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Measurement of noise levels that staff are exposed to at live music events

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Measurement of noise levels that staff are exposed to at live music events

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More stringent noise at work regulations, developed by HSE after public consultation, came into force for general industry on 6 April 2006. The music industry was granted a two year period to develop sector specific guidance on compliance, but should meanwhile comply with existing noise regulations. Local Authorities also have issues concerning monitoring and compliance. Following a period of debate, it was agreed that Capita Symonds Ltd (CS) would complete a noise study to assess the current noise exposure of groups of people within the industry and would then report back on the impact of the proposed legislation on 'live' music concerts.

This report contains details of the personal exposures of a cross section of staff working at twelve events throughout the year. It explores the adequacy of any control measures in place and makes recommendations for improvements.

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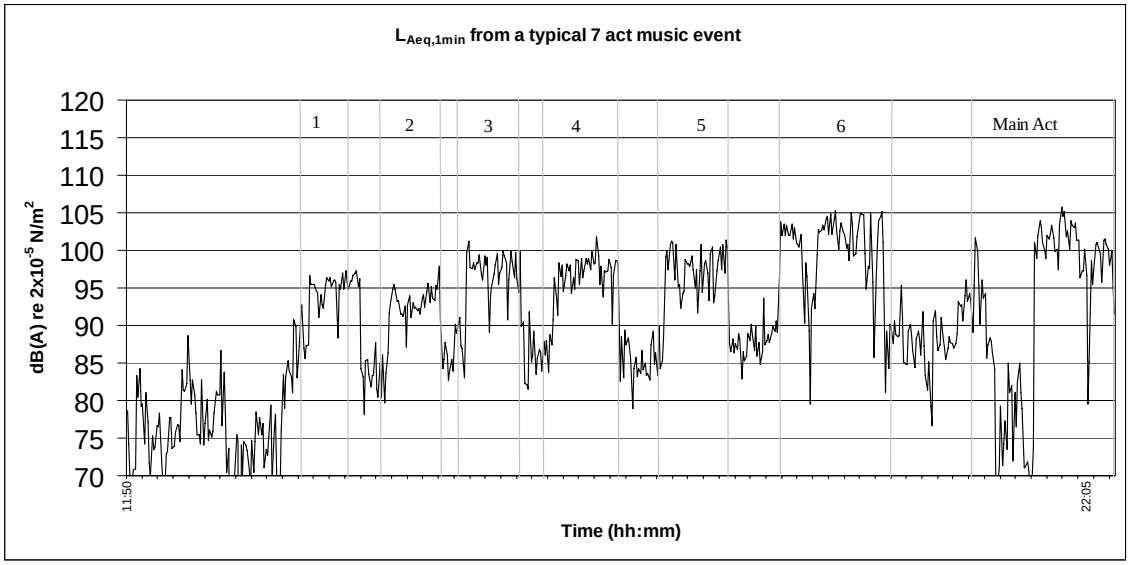
Contents



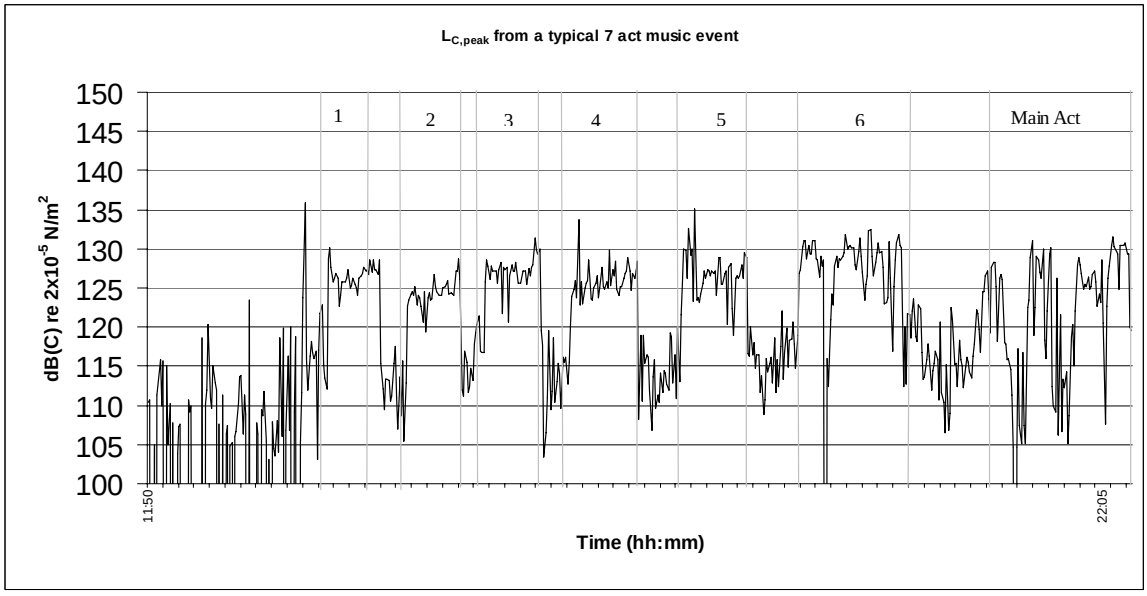


Figure 4.3 – Graphs to show typical dosemeter levels measured throughout a concert.

