Acoustic Shock

Whitepaper

THE QUEEN'S AWARDS FOR ENTERPRISE: INTERNATIONAL TRADE 2022

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Introduction

When designing headsets, one of the critical features to consider is user protection. In addition to sound quality and comfort, this white paper discusses the statuary standards for sound levels and the testing of headsets to ensure the protection of users.

Why Test Headsets

When purchasing a headset, there are two potential hazards that users may face. The first hazard is unexpected high tones (HPT). This can be caused by disruptions in a call that cause pops, clicks, or whistles down the line. Without headset sound protection, this can lead to "acoustic shock," which startles the user and over time can cause headaches, tinnitus (ringing in the ears), hearing damage and/or permanent hearing loss. Guidelines to protect workers from this have been issued by the United States and the European Union.

The second hazard is overexposure to high sound levels over a full working day, which can cause fatigue, stress, low productivity, and in some cases, hearing damage. Workers in contact centres or other office environments are particularly at risk of this hazard. Testing headsets and implementing protection software can reduce the effects of these two hazards, improving the comfort and length of time users can wear their headsets.

Headset Testing and Equipment

To test headsets, the sound levels are measured using a "Kemar" manikin, an artificial head and torso designed to be geometrically and acoustically representative of a median adult human. The manikin has pinnae, ear canals, and ear simulators with microphones at the eardrum positions. The ear simulators mimic the acoustical properties of a human ear, and a headset can be "worn" by the manikin in the same way as it can be worn by a real person. The sound levels at the eardrum microphones are measured using the Brüel & Kjær (B&K) data acquisition system, which allows simultaneous measurements to be made across many channels at the same time.

Fig 2: Inside a Kemar Manikin

Before the test, the headset is placed on the manikin, and the volume is set to the maximum level (100/100), and a tone is played to test that the software is reading correctly. This will show if the left and right ear are reading similar levels, indicating that the headset is correctly positioned on the manikin. Once correctly positioned and calibrated, the test can begin.

The test tones are played through the headset at each one-third octave band, from 100 Hz to 10 kHz. Each tone lasts for 5 seconds, and is separated by a 2-second period of silence. The sound levels produced by the headset are then measured using the two-channel B&K system. The B&K software measures the linear (un-weighted) one-third octave band average sound level every 1 second (LZeq,1s). The measured quantities, which are needed to determine compliance with statutory requirements or recommendations, are recorded. This is done for each headset twice to get an overall average between the two. The test is done using both sine and square waves at the maximum volume of the headset before the sound levels are then processed. The sound levels measured at the artificial ear are known as the ear-drum reference point values (DRP). A correction function is given by the International Telecommunication Union to correct the sound levels measured in the ear simulator to the ear reference point (ERP), where the human ear would pick up sound.

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Standards and Regulations

When reading the results of the test, we look at the Root Mean Square value (RMS). It's an expression of the effective energy in the sound waves. The RMS value is used to define a standard for continuous sound lasting longer than 500 milliseconds. The EU and US authorities agree that 118 dB (RMS value) should be the maximum level for the total sound exposure from a continuous sound.

Sudden peaks in tones at or slightly above 118 dB can cause acoustic shock, which can startle the user of the headset. At 118 dB, the levels may not be high enough to cause hearing damage; however, they can be annoying and stressful for the user. The 'absolute peak value' is the maximum level of sound that the speaker can deliver to the ear. In the EU and US, 140 dB(C) is accepted as the absolute peak value during any sudden peaks.

The EU Noise at Work Directive 2003/10/EC and the Occupational Safety and Health Administration (OSHA) also look into the time-weighted average sound levels. Time-weighted average (TWA) is the average exposure to any sound level in the workplace based on an eight-hour workday. It is the maximum amount one may be exposed to without experiencing significant adverse health effects over said period of time. The EU's TWA upper maximum exposure limit is 87 dB(A), whereas in the US, this should not exceed 85 dB(A). If this is exceeded, a risk assessment is to be carried out, and training and hearing protection must be given to reduce these levels.

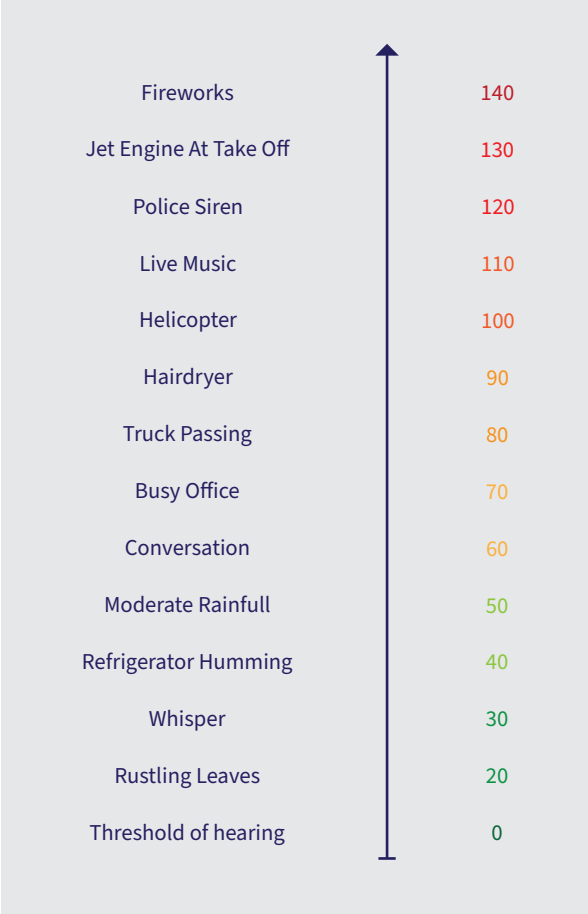

Fig 1: Table of decibel levels from common sources

The TWA can be seen as a trading relation. In other words, by reducing the duration of the daily noise exposure, it allows for an increase in the exposure limit. In the US, the action level is 85 dBA for eight hours, which is equivalent to 80 dBA for 16 hours or 90 dBA for four hours. In the EU, the upper action value is 85 dBA for eight hours, which is equivalent to 82 dBA for 16 hours or 88 dBA for four hours.

However, these regulations only relate to 'open field noise' in workplaces such as factories, offices, and other inherently loud locations. No government regulations specifically address sound that is emitted on or in the ear by headsets. This is why when recording the results, a correction function is given to find the levels at the ERP.

JPL Sound Shield™ technology

To ensure that all our users are protected when using our headsets, we have developed Sound ShieldTM technology, which is implemented across all JPL headsets. This technology analyses the sound waves emitted through the headset, assesses any dangerous levels, and either reduces or removes them from your call. This gives you a clear and safe conversation without affecting the overall sound level of the call.

In noisy office environments, users are more likely to increase the volume on calls to be able to hear the conversation. These high sound levels can have a negative effect on their hearing. However, with Sound ShieldTM, the incoming sound on a call is clear without the need to increase the volume. This software is also applied to our audio telephony headsets. When listening to music, a user is likely to turn up the volume to hear the full range of the treble, mid, and bass tones. With our Sound ShieldTM technology and stereo audio, the music is clear and punchy without the need to increase the volume. This reduces the likelihood of hearing damage from high sound levels over a long period of time.

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Contact JPL

Contact JPL Telecom for all your headset requirements. You can contact JPL Telecom by phone or e-mail during business hours: Monday to Friday, 9:00am to 5:00pm.

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