



## **CBSO YOUTH ORCHESTRA**

### **Guidelines on Hearing Protection**

Good hearing is vital for both your career as a musician and your quality of life. The aim of noise legislation is to eliminate exposure, or minimise exposure to the lowest level possible. There are many things you can do to look after the hearing you have:

- Get into **good habits**
- **Protect** your hearing both inside and outside work
- **Invest** in your hearing health
- **Learn** more about your ears
- **Don't ignore** any problems
- **Talk** to your colleagues – **sharing** the responsibility makes things easier

#### **How we experience noise**

- **Outer ear** (pinna): This captures vibrations and sends them down the ear canal to the ear drum. There are two, for stereo sound.
- **Middle ear**: Within the eardrum there are three ossicles (tiny bones) which transmit vibrations from the air to the inner ears. The stapedius muscle and eustachian tubes are located here. Potential problems include conductive hearing loss, ear infections, and perforated eardrum.
- **Inner ear** (part of the brain): The cochlea translates signals and sends them to the brain. This also works with the vestibular system to provide us with a sense of balance. Potential problems include auditory fatigue, threshold shift, and sensorineural hearing loss.

#### **About tinnitus**

[www.entuk.org](http://www.entuk.org)

- **What is tinnitus?** A sensation or awareness of sound that is not caused by a real external sound source. It can be perceived in one or both ears, inside the head or in the person's immediate environment. Tinnitus can take almost any form including ringing, hissing, whistling, humming, and buzzing. Some people hear musical sounds or sounds resembling indistinct speech. Some people hear a single sound whereas others hear multiple noises. For some, the sound is constant: for others it is constantly changing. Displacusis is a form of tinnitus where sounds are perceived as 2 different auditory pitches. This is a secondary symptom of hearing loss.
- **Symptoms?** Tinnitus is a symptom itself. It may be accompanied by hearing loss, dizziness, pain in the ear, or dislike of loud sounds. Many people also feel their ears are blocked.
- **What can I do to help myself?** Tinnitus is extremely common. Approximately 1 in 10 people have some degree of tinnitus. In most people, the symptom is mild and does not interfere greatly with their lives. Most people with tinnitus find that it appears louder if they are sitting somewhere very quiet. Having a little bit of quiet background sound (TV/Radio etc.) can help. Many people notice that their tinnitus becomes more distressing if they are stressed or anxious. Learning to try to reduce stress levels can help.

## Age and noise exposure: a potential cocktail

- **Ageing:** you lose the ability to hear the higher frequencies as you get older. This cannot be prevented.
- **Noise exposure:** can trigger tinnitus (a ringing 'noise' in the absence of external sound) or hyperacusis (a low level of noise tolerance). It can also mean losing the ability to hear 4-6kHz (including the consonants in speech).
- The combination of **age** and **noise exposure** will exacerbate hearing problems.

## Hearing problems: what you can do about them?

- Act sooner rather than later if you have any concerns and contact your GP in the first instance.
- If you use the internet to learn about hearing, remember it is not specific to your particular case and it is **not a substitute for medical help**.

You can reduce the likelihood of damaging your hearing by reducing the:

- **Volume** of the sounds to which you are exposed
- **Duration** of the exposure

You can achieve this by:

- **Shifting your position slightly:** in theory, 3dB reduction for every doubling of distance from the sound source.
- **Marking up the score:** you can avoid peaks of 120dB and over by having cues as to where to put earplugs in.
- **How you spend your breaks:** you could reduce your daily exposure to noise if you make the choice to spend your breaks quietly.
- **How you warm up/down/practise:** be aware of the fact that this can affect your daily exposure values. Spare your ears (and those of your colleagues) and find other ways of practising.
- **Reducing your noise exposure outside of rehearsals:** you could do this by avoiding the use of headphones during your breaks and journeys to and from rehearsals.

**Remember!**

Ears can't be switched off and it is hard to know what our noise exposure is. While we may like the music we can't assume that it isn't harming us.

## Describing and Measuring Sound

The **sensory** experience **can't be measured** but **can be described** subjectively. The physical phenomenon can be measured in terms of **pitch, duration** and **intensity**.

