

Hearing Conservation Guidance for the Performing Arts – a Consultation

Best Practice Guidance 2019

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Summary of recommendations

Healthy hearing is essential for musicians.

Education providers and industry organisations recognise the potential risk of sound exposure to performers and have a duty to identify hazards to health, and take appropriate steps to minimise the risk of causing harm.

Modification of environment, repertoire and rehearsal schedule all contribute to level of exposure and must be carefully planned in advance.

Hearing tests are vital for health surveillance. Early recognition of changes to musicians' hearing is best identified with a hearing test called 'Otoacoustic Emissions'.

Personal protection with custom moulded earplugs must be verified to ensure adequate protection.

Instruction and continuous education for all staff and students must be available and recorded.

1. Background

Sound exposure is inescapable in our society. Prolonged exposure to intense sound is an integral part of a musician's every-day activities, both related to and outside performance. Healthy hearing is vital to performers and maintaining good function of this delicate sense, through recognition and management of risks to hearing health is essential to a musician's career (Sataloff, 1991).

Education providers and industry organisations in the performing arts industry increasingly recognise their legal and moral obligations regarding their students' health and wellbeing. On-going research in a cohort of over 3000 individual music students indicates evidence of noise-induced injury was present in every participant (Dance & Shearer, 2017). This work highlights the significant demand for guidance on an appropriate hearing conservation strategy for music students, teachers, professionals and organisations.

The guidance has been developed by clinicians working with the British Association for Performing Arts Medicine at the request of the Healthy Conservatoires Network to inform the development and implementation of health conservation strategies initially in educational institutions and is expected to be of interest to the wider industry.

The Law

The HSE guidelines for employers outline their responsibilities toward their employees and others they may be responsible for. This guidance is based on *The Control of Noise at Work Regulations 2005* ('*The Noise Regs*'), which came into effect for the music and entertainment sector in April 2008. These are the minimum standards required by law.

Although the 'Noise Regs' do not apply directly to students, there is a duty of care toward non-employees such as students outlined in the overarching *Health and Safety at Work etc. Act 1974 Section 3* and associated *The Management of Health and Safety at Work Regulations 1999* ('*the Management Regulations*') that is likely to be considered pertinent. It would be sensible, therefore, on recognition of a risk such as sound exposure, to adhere to the limits set out in the 'Noise Regs'.

"It shall be the duty of every employer to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that persons not in his employment who may be affected thereby are not thereby exposed to risks to their health or safety."

Health and Safety at Work etc. Act 1974

"Every employer shall make a suitable and sufficient assessment of...the risks to the health and safety of persons not in his employment arising out of or in connection with the conduct by him of his undertaking, for the purpose of identifying the measures he needs to take to comply with the requirements and prohibitions imposed upon him by or under the relevant statutory provisions..."

The Management of Health and Safety at Work Regulations 1999

Consultation period

This document is being consulted on until February 2020. Any comments are very welcome and respondents are encouraged to discuss with colleagues and use the online survey at the following link <https://www.surveymonkey.co.uk/r/L2M7LHH>. The final guidance document will take account of responses.

Best Practice: The Gold Standard

In establishing an effective hearing conservation strategy, the HCN is leading the way internationally. BAPAM guidelines to the sector include all aspects of effective hearing conservation, which are not only compliant with the 2005 HSE regulations but exceed these minimum standards in preventing unnecessary injury to health. It aims to provide recommendations to educational institutions, students, performers, teachers, managers and venues on appropriate hearing conservation in a music-rich environment.

Introduction

Loud sounds are not necessarily unpleasant or classified as noise; they include sound we enjoy listening to, such as music. Exposure to very loud sounds or prolonged exposure to moderately loud sounds can cause injury to the vulnerable hair-like structures of the inner ear, *figure 1* and lead to permanent and irreversible hearing loss, known as Noise-Induced Hearing Loss (NIHL) (Zhao, Manchaiah, French, & Price, 2010).

