total effect of sound on ear and hearing is proportional to the total amount of sound energy received by the ear, irrespective of the distribution of that energy in time. According to this principle, equal amounts of sound energy are expected to cause equal amounts of sound-induced permanent threshold shift regardless of the distribution of the energy across time.

In practical terms this implies that listening to lower volumes for long periods of time can have the same impact as listening to very loud volumes for a short duration: for example, listening to a 100 dB sound for 16 minutes will have the same impact as listening to an 80 dB sound for 40 hours. Based on this principle, “dose” of sound energy is defined as the squared A-weighted sound pressure, pA, integrated over the exposure time $T=t_2-t_1$.

Mathematically, this is expressed as:

$$\text{dose} = \int_{t1}^{t2} (p_A(t))^2 dt$$

where p_A is the A-weighted and diffuse-field corrected sound pressure. The unit of this value is Pascal squared hours, or Pa^2h.

References

1. Environmental noise guidelines for the European Region. World Health Organization; 2018 (https://www.who.int/europe/publications/i/item/9789289053563, accessed 12th December, 2024).
2. WHO-ITU global standard for safe listening devices and systems. World Health Organization (2019).
3. ITU-T H.870 Guidelines for safe listening devices/systems. Geneva: International Telecommunication Union; 2022 (https://www.itu.int/rec/recommendation.asp?lang=en&parent=T-REC-H.870-202203-I, accessed 28 January 2025).

Annex 4

Extended list of safe listening warnings and message examples

Examples for video game devices

Safe listening messages to game players concerning sound exposure

Compliant video game devices must provide messages to the game player regarding time spent, sound allowance consumption and/or prediction of when sound allowance will be exceeded.

As preserving immersion is important to the gameplay experience, early warnings and access to general sound allowance allows players to be informed about their sound dose without disrupting their gameplay. Figures A4.1 to A4.4 provide examples of how messages from a video game device to a game player can be handled.

Figure A4.1 – Dosimetry information: Safe/OK status when voluntarily accessed from a sound menu

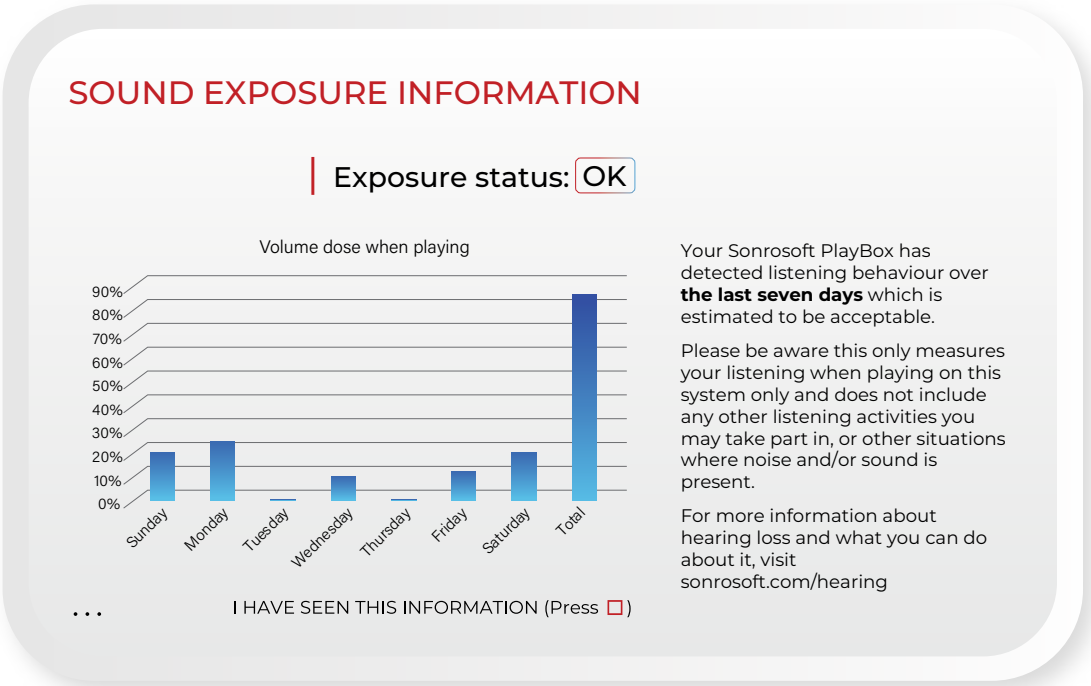


Figure A4.2 – Dosimetry information: At Risk status when voluntarily accessed from a sound menu