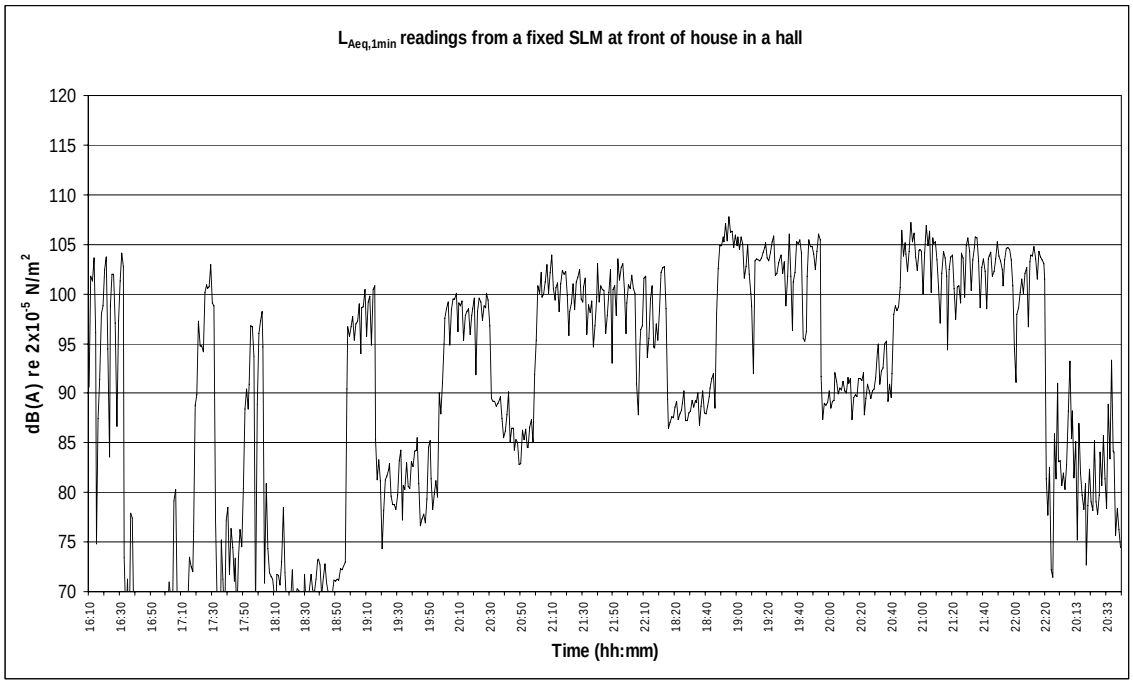
Once the load-in/build-up (the time prior to the event where equipment (stage, PA, lighting etc) is loaded in to the venue and then constructed) has been completed, a full system check is carried out. This involves running pink (see Appendix A) noise through the sound system so that the frequency response and coverage can be optimised. The engineer then usually plays a few tracks to make sure it sounds fine with music. Once the engineer is happy with the system setup, a line-check **(**A test to make sure the audio signals from the stage are reaching the front of house channel inputs cleanly) is carried out. This involves checking the signal from stage to mixer is ok and individually equalizing each instrument or part of instrument on each channel of

the mixing desk, usually starting with the drums. Some engineers prefer to initially mix through their headphones, but at some stage they will want to see what it sounds like through the Front of house (FOH) system. Sound pressure levels can in some cases be up to 104dB(A), however usually for short periods of time. In this example the sound-check was carried out the night before, which is common practice for full-day events.
The doors open to the public while low-level background music is played usually around 20-30 minutes before the first band comes on. The first band that comes on often plays a short set for around 30 minutes and at a lower level than the main act would. This can be seen in section **1** on the graphs shown above. The next four support bands also play for short lengths of time. They tend to run at levels lower than 100dB(A) and have C-weighted peaks below 130dB. Section **1-6** show a gradual increase in level between bands as the time gets nearer to the main act. Section **6** would be a more well-known band and can be seen here to run at levels of up to 104dB(A),$LA_{eq,1min}$ and C weighted peaks of around 132dB. The change over time between the last support band and the main act can be anything up to an hour, however it can be seen that the crowd noise alone can reach levels of over 100dB(A). The main act is usually on for about 1.5 hours before leaving stage briefly before a final 10-15 minute encore. The levels during the main act can reach 105dB,$LA_{eq,1min}$ however the 15minute L_{eq} values average around 102dB(A).