Sound exposure can also cause other hearing problems such as

- tinnitus (ringing in the ears)
- hyperacusis (reduced tolerance to louder sounds)
- diplacusis (problems with pitch perception) (Zhao et al., 2010)

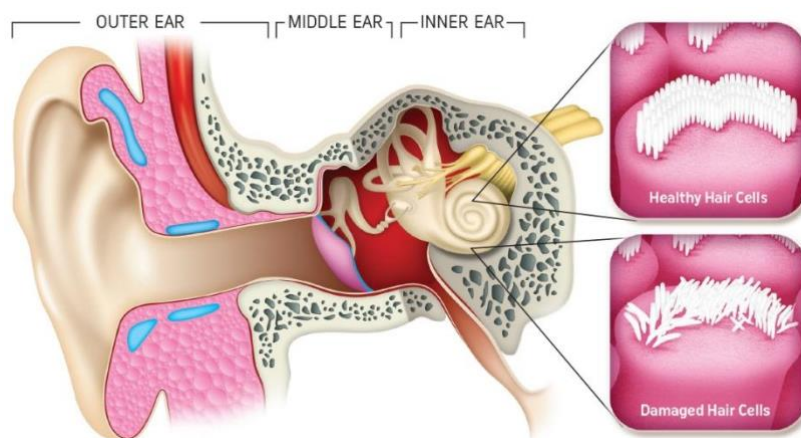


Figure 1: vulnerable hair-like structures in the inner ear

These injuries and NIHL are avoidable and 100% preventable.

For musicians, this can be a threat to sustaining a career in music (Di Stadio et al., 2018), and this guidance outlines how both performers and those working in the performance environment can work together to conserve auditory health.

Current recommended exposure limits

Recommended exposure limits are set out in the HSE's publication, *Sound Advice* (Health and Safety Executive, 2008), and the excerpts below are taken directly from this guidance. The full document can be viewed online <http://www.hse.gov.uk/pUbns/priced/hsg260.pdf>

How sound is measured

Noise is measured in units called decibels, shown as dB. Some sounds, which can be measured, cannot be detected by the human ear. For example, people cannot usually hear bats communicating at very high frequencies or when whales use very low frequencies. To account for the way that the human ear responds to sound of various frequencies a frequency weighting, known as the A-weighting, is commonly applied when measuring noise. The exception is when measuring peak noises, where a C-weighting is applied to ensure that proper account is taken of the sound energy in the peak sound.

Noise can contain many different frequencies. However, when considering ways to control noise, low-frequency noise needs to be treated differently to high frequency noise. So the division of the A-weighted measurement into its constituent frequencies (frequency analysis) becomes necessary. It is also very important, particularly in music and entertainment, when selecting personal hearing protection, to ensure the correct type for protection from the most damaging frequencies identified during a noise risk assessment

Reproduced from Sound Advice, HSE 2008

Noise action and limit values

The Noise Regulations require employers to take specific action at certain action values. These relate to:

- the levels of exposure to noise of employees averaged over a working day or week; and
- the maximum noise (peak sound pressure) to which employees are exposed in a working day.

The values are:

- lower exposure action values (LEAV):
 - daily or weekly exposure of 80 dB;
 - peak sound pressure of 135 dB;
- upper exposure action values (UEAV):
 - daily or weekly exposure of 85 dB;
 - peak sound pressure of 137 dB.

There are also levels of noise exposure which must not be exceeded (but take account of any reduction in exposure provided by hearing protection):

- exposure limit values (ELV):
 - daily or weekly exposure of 87 dB;
 - peak sound pressure of 140 dB.

Reproduced from Sound Advice, HSE 2008

Noise exposure

The noise exposure level (often referred to as the 'noise dose') takes account of both the sound pressure level and how long it lasts. Generally the potential for hearing to be damaged by noise is related to the noise 'dose' a person receives. Being exposed to a noise level of 105 dB (a not unusual sound level for a pub band, or that generated by a brass or woodwind instrument at full blast) for 5 minutes would be the same dose as being exposed to 94 dB (a nightclub bar) for 1 hour, or 88 dB (chamber music) for 4 hours.

Each 3 dB added doubles the sound energy (but this is only just noticeable to a listener). When 10 dB is added, the energy is increased ten-fold, while adding 20 dB is a hundred-fold increase. Therefore:

- If the sound intensity is doubled, the noise level increases by 3 dB.
- Two instruments with the same noise level of 85 dB together produce 88 dB.
- A noise level reduction of 3 dB halves the sound intensity (and reduces its propensity to damage).

