NOISE EXPOSURE OF MUSICIANS IN AMATEUR WIND BANDS

D Yates Syntegra Consulting, Reading, UK

1 INTRODUCTION

There are a large number of wind bands and therefore musicians across the UK, the precise number of which is extremely difficult to estimate as there are various definitions of a wind band, not all bands may be registered and the number of musicians in each band can vary greatly, with some bands being very short of musicians and others over staffed. This paper has specifically considered mixed woodwind and brass bands (typically referred to as wind or concert bands) and brass bands on their own.

From a small amount of on-line research, there is an estimated 376 concert/wind bands[1] and 1200 brass bands[2] in the UK. With approximately 50-60 members of a concert band and 25-30 members of a brass band, this makes an estimated 50,000 musicians involved. With the difficulty in estimating the number of bands as described above, this could be a vast under-estimation of the number of players, and it is noted that many players do play across multiple bands which adds a further level of complexity to any estimate.

Whilst this includes some military bands that would be classed as professional, it does not include professional groups or orchestras and so is limited to the very niche category of wind bands (woodwind, brass and percussion instruments) and brass bands (brass and percussion instruments).

Members of these organisations are not employed, in fact they generally pay to be a member of these bands, and therefore are not covered under the Control of Noise at Work Regulations[3], particularly for rehearsals. It could be argued that for concerts where the band is being paid the organiser and venue owners have some liability, however this is a very grey area.

Whilst not directly covered by the Control of Noise at Work Regulations[3], amateur musicians are obviously exposed to the same general levels of noise during rehearsals and performances as professional musicians are. An array of anecdotal and physical evidence exists from this author's music career of amateur musicians losing their hearing either gradually over many years of playing in bands or suddenly through peak noise levels with a particular incident involving the positioning of a player too close to a cymbal on a drum kit.

As amateur musicians are exposed to the same noise levels and sources as professional musicians, it is considered appropriate to asses noise exposure against the same noise exposure levels despite the regulations not being in force. Assessment against the noise exposure levels and the guidance provided within the Control of Noise at Work Regulations[3] will give a reasonable indication of the risk of hearing damage to amateur musicians.

Under the Control of Noise at Work Regulations 2005[3] there are two types of sound exposure: peak levels measured using the acoustic parameter L_{Cpeak} and average levels measured using the acoustic parameter L_{Aeq}. To give a normalised daily average a time period of 8 hour is used, this gives the acoustic parameter $L_{EP,d}$. Peak sound exposure limits were designed to capture explosive type

sounds e.g. shooting and clashing. If the exposure was above the 137 dBC limit value then it is likely that immediate hearing damage would occur.

Average sound exposure limits were designed to measure over time sustained noise levels e.g. construction, mining or factory noise. These would cause a slow, but noticeable, decline in hearing acuity, called noise induced hearing loss. There is therefore a direct correlation with these types of work and playing in a wind band for many years.

Table 1 below presents the noise exposure limits presented in the Control of Noise at Work Regulations[3].

Table 1: Noise exposure limits

	Daily or Weekly Personal Noise Exposure Level in dB(A)	Peak Sound Pressure Level in dB(C)
The lower exposure action values	80	135
The upper exposure action values	85	137
The exposure limit values	87	140

2 SOUND EXPOSURE MEASUREMENTS

Noise level measurements were carried out during rehearsals at a wind band with approximately 50 members, Trinity Concert Band, Reading and also at a brass band with approximately 25 members, Reading Spring Gardens Band. All measurements were carried out over an approximately two and a half year period from April 2022 to July 2024 as opportunities allowed. Measurements were all carried out with calibrated Class 1 sound level meters.

2.1 Rehearsal 1 – Wind Band

Measurements were carried out at two locations during a full rehearsal at Trinity Concert Band, Reading. The positions chosen were adjacent to the conductor to obtain the typical ambient noise levels in the room and a reasonably worst-case position within the band, adjacent to the bassoon players who sit in front of the trumpet and trombone sections. Noise level measurements over the whole rehearsal period (approximately 1.5 hours not including a mid-rehearsal break) are presented in Table 2. The L_{Aeq} is the logarithmic average of 1 second measurements over the 1.5 hour period and the L_{Cpeak} is the highest measured L_{Cpeak} over the same period.