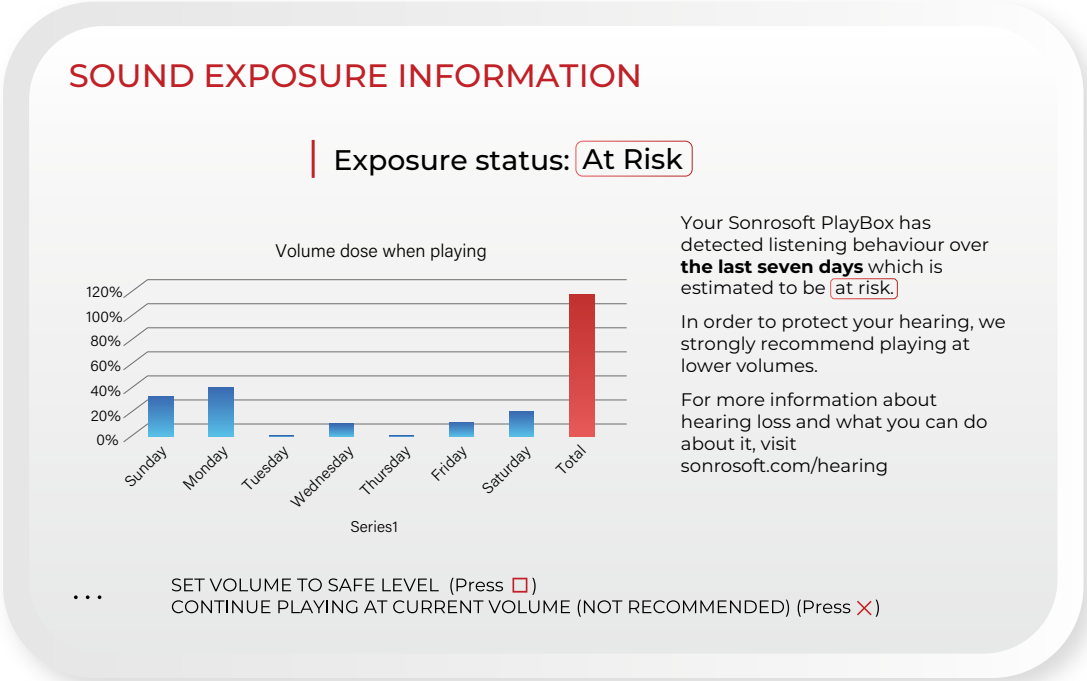


Figure A4.3 – Dosimetry information: Warning message shown upon exceeding 100% calculated sound dosage

