Noise exposure in rehearsal and use of personal hearing protection

The Summary

Noise exposure during rehearsals is invariably **above** the limit set at which hearing protection is recommended. It is often at, or just below, the level deemed hazardous to hearing.

Noise readings were taken in the middle of the rehearsal area, and actual results will vary for each individual depending on where they sit. Almost certainly, some people will be subjected to a higher exposure than that recorded in the middle of the room.

Members of the band are advised to purchase and use ear plugs designed to be used by musicians. These generally have filters of varying strengths to reduce noise. Using the weakest filter will reduce noise expose to safe levels.

An example of an ear plug is:
www.alpinehearingprotection.co.uk

Alpine MusicSafe	£14.95	(two filters; 19 and 22 dB)
Alpine MusicSafe Pro	£24.95	(three filters; 16, 19 and 22dB)

The 'Pro' version has the weakest filter option.

To successfully and safely wear ear plugs, a period of adjustment and adaption is needed.

Members must also be aware of the consequence of each rehearsal being at, or close to, the highest safe daily dose of noise in relation to the rest of that day. If there is noise exposure before or after the rehearsal on that day, the daily dose may fall into the hazardous range.

The Detail

We are constantly exposed to noise, but too much noise can damage our hearing. The levels of noise that are hazardous to our hearing are well established. The levels that are hazardous vary depending on how loud the noise is, and how long we are exposed to it.

Decibels as the unit of noise

The unit of noise is decibel (dB). Values that represent an average level over time are referred to as A weighted (dBA). An instantaneous peak noise is referred to as C weighted (dBC). Health and Safety Regulations mainly use dBA, as safe levels are described as an average dose over time.

The relationship between decibels and noise power

The number of decibels does not simply rise in a straight line, as the power of the noise it describes increases.

- Each 3 dB added doubles the sound energy.
- When 10 dB is added, the energy is increased 10 times.
- When 20 dB is added, the energy has a hundred-fold increase.

Another way of looking at it is:

- If the sound intensity doubles, 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 is propensity to damage hearing)

Also remember that dBA describes an intensity **in relation to time**. Halving the noise dose can be achieved by **either** reducing the noise level by 3 dB **or** halving the exposure time.

Relationship between noise dose and time of exposure

The noise exposures below are identical and all represent the level after which protection is advised, or is hazardous.:

Action levels for protection	Levels that, above which, are hazardous
80 dB for 8 hours	85 dB for 8 hours
83 dB for 4 hours	88 dB for 4 hours
86 dB for 2 hours	91 dB for 2 hours
89 dB for 1 hour	93 dB for 1 hour
92 dB for 30 minutes	95 dB for 30 minutes

Relationship between noise dose and distance from source

The power of noise that can cause damage reduces significantly the further away from the source you are.

1 trumpet	at	1 m distance	=93 dB
1 trumpet	at	2 m distance	=90 dB (half the power of 1 m)
1 trumpet	at	3 m distance	=87 dB (quarter the power of 1 m)

Exposure when not at rehearsal

It is important that people consider other noise exposure on the day of rehearsal because cumulative exposure leads to hearing damage, whether or not it is rehearsal related. Common exposure to consider may include:

- Audio and video equipment
  - Ear buds / headphones
  - Car stereos
  - Computer speakers
  - Televisons
- Concerts
- Clubs
- Cinemas
- Sporting events
- Power tools
- Noisy hobbies
- Usual employment

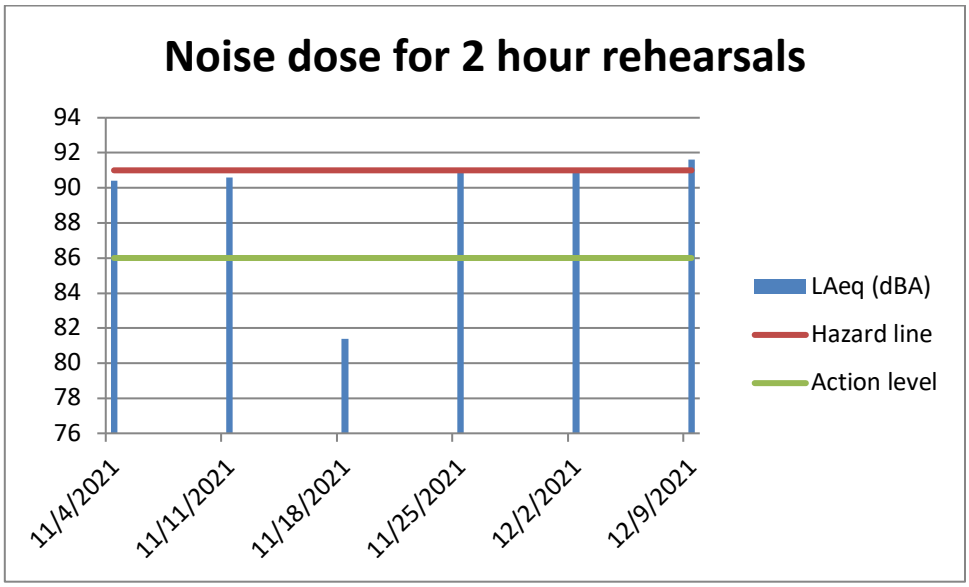
Rehearsal Noise Levels

The reports I have produced give a variety of readings all derived from the noise detected in the 2 hour rehearsal session.