Table 2: Noise Exposure Measurements – Rehearsal 1 (Wind Band)

Position	Measured Average Noise Level dB(A)	Measured Peak Noise Level dB(C)	T (minutes)
By conductor	87	116	90
Within band (adjacent to bassoons)	91	119	90

It can be identified, from Table 2, that the rehearsal gave an average level (L_{Aeq}) of 87 dBA at the conductor and 91 dBA within the band at the worst-case position over the 90 minute rehearsal period. This is equivalent to an $L_{EP,d}$ of 81 dBA at the conductor position and 84 dBA within the band (averaged over an 8 hour day). It can also be seen that all the peak levels were well below the allowed levels.

2.2 Rehearsal 2 – Wind Band

Measurements were carried out at two locations during a full rehearsal at Trinity Concert Band, Reading. The positions chosen were both within the band, adjacent to a clarinet player sat in front of the trombone section and adjacent to a saxophone player who sits in front of the trumpet section

respectively. Noise level measurements are presented in Table 3. The L_{Aeq} is the average of 1 second measurements over the 1.5 hour period and the L_{Cpeak} is the highest measured L_{Cpeak} over the same period.

Table 3: Noise Exposure Measurements – Rehearsal 2 (Wind Band)

Position	Measured Average Noise Level dB(A)	Measured Peak Noise Level dB(C)	T (minutes)
Within band (adjacent to clarinets)	92	123	60
Within band (adjacent to saxophones)	91	121	30

It can be identified, from Table 3, that the rehearsal gave an average level (L_{Aeq}) of 92 dBA adjacent to the clarinets over a 60 minute period and 91 dBA adjacent to the saxophones over a 30 minute period. This is equivalent to an $L_{EP,d}$ of 83 dBA adjacent to the clarinets and 79 dBA adjacent to the saxophones (averaged over an 8 hour day). It can also be seen that all the peak levels were below the allowed levels.

2.3 Rehearsal 3 – Brass Band

Measurements were carried out at one location during a full rehearsal at Reading Spring Gardens Band. The position chosen was adjacent to the conductor to obtain the typical ambient noise levels in the room. Noise level measurements are presented in Table 4. The L_{Aeq} is the average of 1 second measurements over the 2.5 hour period and the L_{Cpeak} is the highest measured L_{Cpeak} over the same period.

Table 4: Noise Exposure Measurements – Rehearsal 3 (Brass Band)

Position	Measured Average Noise Level dB(A)	Measured Peak Noise Level dB(C)	T (minutes)
By conductor	91	124	150

It can be identified, from Table 4, that the rehearsal gave an average level (L_{Aeq}) of 91 dBA adjacent to the conductor over a 150 minute period. This is equivalent to an $L_{EP,d}$ of 86 dBA adjacent to the conductor (averaged over an 8 hour day). It can also be seen that all the peak levels were below the allowed levels.

It is noted that the measurements are 4 dB higher than those for the wind band.

If it is assumed that the same increase in noise level is expected within the band then an $L_{EP,d}$ of 90 dBA at the worst-case positions (averaged over an 8 hour day) may be expected. Peak noise levels would still likely be below the allowed levels.

3 DISCUSSION OF RESULTS

It is apparent, from the data presented in Section 2 that noise levels during rehearsals at Trinity Concert Band are typically between the lower and upper exposure action value for average noise levels as presented in Table 1.

Noise levels measured during the rehearsal with Reading Spring Gardens Brass Band show noise levels above the upper exposure action value for average noise levels at the conductor position. It is likely that noise levels above the exposure limit value would be present within the band. As the rehearsal room was somewhat smaller than the Trinity Concert Band rehearsal room this could contribute to the increased noise exposure, however, it is also noted that brass players have a greater deal of freedom in their higher dynamic levels when playing in a brass band compared to a wind band and so this could generally be true.

It is noted that peak noise levels did not exceed the exposure action values detailed in Table 1 at any time and therefore is not generally considered to be an issue in these rehearsals. It is, however, noted that there is the potential for some instruments, especially percussion instruments, to exceed these peak noise level exposure action values and therefore consideration of this should not be disregarded entirely.

Whilst breaches of the exposure actions values and limit value (within the brass band) have been identified, the significance of this needs to be considered.

In respect of the wind band rehearsals, if these levels are experienced for one, possibly two, rehearsals a week then it is not likely to be an issue, assuming the players job and other leisure activities are relatively quiet. Should the player work in a noisy environment or attend many rehearsals a week, as some players like to do, then regular exposure to such average noise levels could clearly start to contribute to hearing loss.