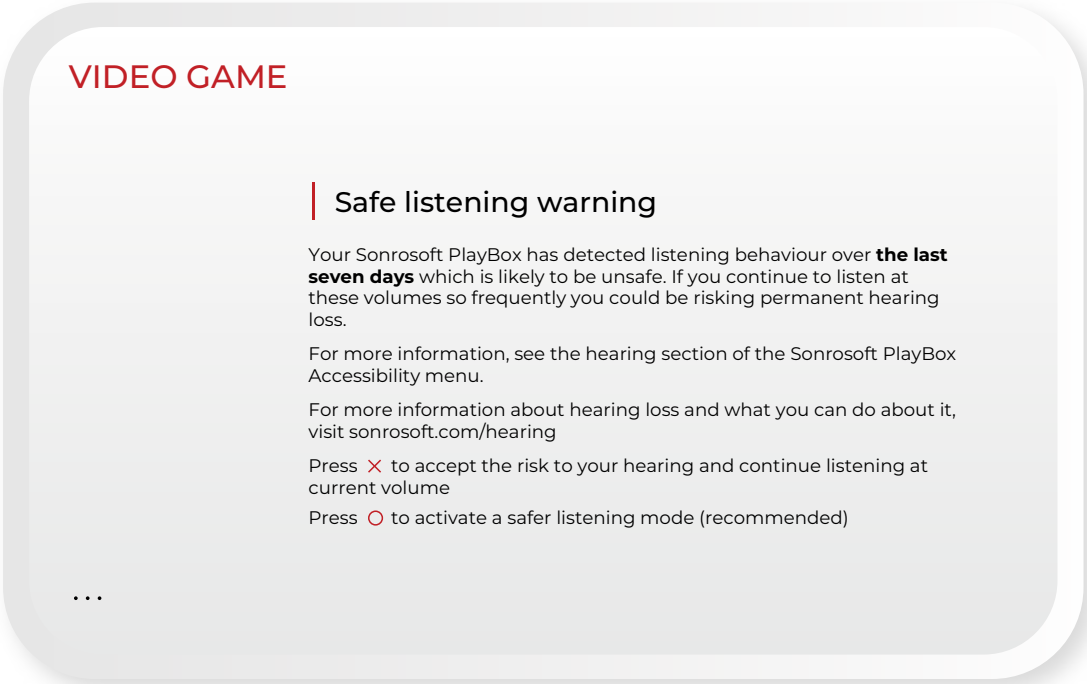
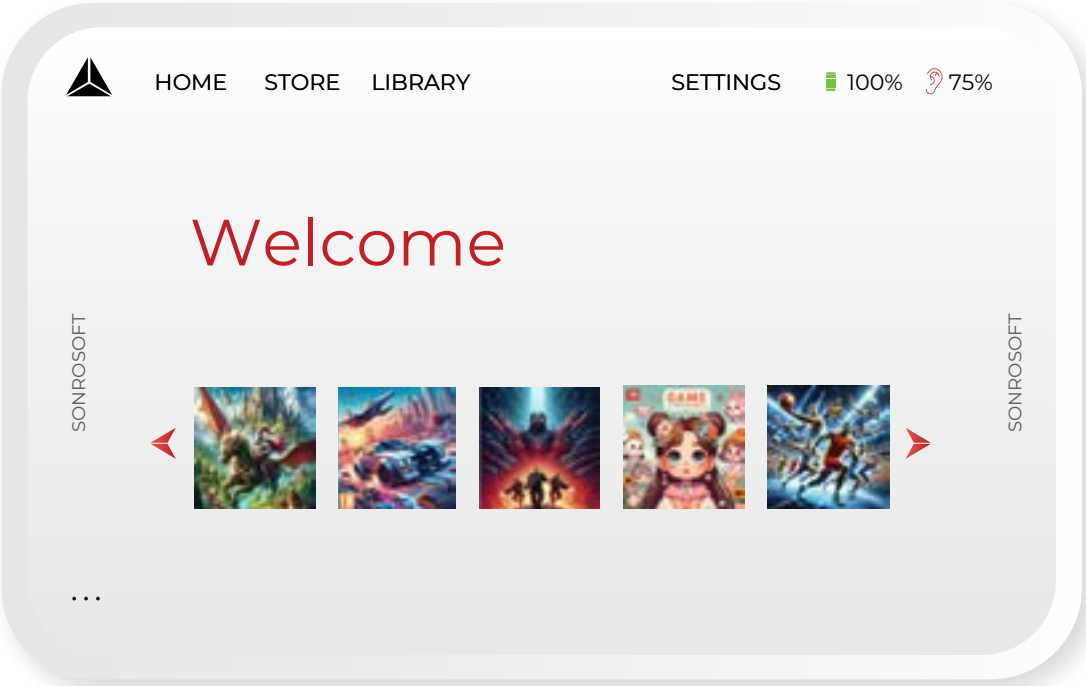


Figure A4.4 – Dosimetry information: Video game device initial load screen with safe listening icon and dosage indicator in the top right corner