- **Pitch:** Frequency (pitch) is measured in Hertz (Hz) which are cycles per second. The human hearing range is 20-20,000Hz (it reduces as we get older). Noise-induced hearing loss (4-6kHz) means missing out on upper harmonics in music and consonants in speech. High frequencies are easier to block out. Certain sounds can be tiring on the ears (e.g. a pure tone, a dissonance).
- **Duration:** **Leq** (or LAeq) refers to the level over a given period of time (T) and **Lepd** is the level of exposure calculated over an **eight-hour day**.
- **Decibels:** sound intensity is measured in decibels (dB) and a reduction of 3dB is **halving** of sound intensity and an increase of 3dB is a **doubling** of sound intensity.

## 3dB is a doubling or halving of the sound pressure level

**Doubling the number** of (identical) sound sources **increases** the level by 3dB. For example, to illustrate this approximately: if 1 trumpet (@ 1m distance = 93dB, then 2 trumpets (@ 1m distance = 96dB and 4 trumpets (@ 1m distance = 99dB etc.

**Doubling the distance** from a single sound source **reduces** the level by c.3dB: For example, to illustrate this approximately: if 1 trumpet (@ 1m distance = 93dB, then 1 trumpet (@ 2m distance = 90dB and 1 trumpet (@ 4m distance = 87dB etc.

Doubling the duration **increases** your exposure by 3dB.

So, to **halve your daily dose** you need to **halve the exposure time**: For example, to illustrate this approximately:

- 85dB over 8hrs is the equivalent of:
- 88dB over 4hrs (time to reach 85dB Lepd)
- 91dB over 2hrs
- 94dB over 1hr
- 97dB over ½hr (e.g. solo trumpet)

If these levels are reached rapidly then consideration needs to be given to any other exposure to noise during that day.

N.B. by **taking off 3dB** you **halve your daily dose**.

## It all adds up

Consider measuring your noise dose **inside** and **outside** rehearsals – your ears don't differentiate between the two. You do have some control over your daily exposure and can reduce your daily dose by using hearing protection. Be aware of other sources of loud noise outside rehearsals and try to avoid those on days when noise levels have been particularly high.

### Typical sound levels taken over a short duration

- 20dB(A) rustle of leaves in a forest
- 77dB(A) cycling (in Central London)
- 79dB(A) quiet coach on a train
- 80dB(A) solo piano, cello, double bass
- 85dB(A) solo violin, oboe playing mf
- 85dB(A) busy canteen
- 85dB(A) football crowd (peaks when cheering 152-167dB)
- 85dB(A) sitting on an aeroplane (105dB for take off & landing)
- 90dB(A) solo trumpet, horn playing mp
- 93dB(A) motorbike
- 130dB(C) cymbal crash

## Earplug essentials

- Use **just enough** protection (make sure you balance the reduction of exposure to noise with your ability to perform).
- Find an earplug that **suits you** and your instrument .
- Always carry your earplugs with you.
- See it as a **long-term** project – your brain needs time to adjust so don't expect to get used to earplugs immediately. Equally, don't expect to cope if you put them in just before you go on stage.
- Use earplugs for **private practise** and **rehearsals** when appropriate.
- Use them to protect your ears in **other situations** e.g. plane, amplified concerts etc.
- It is not recommended that you wear hearing protection in only one ear. We have two ears to enable us to locate sounds in space – and so we need to get information in **both ears**. We all need adequate protection in both ears and one ear can still be damaged by excessive sound if only one earplug is worn (in fact protection in only one ear is generally regarded as near useless).



The most important things to aim for are a **reduction in dBs** and **giving your ears a rest**.

## Types of Earplugs

There are several different types of earplug you can use. Please see the information listed below:

### Compressible earplugs (disposable)

Usually made of foam, these earplugs are compressed before being inserted into the ear canal, where they expand to seal it off.



#### ADVANTAGES

- Inexpensive and simple to use.
- Effectively protect against high sound levels.
- Small and easily transportable.

#### DISADVANTAGES

- Intended for single use only.
- Provide uneven frequency attenuation\* – remove more high frequencies than low.
- Occlusion effect\* distorts sound perception for reeded woodwind and brass instruments.
- Interfere with speech communication.
- Require careful insertion to ensure effective protection.
- Risk of infection from dirty hands.