In respect of the brass band rehearsals, the same principles apply in that if all other time is quiet and only rehearsing once a week then it should not be a significant issue, however due to the slightly higher noise levels this author recommends further caution in the brass band environment.

This does match the anecdotal evidence obtained by this author in his experience in playing in more brass band players experiencing gradual hearing loss than those who only play in wind bands.

4 MITIGATION OF NOISE EXPOSURE

Due to the risks of hearing damage, it is appropriate to consider mitigation measures to reduce the risk of prolonged exposure to high noise levels. A number of mitigation measures are regularly employed and the effectiveness of these measures are discussed below both qualitatively and quantitatively based on measurements and this authors experience.

4.1 Distance

As is well known from environmental acoustic consultancy, the easiest way to reduce noise exposure is to increase the distance between the source and receiver. With rehearsals and concerts taking place within a single room, this is clearly only possible to a certain extent for a wind band.

Traditional seating arrangements in both wind bands and brass bands, particularly in an amateur setting, is to sit as close as possible together to encourage better listening and playing closer. Obviously, this is not strictly necessary and Trinity Concert Band, among others, now have a policy of spreading the band out as much as possible to fill the space available, albeit that this is dependant on the size of the available rehearsal space. This distancing is particularly important from percussion instruments and instruments that face directly forward and held high such as trombones, cornets and trumpets from the brass section and flutes in the woodwind section.

4.2 Full Screens

It is relatively common practice for full screens to be placed within bands, particularly around drum kits and in front of other percussion instruments. These are a Perspex screen up to approximately 1.5m high to sit between the noise source and the listener, who would generally be sat down.

As part of the research for this paper, this author did carry out noise level measurements during a rehearsal to assess the difference between noise levels either side. The results of the testing were inconclusive with higher levels of noise actually measured on the other side of the screen adjacent to the closest wind player (a trombone player) compared to behind the screen adjacent to the drum kit.

It is noted that the test was not specifically of the noise reduction of the screen, but to assess the change in noise exposure of nearby players during a realistic in use scenario. Due to the other noise sources of the room during a live rehearsal it was not possible to measure the actual level difference produced by the screen.

It is clear subjectively, however, that such screens do work to reduce the noise exposure from percussion instruments. The actual change in noise levels may not be very high, however they serve to soften the exposure and are particularly helpful in reducing peak noise levels which could be at risk of breaching the exposure limit value. As well as the physical screen, the placement of the screen also encourages the player to sit at a further distance from the noise source, which in turn helps to reduce noise levels and soften the exposure.

4.3 Individual Screens

Another sort of noise screen in regular use are smaller individual noise screens which are designed to wrap around the back of a persons head and ears, without touching them, creating a solid Perspex screen around the ears to protect from noise sources behind. These are less intrusive than the full screen and sit well in the middle of the band.

This author also carried out noise measurements of this type of screen during a wind band rehearsal and is able to report some results. It is noted, again, that the measurements were carried out during a live rehearsal and captured other noise sources in the room with the full band playing and so these were not measurements of the full effectiveness of the screens.

The first set of measurements were carried out adjacent to a clarinet player with the bass trombone player directly behind, who happens to be probably the loudest player and potentially loudest wind instrument in the band. A Type 1 sound level meter was placed either side of the screen. The measurements were analysed in 5 minute periods for ease, however the 1 second data was measured for potential further analysis. Over a 60 minute period, the average (L_{Aeq}) noise level reduction across the screen ranged from approximately 0.5 dBA to 1.5 dBA with an arithmetic average of 1.0 dBA reduction. In terms of peak (L_{Cpeak}) noise levels the noise level reduction ranged from approximately 1.0 dBC to 4.5 dBC, with an arithmetic average of 2.5 dBC reduction.

The second set of measurements were carried out adjacent to a saxophone player with the trumpet section directly behind, which are also generally considered loud instruments in the band. A Type 1 sound level meter was placed either side of the screen. The measurements were analysed in 5 minute periods for ease, however the 1 second data was measured for potential further analysis. Over a 30 minute period, the average (L_{Aeq}) noise level reduction across the screen ranged from approximately –4 dBA (an increase in noise levels) to +3 dBA with an arithmetic average of 0.5 dBA reduction. In terms of peak (L_{Cpeak}) noise levels the noise level reduction ranged from approximately –5 dBC to +2.5 dBC, with an arithmetic average of 1.5 dBC reduction.