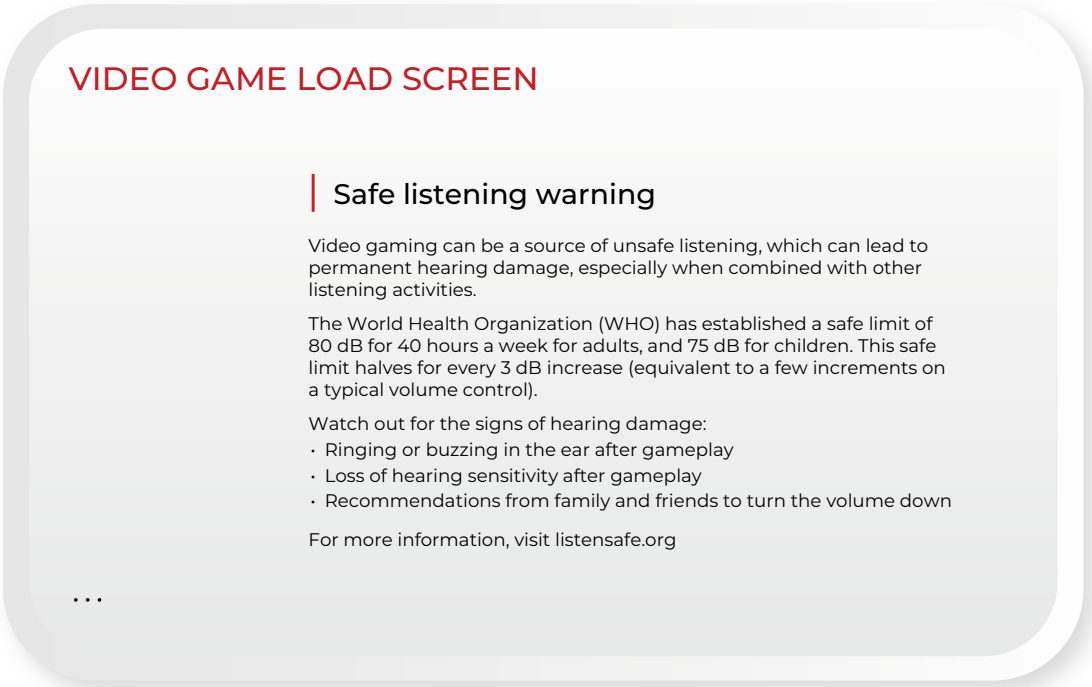
Examples for video game software titles

Safe listening warnings upon initial load of a video gameplay software title

Compliant game software titles include a warning, during the first load of the game, as illustrated in Figure III.1. This warning should include the following information:

- A warning to the game player of potential risk to hearing from exposure to loud sounds.
- Examples of potential symptoms to be aware of that indicate unsafe listening.

Figure A4.5 – Initial load screen warning example

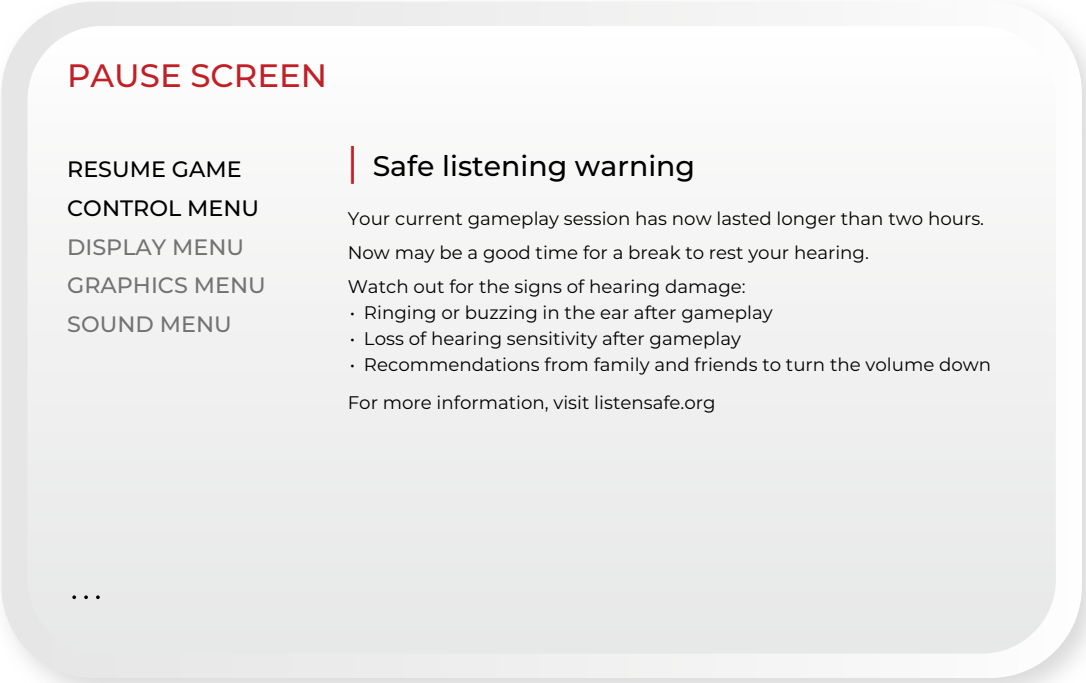


Safe listening warnings during gameplay

At a convenient in-game moment (for e.g., at the end of a round of gameplay, after completing a level, after losing a life, when pausing game, etc.) a warning message is displayed.

In the example in Figure III.2, the warning is being displayed during pause screen and notifies the game player of the amount of time they have been exposed to sound in this particular game play session.