We advise that you use these earplugs in case of emergency only, e.g. if you forget to bring your own. The CBSO will provide these earplugs at all rehearsals in case this occurs, however we strongly advise you to purchase a permanent pair of earplugs to specifically suit you.

\* See Terminology (page 6)

## Pre-moulded earplugs (reusable)

Pre-moulded earplugs are shaped for the average user's ear canal, often referred to as 'generic-fit' or 'universal-fit'. On the whole, two shapes are available: **triple-flanged** (shaped like a Christmas tree) and **domed** (shaped like a toadstool). Various types are available, including uniform attenuation\* and amplitude-sensitive\*.



### ADVANTAGES

- Less expensive than custom-moulded earplugs.
- Easy to insert properly.
- Last longer than disposable earplugs.
- Do not require custom fitting – can be purchased 'off the shelf'.
- Reusable (if kept clean).

### DISADVANTAGES

- More expensive than disposable earplugs, *however they can be purchased at a reasonable price.*
- Require regular cleaning.
- Uniform attenuation\* types generally not as 'flat' as custom-moulded uniform attenuation\* earplugs.



## Custom-moulded earplugs (permanent)

Typically made by a laboratory that supplies local audiologists and hearing clinics, these silicone earplugs are moulded to the shape of the user's ear canal and can come in filtered\* or vented/tuned\* varieties.

### ADVANTAGES

#### **Filtered:**

- Provide even attenuation\* of frequencies up to about 6,000 Hz.
- Can be modified to adjust high-frequency attenuation\*.
- May be flesh-coloured and unobtrusive.

#### **Vented/Tuned:**

- Allow musicians playing lower frequencies to hear themselves while screening out surrounding higher frequencies
- Very little occlusion effect\*.
- Right and left earplugs can be adjusted separately.

### DISADVANTAGES

#### **Filtered:**

- Expensive.
- Need to be custom-fitted by a qualified professional.

#### **Vented/Tuned:**

- Expensive.
- Need to be custom-fitted by a qualified professional.



Custom-made earplugs are the best option for musicians who would like to have a long career in music. However, we appreciate that they are the most expensive option. Therefore, we advise that you either purchase a pair of pre-moulded or custom-moulded earplugs. They will be much more effective than disposable earplugs. Please use the following link for a brand that is popular with CBSO musicians:

<https://www.acscustom.com/uk/products/hearing-protection/universal-fit/pacato>

\* See Terminology (page 6)

## Terminology

TERMINOLOGY	DEFINITION
Attenuation	Flat/uniform attenuation is an equal reduction in sound across frequency. In the past, earplugs were designed to stop the vibrations in the ear canal, which would prevent damage to hearing, but would also make everything seem quieter. However, improvements to hearing protection meaning that it is now possible to purchase earplugs that can reduce sound levels equally across a range of frequencies.
Occlusion effect	The occlusion effect occurs when an object (in this instance, an earplug) fills the outer portion of the ear canal, resulting in the user receiving 'hollow' or 'booming' echo-like sounds of their own voice. This can potentially result in further hearing damage as the sound cannot escape. The occlusion effect is caused by bone-conducted sound vibrations reverberating off the object filling the ear canal. This is not deemed as a desirable feature of an earplug, but simply the effect that some earplugs can have on the quality of sound the user hears. <i>The occlusion effect can be tackled by using custom-moulded earplugs, which reach into the inner bony portion of the ear canal, thereby reducing the possibility of vibration and jaw resonance. Alternatively, vented earplugs can be effective as they allow the trapped low-frequency sound to escape.</i>
Amplitude sensitive earplug	These earplugs are designed to be adjustable in order to protect against different amplitudes, which is particularly useful for brass, woodwind and percussion instruments which have a large dynamic range.
Filtered earplug	Filtered earplugs work by reducing the volume of sound the user hears, while still maintaining audio quality and clarity. There are two types available: <ol style="list-style-type: none"> <li>1. <b>Active:</b> retain sound quality using an inbuilt microphone, which analyses the environment to reduce specific frequencies.</li> <li>2. <b>Passive:</b> rely on their design to absorb and filter volume by applying reduction at specific frequencies in any environment.</li> </ol> <i>Active earplugs are theoretically superior, but are quite expensive and require batteries. Passive earplugs are cheaper, do not require batteries, and suit most average ears.</i>
Vented/Tuned earplug	These earplugs are fitted with a vent, which reduces the amount of low-frequency sound the user hears, by allowing low-frequency wavelengths to leak out, therefore improving the quality of sound the user hears.