The marked differences between the two sets of measurements, with increases in noise levels seen in the second set of measurements, are likely due to the different instrumentation with the trumpets being quieter than the bass trombone and the saxophone being a louder instrument than the clarinet. Additionally, differences in the repertoire played would be a source of uncertainty with some pieces being louder than others and different sections needing to play more and louder or quieter in different pieces.

It is clear, however, that there appears to be a measurable difference in noise levels either side of the screen, albeit by just a small number of decibels. The purpose of the screens therefore should be to soften the noise exposure where needed with a loud instrument behind and not necessarily relied upon for a significant reduction in noise exposure levels.

4.4 Personal Hearing Protection

Personal hearing protection, in the form of ear plugs, is now in common use amongst wind musicians, in fact they are mandatory in many professional bands including military bands. Musicians traditionally do not like to use ear plugs as they affect the tone and quality of the sound being heard. Accordingly, it is important to select the correct sort of hearing protection with as a flat a frequency response as possible. This has the effect of just “turning down the volume” rather than affecting the tone and quality of what is being heard. There are three main types of ear plugs which will be discussed in turn.

Moulded ear plugs are the best sort to use as they are individually fitted to your ear and designed for purpose, to provide a flat frequency response. Most professional musician use these, however, they are very expensive and therefore not very common amongst amateur musicians.

Normal foam ear plugs, whilst very cheap, are not particularly suitable for music use as they provide reasonable high and mid frequency attenuation but very little low frequency attenuation. This just serves to distort the music being heard and is not an enjoyable effect.

Silicone based ear plugs, which can also come with different inserts to provide lesser or greater noise attenuation, are a reasonable compromise. They are relatively cheap and provide a reasonably flat frequency response. They still do not provide great low frequency attenuation compared to the high and mid frequencies, but are significantly better in that respect than foam ear plugs.

The use of any ear plugs whilst playing music is an unusual experience at first and takes a little time to get to used to. However, once the player is comfortable with the slight change in sound, which does normally come relatively quickly, the reduction in noise levels should be significant enough to adequately protect the musician from hearing loss. It is evident from the noise level measurements carried out and discussion in this paper that only a small amount of attenuation is typically required to reduce the noise exposure to reasonably safe levels.

5 CONCLUSIONS

This paper has considered the noise exposure experienced by amateur wind musicians and has specifically considered mixed woodwind and brass bands (typically referred to as wind or concert bands) and brass bands on their own.

Whilst not directly covered by the Control of Noise at Work Regulations[3], amateur musicians are clearly exposed to the same sort of noise levels during rehearsals and performances as professional musicians as the noise sources are the same. The difference is generally the amount of time spent playing with amateur musicians typically attending evening rehearsals, often just once or twice a week, rather than rehearsing all day.

Through a series of noise level measurements the typical noise levels during rehearsal for two bands, one wind band and one brass band, has been determined and the effective 8 hour exposure level from the shorter rehearsal period calculated.

It is clear that noise exposure levels, as set out in the Control of Noise at Work Regulations[3], are breached and therefore the risk to hearing damage can be analysed. It is considered by this author that musicians attending a very small number of rehearsals per week, and with no considerable noise exposure at work or during other leisure activities, should not be at significant risk of hearing damage. The risk appears to be greater for a brass band compared to a wind band.

6 RECOMMENDATIONS

To reduce the risk of hearing damage, a number of mitigation measures have been considered and it is the opinion of this author that encouraging greater distance between players alongside the use personal hearing protection are the most effective forms of reducing noise exposure.

The use of screens around particularly loud instruments such as percussion, or in front of louder wind instruments facing towards another players head such as trombones and trumpets, can help to soften noise exposure and can be useful to control peak noise levels against the small risk of breaching the peak noise level exposure value.

7 REFERENCES

1. https://www.windbanddirectory.co.uk/, accessed on 14/08/2024.
2. G. Holman, 'How Many Brass Bands? – An Analysis of the distribution of bands in Britain and Ireland over the last 200 years', academia.eu (March 2018).
3. Control of Noise at Work Regulation 2005, Published by the Health and Safety Executive Her Majesty Government, UK.