Figure A4.6 – An example of Safe listening warning in shown in the pause menu



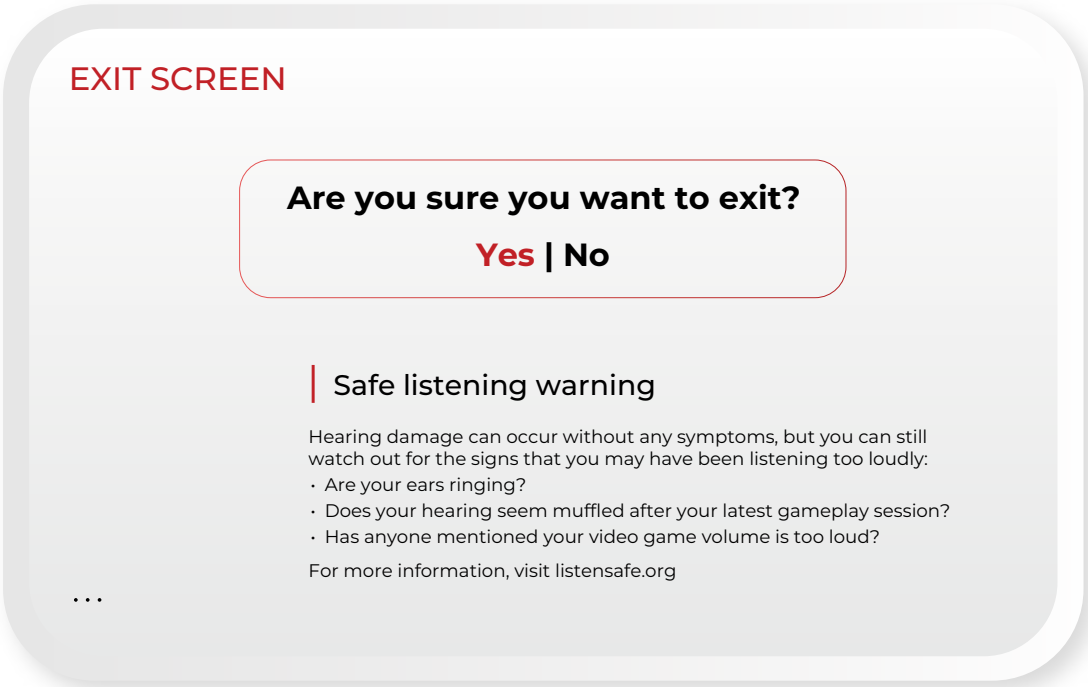
Safe listening warnings upon exit of the game

For warnings placed upon game exit, a final message should be displayed prompting the gamer to check their hearing status with simple messaging. For example, as illustrated in Figure III.3:

- Are your ears ringing?
- Does your hearing seem muffled after your latest gameplay session?
- Has anyone in your household mentioned your video game volume is too loud?
- Did you know: hearing damage can occur without any symptoms?

The warning should display for a reasonable amount of time to allow the game player sufficient time to read the displayed content, and could include a call to action to confirm understanding, for e.g. “I have seen this message”.

Figure A4.7 – Safe listening warning on exit of video game



Annex 5

Textual information examples

Textual information provided with video gameplay devices

- Provide a simple statement confirming that activities which include exposure to loud sounds can lead to hearing damage.
- Provide a list of common auditory symptoms that can indicate hearing damage, including tinnitus and loss of hearing sensitivity.
- The message should also indicate that absence of these symptoms does not necessarily indicate an absence of hearing damage.
- Provide simple instructions to incorporate safe listening into video gameplay, including references to more information as well as any onboard features they can use.
- Avoid technical or complex terminology, or references that are not easy to understand for a lay person.

Examples to guide textual information design and implementation

The examples below show *insufficient* warnings which lack important information or are too technical as well as *sufficient* examples with an ideal content to inform the user of the device and/or software title.

Figure A5.1 – Example of an insufficient textual warning

Hearing Damage

To prevent possible hearing damage, do not listen at high volume levels for long periods.

Figure A5.2 – Example of an overly technical example of a textual warning

Using headphones or earphones

If your computer has both a headphone connector and an audio-out connector, always use the headphone connector for headphones (also called a headset) or earphones.

CAUTION:
Excessive sound pressure from earphones and headphones can cause hearing loss. Adjustment of the equalizer to maximum increases the earphone and headphone output voltage and the sound pressure level. Therefore, to protect your hearing, adjust the equalizer to an appropriate level.

Excessive use of headphones or earphones for a long period of time at high volume can be dangerous if the output of the headphone or earphone connectors do not comply with specifications of EN 50332-2. The headphone output connector of your computer complies with EN 50332-2 Sub clause 7. This specification limits the computer's maximum wide band true RMS output voltage to 150 mV. To help protect against hearing loss, ensure that the headphones or earphones you use also comply with EN 50332-2 (Clause 7 limits) for a wide band characteristic voltage of 75 mV. Using headphones that do not comply with EN 50332-2 can be dangerous due to excessive sound pressure levels.

Figure A5.3 – Example of a sufficient textual warning

Warning: Protect Your Hearing During Gameplay!

Video gaming and esports activities can provide exciting and immersive experiences, but it's important to be aware that they can also pose risks to your hearing due to high volume levels and extended gameplay. To ensure your auditory well-being, follow these guidelines:

Recognize the common signs of hearing damage:

- Tinnitus: If you experience ringing, buzzing, or hissing sounds in your ears, it could be a sign of auditory damage.
- Loss of Hearing Sensitivity: If you find it harder to hear quiet sounds or conversations, take action to prevent further hearing loss.