LAeq

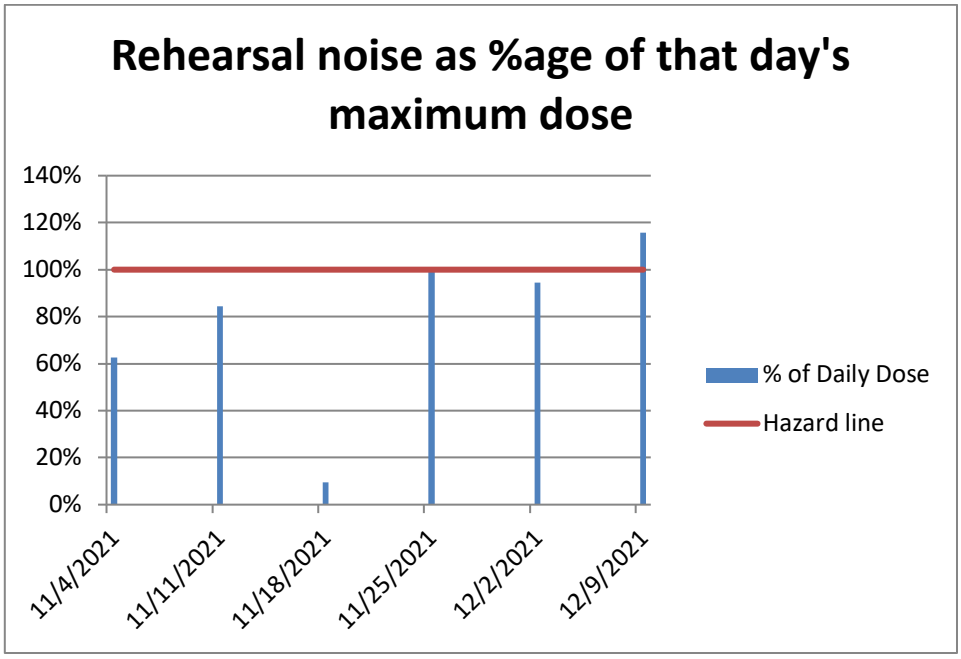
If all the noise energy over the two hour rehearsal was smoothed out into a single, continuous, intensity, LAeq would be the level of that continuous intensity. If you look above at the table of hazardous levels, you will see that a noise dose of 91 dB over two hours is the maximum safe limit for that day. Further noise exposure in that day would be hazardous to hearing.

The results from our rehearsals (below) show levels to be largely at, or close to, the hazard line.



Dose

The dose in my reports is a percentage. The result is the percentage of the maximum dose in a day that is experienced within our two hour rehearsal. If the result is 100%, it means any further noise exposure takes the daily exposure into the hazardous range.