Halving the noise dose can be achieved either by halving the exposure time, or by halving the noise level, which corresponds to a reduction of 3 dB. These noise exposures are identical: 80 dB for 8 hours 83 dB for 4 hours 86 dB for 2 hours 89 dB for 1 hour 92 dB for 30 minutes

| Average noise level | Time taken to receive a dose equivalent to the upper exposure action value (85 dB) |
|---------------------|--|
| 85dB | 8 hours |
| 95 dB | 45 minutes |
| 100 dB | 15 minutes |
| 105 dB | 5 minutes |
| 110 dB | Under 2 minutes |
| 115 dB | Under 30 seconds |

Reproduced from Sound Advice, HSE 2008

2. How to recognise hearing damage

NIHL is typically diagnosed using a hearing test called Pure Tone Audiometry (PTA). This test is designed to diagnose hearing problems which will cause difficulty interpreting speech. In the early stages of damage to the inner ear however, a significant proportion of hair cells can be affected causing reduced function, but without any apparent symptoms of NIHL. Traditional hearing tests cannot detect these early changes; therefore, there is no opportunity to take steps to prevent progression. More recent advancements in technology, known as 'Otoacoustic Emissions' (OAE) measurement is capable of detecting these changes much earlier (Job et al., 2009). Early recognition of sound-related changes to these vulnerable structures enables people to alter their individual behaviour and their way of working, to protect themselves from further injury (Mansfield, Baghurst, & Newton, 1999).

3. Developing a hearing conservation strategy

A genuinely effective hearing conservation program will involve several simultaneous actions: assessing risk, allow proactive intervention to prevent hearing loss or other auditory disorders and inform on the efficacy of control processes. These cohesive elements motivate the participants to embrace protective measures and take some responsibility of how THEIR auditory health is protected (Fligor, 2013; Murray, LePage, & Mikl, 1998).

A multi-faceted strategy including risk assessment and health surveillance must be taken. The HSE advises employers to *'think about what might cause harm to people in your workplace and decide whether you are taking reasonable steps to prevent or control that harm.'* (<http://www.hse.gov.uk/simple-health-safety/risk/index.htm>) This advice is easily adaptable to those responsible for music environments who have a duty to all people using, performing, studying and working in those settings.

Risk assessment in musical environments will identify a need for methods of controlling risks identified and for health surveillance. Health surveillance is a system of ongoing health checks to

- 1) detect adverse effects early, and
- 2) provide information on effectiveness of control processes and to minimise further harm being caused. (<http://www.hse.gov.uk/health-surveillance/what/index.htm>)

Assessing and Controlling Risk

Risk Assessment

The initial step of risk assessment includes:

1. Identification of potentially hazardous sound and those at risk: music rehearsal, tuition or performance
2. Characterisation of sound: variation according to the instrument, environment, duration, intensity etc

- *Consideration of all music-related sound exposure: includes performance, rehearsal and personal practice time. For students, this will not only be while on-site in conservatoire practice spaces but includes outside the structured learning environment*
- 3. Exposure assessment: document the nature and extent of expected exposure
 - *Measurement of personal sound exposure, known as dosimetry*
- 4. Estimation of risk: what is the probability of hearing damage due to sound exposure in the identified context

Risk Management

Following risk assessment, risk management utilises a value judgement to decide between possible courses of action – reflecting interests of all people who may be affected by the decision

Appropriate management of risk to the individual or group of people and implementation of controls to risks identified **should not** be limited to noise level area measurement. The hierarchy of control model could be considered, using the following components in turn:

1. Controlling sound at source
2. Prevent/control transmission of sound to individual
3. Individual protection

Controlling sound at source

- Eliminate the risk: this is *unlikely* to be a reasonable solution – music *is* the product rather than an unwanted by-product of sound exposure, therefore evaluation and control of this unavoidable risks is essential
- Modify the process to reduce frequency, intensity and duration of sound
 - Consideration of appropriate design of practice and performance space (i.e. small rooms with untreated walls/mirrors represent potentially more significant risk than large performance areas)
 - Investigation of recent innovations such as noise mapping for orchestras
 - Advice on noise level risk assessment of practice spaces for teaching organisations developing standards on timetable structure with a reduction of risk by
 - awareness of design of playing space
 - avoidance of prolonged exposure
 - Build on current information given to performers on all aspects of possible exposure to risk including non- vocational and personal risk (e.g., transport, personal music-players)
- Substitute sound source
 - Careful consideration of repertoire alternating louder, intense pieces with quieter work, allowing time for recovery from exposure
 - Planned rest/quiet time and provision of quiet space for recovery