Safe Listening Practices:

- Adjust Volume: Keep your gaming device's volume at a comfortable level. If you can't hear external sounds while playing, it's too loud.
- Take Breaks: Give your ears a break by taking 5-10 minute breaks every hour of gameplay. This helps reduce strain on your hearing.
- Use Headphones Wisely: Opt for over-ear headphones that provide better noise isolation at lower volumes.
- Enable Volume Limiting: Check your gaming device's settings to enable this feature.
- Listen to Your Body: If you notice discomfort, pain, or auditory symptoms, take a break and allow your ears to recover.

Get More Information:

- Refer to your device's user manual or visit the manufacturer's website for details on safe listening practices.
- Explore resources from reputable sources like the World Health Organization (WHO) and hearing health organizations.

Remember, responsible gameplay includes looking out for your hearing.

By incorporating safe listening practices into your gameplay routine, you can enjoy a world of video games while safeguarding your hearing for years to come.

Figure A5.4 – Alternative example of a sufficient textual warning

PlayBox User guide

Warning: protect your hearing while gaming!

Playing video games can be really fun, but loud sounds can hurt your hearing if you play for too long. Follow these tips to keep your ears healthy.

Watch for signs of hearing damage:

- **Ringing or buzzing:** if you hear ringing or buzzing in your ears during or after gameplay, it could mean your hearing is being damaged.
- **Hard to hear:** if you struggle to hear quiet sounds or conversations, take action to protect your hearing.

Safe listening tips:

- **Keep the volume down:** Set your game volume at a comfortable level. If you can't hear external noises, it might be probably too loud.
- **Take breaks:** give your ears a rest by taking 5-10 minute breaks every hour. This helps prevent ear strain.
- **Choose headphones carefully:** use over-ear headphones that block out noise. These can help you play at lower volumes.
- **Use volume limits:** check your device settings to limit the maximum volume.
- **Listen to your body:** if your ears hurt or you notice hearing problems, take a break and let your ears rest. Get more info:
- **Check the manual:** if using other audio devices such as headphones or earphones, check the manual or the manufacturer's website for safe listening tips.
- **Visit trusted sources:** find more information from places like the World Health Organization (WHO) and other hearing health organizations.

Remember: playing safely means protecting your ears. By following these tips, you can enjoy gaming without damaging your hearing.

Safe listening feature information examples for within video gameplay software titles

To ensure the effective use of any safe listening features available within a video game software title, compliant titles shall also include necessary supporting information within the video game itself to inform, guide and encourage the gameplayer of any features that have been included for the purpose of safe listening.

At the point of activation and access (for example an in-game sound or audio menu), software titles shall:

- Provide a short description of the safe listening feature, including rationale and purpose with regards to safe listening.
- Provide guidance to the gameplayer how to use the safe listening feature.
- Information should avoid technical or complex terminology, or references that are not easy to understand for a lay person, or younger audiences.