In addition to the dosemeters, fixed sound level meters were placed front of house and to the side of the stage. Table 4.1 below shows typical levels measured at concerts throughout the period of the survey. This is followed by the results shown in graphical form.

Venue Type	LAeq	Time allowed before Exposure Action Value is reached		LCpk
		Lower Exposure Action Value 80dB(A)	Upper Exposure Action Value 85dB(A)	
Arena (FOH)	95.6	13m	41m	137.9
Arena (stage)	95.4	13m	43m	133.4
Stadium (FOH)	99.5	5m	17m	131.6
Hall (FOH)	97.7	8m	25m	134.8
Outdoor Festival (FOH)	96.2	11m	36m	127.4
Large indoor (FOH)	96.5	10m	33m	131.5

Table 4.1: Noise Measurement Results showing typical levels measured using the fixed sound level meters.


$L_{Aeq,1min}$ readings from a fixed SLM at front of house in a hall
dB(A) re 2x10^{-5} N/m^2
120
115
110
105
100
95
90
85
80
75
70
16:10
16:30
16:50
17:10
17:30
17:50
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21:40
22:00
22:20
20:13
20:33
Time (hh:mm)


$L_{Aeq,1min}$ readings from a fixed SLM at front of house in a large inddor venue
dB(A) re 2x10^{-5} N/m^2
120
115
110
105
100
95
90
85
80
75
70
15:00
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15:30
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Time (hh:mm)

Questionnaires were sent to all Local Authorities where events took place and monitoring was done, (See Appendix D) Eleven questionnaires were sent and 6 were returned, (54 % response.) The questionnaires were designed to evaluate various aspects of Local Authority enforcement and obtain feedback on the difficulties encountered.

The results of the questionnaire are attached in Appendix E. They suggest that there are wide variations in how local authorities deal with Noise at Work.

Within these three categories there are two main types of employee. There are those who are directly involved with the industry and employed on contract (production crew) and there are ‘casual’ or ‘local’ staff. These two groups present very different issues that need to be resolved.

Category A - Do not need to enter main hall/stage area						
	Category	**Occupation**	**Venue type**	**LEP,d**	**LCpk**	**Duration (hours)**
3	A	Catering Staff	Indoor	91.2	145.9	8
4	A	Cashier	Indoor	89.1	139.9	8
5	A	Crew Catering Chef	Outdoor	87.4	146.2	11
5	A	Merchandise Manager	Outdoor	85.1	146.3	9.5
6	A	Merchandise Staff	Indoors	99.5	139.5	8
6	A	Secondary Bar staff	Indoors	97	143.6	5
6	A	Main Bar staff	Indoors	96.6	135.7	5
6	A	Main Bar staff	Indoors	95.5	145.6	5
6	A	Cloakroom Staff	Indoors	90.2	144.7	5
6	A	Bar Staff - outside main	Indoors	80.2	117.6	8
7	A	Fairground staff	outdoors	97.6	145.5	13.5
7	A	Merchandise Staff	outdoors	93.8	146.3	14.5
11	A	Bar Manager	outdoor	85.5	137.1	5.5
11	A	Market Stall Staff	outdoor	101.5	145.8	5.5

Table 5.1 – Table 5.1 illustrates those personnel who do not need to enter the main arena to perform their duties. (Category A).

Although these workers are classified as persons who do not need to enter the main arena, currently they very often are situated there on a permanent basis. They also tend to be persons employed on a non-contractual, casual basis and there is little or no control on their exposure.

Most of these persons work for the various types of concessions that are associated with entertainment venues and they do not generally wear any type of hearing protection. Most of them do need to be able to communicate to do their work satisfactorily.

There are no compelling reasons why this category of person needs to enter the arena during an event. Bars, market stalls, food concessions etc could be relocated outside of the main arena in a quiet area. This also has the benefit that members of the audience will tend to leave the arena to gain access to these outlets and thus reduce their own individual exposure.

The next category of persons exposed to high levels contains those who are exposed to high levels and need to be because of their role. It is considered however that these persons should wear hearing protection as it would not affect their ability to do their job. If communication is an issue then bespoke hearing protection should be made available.