## Instrument Specifics

### Remember!

It is important to purchase the right hearing protection for you, which means you need to take into consideration the instrument you play and where you sit in the orchestra.

INSTRUMENT	COMMON ISSUES	HEARING PROTECTION TO CONSIDER
Upper strings	<ul style="list-style-type: none"> <li>Compressible earplugs remove higher-frequency sounds.</li> <li>Left-ear hearing loss.</li> </ul>	<ul style="list-style-type: none"> <li>Uniform attenuation earplugs.</li> <li>Amplitude-sensitive earplugs.</li> </ul>
Lower strings and harp	<ul style="list-style-type: none"> <li>Proximity to brass section.</li> </ul>	<ul style="list-style-type: none"> <li>Vented/tuned earplugs.</li> </ul>
Flute/piccolo	<ul style="list-style-type: none"> <li>Intense high frequencies.</li> <li>Right-ear hearing loss.</li> </ul>	<ul style="list-style-type: none"> <li>Uniform attenuation earplugs.</li> <li>Amplitude-sensitive earplugs.</li> <li>Asymmetrical vented/tuned earplugs for right-ear hearing loss.</li> </ul>
Reeded woodwind	<ul style="list-style-type: none"> <li>Proximity to brass and percussion sections.</li> <li>Compressible earplugs don't help to tackle the occlusion effect caused by jaw resonance.</li> </ul>	<ul style="list-style-type: none"> <li>Vented/tuned earplugs.</li> <li>Uniform attenuation earplugs.</li> <li>Amplitude-sensitive earplugs.</li> </ul>
Brass	<ul style="list-style-type: none"> <li>Proximity to percussion section and other members of the brass section.</li> <li>Compressible earplugs don't help to tackle the occlusion effect caused by jaw resonance.</li> </ul>	<ul style="list-style-type: none"> <li>Vented/tuned earplugs.</li> <li>Amplitude-sensitive earplugs.</li> </ul>
Percussion	<ul style="list-style-type: none"> <li>Intense higher frequency sounds (such as cymbals).</li> <li>Compressible earplugs reduce overall sound levels too much and may result in over-hitting to compensate.</li> </ul>	<ul style="list-style-type: none"> <li>Uniform attenuation earplugs.</li> <li>Amplitude-sensitive earplugs.</li> </ul>

### Remember!

It will take a while to get used to your earplugs as all hearing protection affects what the user hears. However, it is vital that you persevere with using hearing protection as, without it, you will suffer hearing damage/loss.



Try wearing your earplugs at home to start off with. Once you've got used to using them in conversation, start to wear them for practise and rehearsals. **It is advisable not to use them for the first time in a concert.**

## Useful websites

### Health & Safety Executive

[www.hse.gov.uk/noise/musicandsound.htm](http://www.hse.gov.uk/noise/musicandsound.htm)

### Musicians' Union

[www.musiciansunion.org.uk](http://www.musiciansunion.org.uk)

### British Association for Performing Arts Medicine (BAPAM)

[www.bapam.org.uk](http://www.bapam.org.uk)

### Musicians' Hearing Service

[www.musicianshearingservices.co.uk](http://www.musicianshearingservices.co.uk)

### Sound Advice

[www.soundadvice.info](http://www.soundadvice.info)

### ENT-UK – Association for British Ear, Nose and Throat Surgeons

[www.entuk.org](http://www.entuk.org)

### Action on Hearing Loss

[www.actiononhearingloss.org.uk](http://www.actiononhearingloss.org.uk)

### British Tinnitus Association

[www.tinnitus.org.uk](http://www.tinnitus.org.uk)

### Full BBC material available:

[www.downloads.bbc.co.uk/safety/documents/safety-guides/audio-and-music/Safety-Musician\\_noise\\_guide\\_Part\\_1.pdf](http://www.downloads.bbc.co.uk/safety/documents/safety-guides/audio-and-music/Safety-Musician_noise_guide_Part_1.pdf)

### A Sound Ear II

<http://www.abo.org.uk/media/20101/A-Sound-Ear-II.pdf>