Figure A5.5 – Safe listening feature information: tinnitus sounds

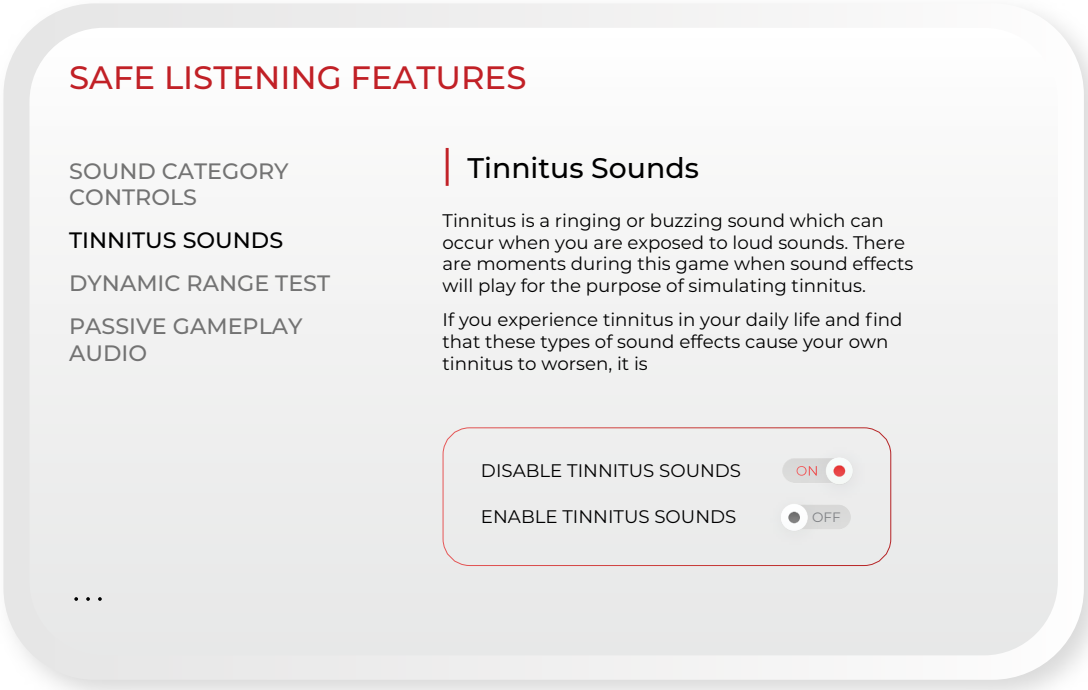


Figure A5.6 – Safe listening feature information: sound category volume controls

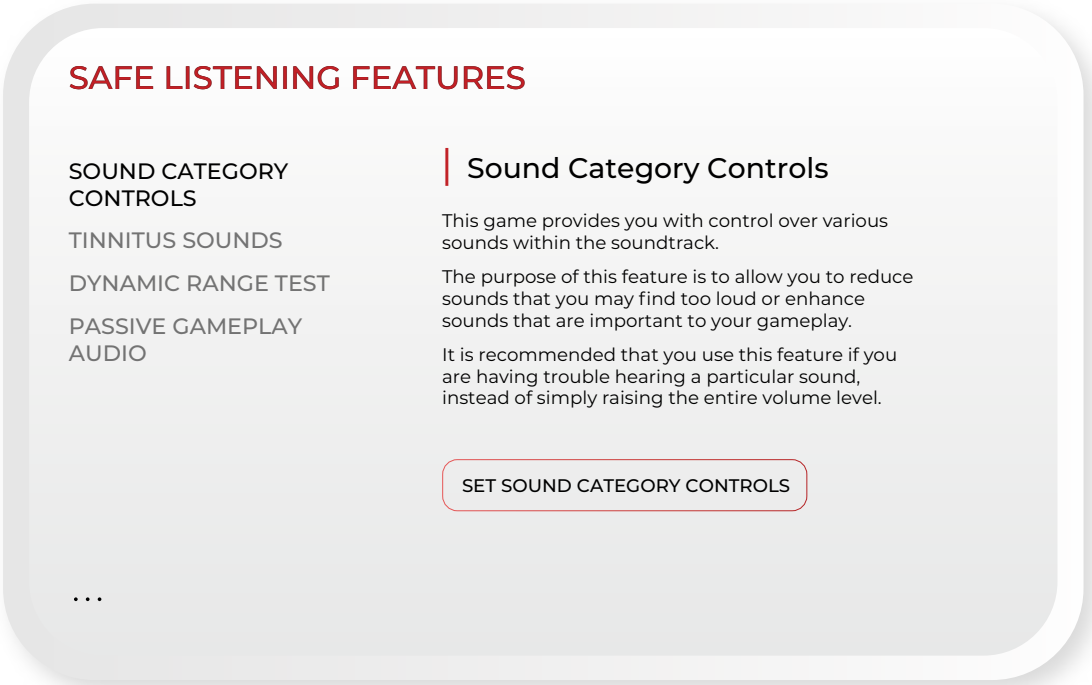


Figure A5.7 – Safe listening feature information: dynamic range test

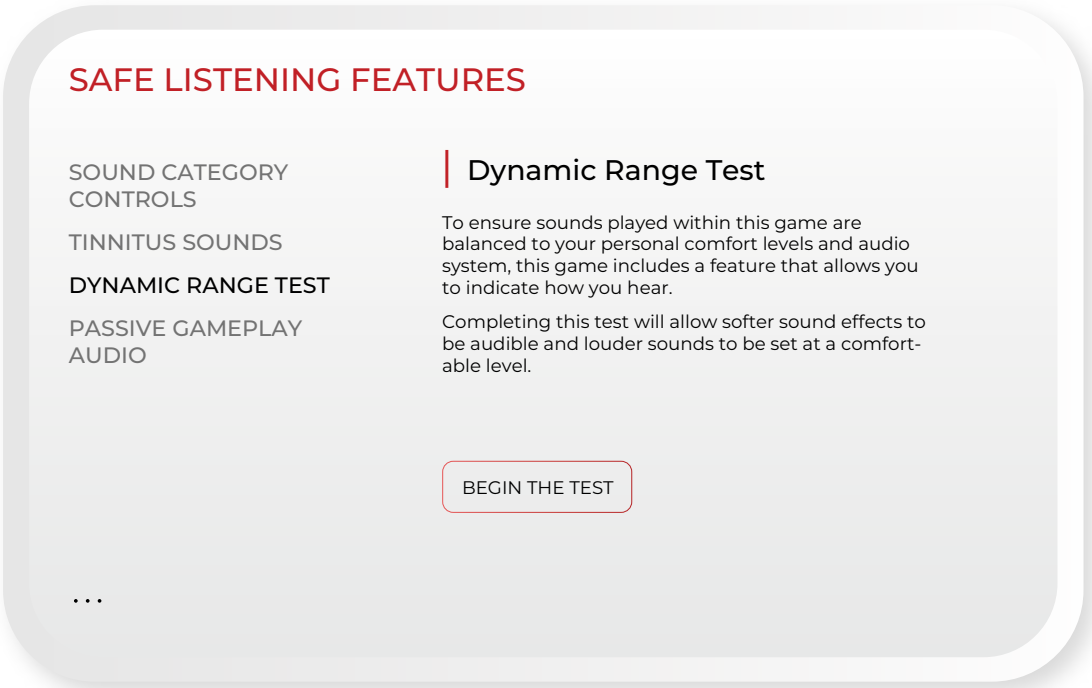
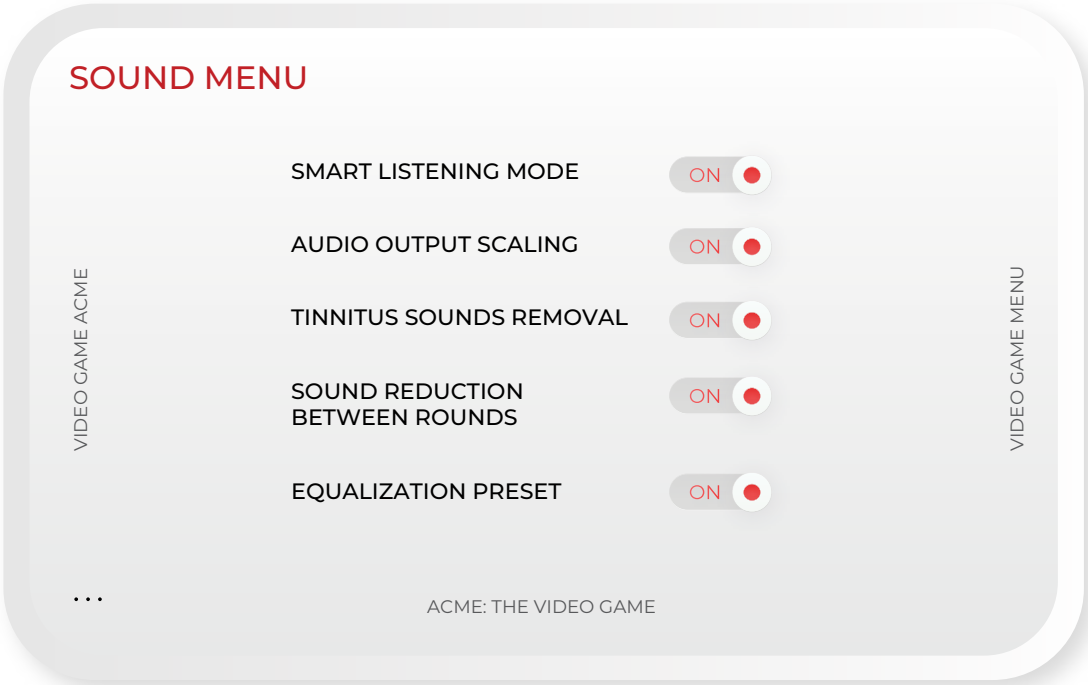


Figure A5.8 – Safe listening feature information: example of smart listening mode



Annex 6

Management of conflict of interest

All invited experts completed and submitted a WHO Declaration of Interests form prior to the development of this standard.

The WHO department for Noncommunicable diseases reviewed and assessed the submitted declarations of interest and performed an internet search to identify any obvious public controversies or interests that may lead to compromising situations.

If additional guidance on management of any declaration or conflicts of interest had been required, the department would have consulted with colleagues in the Office of Compliance, Risk Management and Ethics.

If deemed necessary, individuals found to have conflicts of interest, financial or non-financial, would have been excluded from participation in any topics where interests were conflicting.

No conflict of interest was identified.

World Health Organization
20 Avenue Appia
1211 Geneva 27
Switzerland
website: https://www.who.int/activities/making-listening-safe
e-mail: mls@who.int