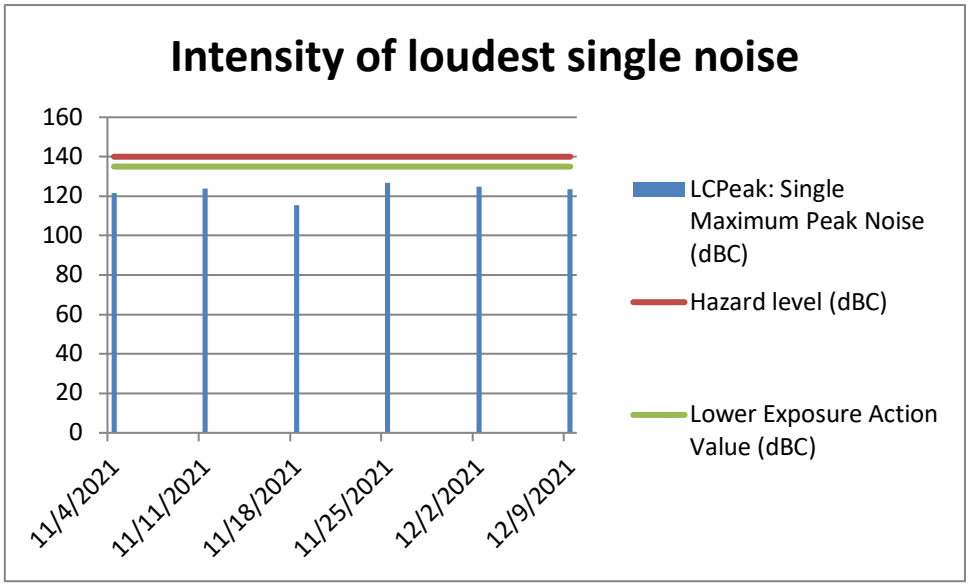


The above shows the difference an apparent small change in dB can make to the dose. The week when LAeq was 91.1 dB, that session was 100% of the daily noise exposure allowed before hazard. The week when the LAeq was 81.4 dB gave a dose that was 9.4% of the daily allowed dose before hazard.

This highlights the fact that a small dB ear plug filter is all that is needed to eliminate the hazard.

LCPeak

The LCPeak is a measurement of the single loudest instant noise within the two hour rehearsal. It is measured in dB(C). The graph below shows that the level was always in the safe zone. This may vary for individuals depending on where they sit.



Using Ear Plugs / noise filters

The levels recorded show that without ear protection, noise exposure in rehearsal is very close to a hazardous level.

As mentioned above, a filter reducing the noise exposure by 10 decibels makes the noise in a rehearsal harmless.

It is strongly recommended that band members use ear plugs designed for use by musicians, which filters a small amount of the noise out of the exposure, while being able to continue to hear the rehearsal and direction, and play in balance with the group. To successfully transition to rehearsing with ear plugs, a period of acclimatisation is needed.

Risks of using ear plugs

While the whole reason to use ear plugs is to reduce risk to health, if used wrongly, they can lead to other problems. A musician has spent their musical life with the immediate feedback of hearing themselves either in practice alone, or within an ensemble. If a device is introduced that reduces that feedback, there is a temptation to compensate for that, and play harder and louder. Overblowing an instrument can not only increase the noise exposure to those around, but can cause health problems because of the increased pressure and effort of playing.

This can be successfully avoided by acclimatisation, which will also help to preserve playing in a balanced way in an ensemble.

Acclimatisation to using ear plugs

There is an interesting paper that discusses the use of ear plugs in trumpets players
www.ncbi.nlm.nih.gov/pmc/articles/PMC4040860/

It notes that while listening to a recording of a trumpet player, turning the sound down by 20 dB does not lose the perception of the same musical dynamics. Another study has shown that listening to a recording of a trumpet, people tend to listen 20 dB quieter than a live performance. Acclimatisation is the process of becoming used to the reduced noise feedback while playing at the same loudness.

It is also about becoming used to other sounds that you may not normally hear. We primarily hear through sound being conducted through air, which vibrates the ear drum (air conduction). We can also hear by our bones vibrating in the head (bone conduction) which means the balance between the two is altered with ear plugs. We become more aware of other noises we generate ourselves, such as breathing, and swallowing. Acclimatisation gets us used to that, too.

Simple steps to acclimatisation can be found in the Health and Safety Executive book *Sound Advice – Control of noise at work in music and entertainment (pg 36)*
www.hse.gov.uk/pUbns/priced/hsg260.pdf

Acclimatising

All hearing protection alters the listening experience, and it can take a long time to get used to it. The acclimatisation process should be managed – if not, people will give up and their hearing will become increasingly damaged. Avoid wearing hearing protection for the first time in a performance.

A typical sequence for a musician acclimatising to earplugs might be:

- **Wear them at home and get used to speaking while wearing them.**
- **Wear them around and about and get used to conversation.**
- **Wear them while practising.**
- **Wear them at rehearsal.**
- **Wear them in performance.**

With enough time to acclimatise to using the right hearing protection, communication with other people should not be a major problem.

Source Material

Rehearsal noise monitoring: Apple iPhone with app – NIOSH SLM
https://apps.apple.com/gb/app/niosh-sound-level-meter/id1096545820

Music, Noise and Hearing: How to play your part – a guide for musicians (BBC 2011)
http://downloads.bbc.co.uk/safety/documents/safety-guides/audio-and-music/Safety-Musician_noise_guide_Part_I.pdf

Musicians' Guide to Noise and Hearing: Part II – Toolkit for managers (BBC 2012)
http://downloads.bbc.co.uk/safety/documents/safety-guides/audio-and-music/Safety-Musician_noise_guide_Part_II.pdf

Sound Advice: Control of noise at work in music and entertainment (HSE 2008)
www.hse.gov.uk/pUbns/priced/hsg260.pdf

Musicians' Hearing Protection (HSE 2008)
https://www.hse.gov.uk/research/rrpdf/rr664.pdf