- Using appropriate instruments (e.g. Baroque instruments for Baroque music, solutions for electronic versus classical instruments)

Prevent/control sound exposure

- Adequate distance between musicians
- Educate, inform on, and reduce the duration of exposure
E.g. Informative visual aids/noise levels indicators

*If not possible/practical to **reduce** exposure to loud sounds then **PROPER** provision of adequate and suitable protection is essential.*

Provision of personal hearing protection

If it is not practical for the risk presented by loud sound to be reduced at source then it is vital that all those exposed are adequately protected.

Hearing protection appropriate to the assessed risk should be employed, i.e. if assessment indicates potential exposure presents only a marginal risk then suitable protection may be different from that required by someone who will be exposed (duration/levels) to risk that significantly exceeds actionable levels.

Published attenuation levels of various types of hearing protectors arrived at in laboratory conditions during the certification process do not adequately predict real world attenuation and often over estimate protective values. (HSE RR720 2009; HSE CRR24 1990)

Measures must be taken to ensure the degree of protection is as close to laboratory figures as possible, and verification by fit testing at time of supply should be undertaken. *When custom moulded hearing protection products designed for musicians are sourced then the fit must be verified when supplied and regularly verified to ensure continued protective levels. Errors can occur during manufacture to affect the fit so although comfortable some samples will not fit properly and this leakage will result in a significant reduction of the real world protective value. (BS EN 352) (Hager, 2011; Schulz, 2011).*

Education & training

All staff and students should have training on hearing conservation, the risks involved in the performance environment and how to protect themselves. Records of staff and students attendance and participation in instruction and education on hearing conservation should be kept and the responsibility held by the designated person identified in health surveillance (see below). Annual refresher training should be required. Online modules would be very suitable if completion can be recorded.

Definitions & abbreviations used

| | |
|--|---|
| 'Management Regs' | The Management of Health and Safety at Work Regulations 1999 http://www.legislation.gov.uk/uksi/1999/3242/contents/made |
| 'Noise Regs' | The Control of Noise at Work Regulations 2005 http://www.legislation.gov.uk/uksi/2005/1643/contents/made |
| BAPAM | see British Association for Performing Arts Medicine |
| British Association for Performing Arts Medicine | A healthcare charity giving medical advice to people working and studying in the performing arts http://bapam.org.uk/ |
| Diplacusis | a difference in hearing by the two ears so that one sound is heard as two |
| HCN | see Healthy Conservatoires Network |
| Health & Safety Executive | The Health and Safety Executive (HSE) is Britain's national regulator for workplace health and safety https://www.hse.gov.uk/ |
| Health surveillance | a system of ongoing health checks. These health checks may be required by law for employees who are exposed to noise http://www.hse.gov.uk/health-surveillance/what/index.htm |
| Healthy Conservatoires Network | A forum of UK conservatoires aiming to create environments that promote and enhance the health and wellbeing of performing artists, enabling them to achieve their full potential and to build healthy, sustainable careers |
| HSE | see Health & Safety Executive |
| Hyperacusis | everyday sounds seem much louder than they should |
| MRHD | see Music-related hearing disorders |
| Music-related hearing disorders | Symptoms experienced by performers including tinnitus, sensitivity to sound, pain and difficulty with pitch perception |
| NIHL | see Noise-Induced Hearing Loss |
| Noise-Induced Hearing Loss | Hearing impairment resulting from exposure to loud sound |
| OAE | see Otoacoustic emission |
| Otoacoustic emissions | sounds of cochlear origin, which can be recorded by a microphone fitted into the ear canal |
| Otoscopy | An examination that involves looking into the ear with an instrument |
| PTA | see Pure Tone Audiometry |

| | |
|----------------------|--|
| Pure Tone Audiometry | Hearing test to screen or diagnose hearing impairment |
| Risk assessment | The process of identifying processes which may cause harm to people in the workplace and decide whether you are taking reasonable steps to prevent or control that harm |
| Tinnitus | Tinnitus is the name for hearing noises that are not caused by an outside source |
| Tympanometry | an examination used to test the condition of the middle ear and mobility of the eardrum and the conduction bones by creating variations of air pressure in the ear canal |

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