Category B - Need access to hall/stage area at all times							
	Category	**Occupation**	**Venue type**	**LEP,d**	**LCpk**	**Duration (hours)**	**Can hearing protection be used?**
2	B	Promoters Rep	Stadium	99.8	146.2	11.5	Y
4	B	Fire Officer	Indoor	100.9	145.6	8	Y
4	B	Events manager	Indoor	86.8	136.9	8	Y
4	B	Assistant operations	Indoor	85.1	134.4	8	Y
6	B	Venue Manager	Indoors	91	137.4	8	Y
6	B	Promotions manager	Indoors	90.3	146.5	3	Y
8	B	Drummer	Indoors	104.7	144.1	6.5	Y
8	B	Guitarist	Indoors	103.3	145.7	6.5	Y
8	B	Bass Guitarist	Indoors	100.9	133.4	6	Y
9	B	Security - Hospitality	outdoors	85	145.5	9	Y
10	B	St Johns Ambulance	outdoor	87.9	136.5	8	Y
10	B	St Johns Ambulance	outdoor	90.2	145.1	8	Y
10	B	St Johns	outdoor	93.7	140.5	8	Y
11	B	Site Manager	outdoor	86.5	129.2	8	Y
12	B	Red Cross (moving)	outdoors	87.5	131.2	7.5	Y
12	B	Red Cross (Van)	outdoors	87.2	142.2	7.5	Y

Table 5.2 – Table 5.2 illustrates those personnel who need access to the arena/stage area at all times(Category B)

It can be seen that again the majority are not directly associated with the Production of the event. All persons listed in Table 5.2 have a need to be in the Arena during some stage of the event, some have communication requirements but these personnel can both restrict the duration of stay in the arena and could wear hearing protection.

Very few of those interviewed wore ear plugs on a regular basis in spite of their exposure to high noise levels. The levels tabulated above clearly show that the majority were exposed to levels above the upper exposure action value.

The practice of Security Personnel varied. Where possible, Security staff were rotated at regular intervals. This was not only to reduce their noise exposure, it was also to keep them alert, allow for comfort breaks etc. Sometimes the rotation did not specifically allow for time spent away from high noise levels. At large outdoor festivals some staff were unable to leave their position and it was suggested that any changeover period could compromise crowd safety.

Some security companies rely on casual staff and cite this as a reason for being unable to provide bespoke hearing protection (most security personnel need access to a radio at all times.)

For this type of key worker it is essential that they are provided with adequate hearing protection if they are within the arena in order to comply with the Regulations.

Particular attention should be paid to personnel in the pit area. They are exposed to very high

levels of low frequency noise and peak noise levels. The only persons allowed access to this area should be essential staff and hearing protection should be provided that gives sufficient attenuation at low frequencies and to protect from peak noise levels. Where possible the sub bass speakers should be situated above their head height.

Included in this category are the artistes. We managed to get permission from one band to measure their noise exposure during a live performance. (see Appendix F-graph 8)

There is no industry standard for musicians. Some wear in-ear monitors (IEM's) whilst on stage and others do not. Those that do not have IEM's depend upon the stage monitors to assist with their performance. No evidence was obtained to suggest that there was any reason that would prevent all musicians being provided with IEM's and provided they were properly mixed and controlled the noise exposure of the musicians could be substantially reduced.

A bonus associated with the removal of stage monitors would be a substantial reduction in noise levels off stage with the likelihood of a similar reduction in environmental noise off site, especially in open air venues.

Hearing protection should be considered as a last resort.

The final category identified is category C. These are the people that need to be present in the arena throughout the event and are without exception directly associated with the production of the event. This category can be split into two – those that can (and some do) wear hearing protection and those who say that they cannot. There is only one class of worker that falls into this final sub - category and those are the sound engineers. (usually freelancers) There is a consensus throughout the industry that it is not possible to 'mix' effectively whilst wearing hearing protection.

Because the majority of this group are employed directly and it constitutes a major part of their employment those that can wear hearing protection should be fitted with the appropriate type of bespoke hearing protection that suits their job. On tour personnel cannot rotate.

A band sound engineer will generally 'mix' for a period of about one and a half hours, preceded by a sound check/rehearsal earlier in the day. This means that even if the exposure was limited to that period they would exceed the upper exposure action value. They do not comply with the current legislative requirements and would not comply with the amended requirements of the Control of Noise at Work Regulations 2005. Good hearing is an essential requirement of their job and with continued exposure to loud music their hearing is likely to be impaired.

Category C - Need to be in hall/stage area all the time during performance							
	Category	**Occupation**	**Venue type**	**LEP,d**	**LCpk**	**Duration (hours)**	**Can hearing protection be used?**
1	C	Keyboard Tech	Indoor Arena	100.7	144.6	12.5	Y
1	C	Promoters Rep	Indoor Arena	95.6	144	12.5	Y
1	C	Production Manager	Indoor Arena	101.3	146	13	Y
2	C	Pit Supervisor	Stadium	101.7	140.3	11	Y
2	C	Stage Manager (main act)	Stadium	98.1	137.2	11.5	Y
2	C	Stage Manager (support)	Stadium	94.5	136.1	11	Y
2	C	Lighting Chief	Stadium	94.4	146.2	11	Y
3	C	Security Staff (Pit)	Indoor Hall	100.2	146.3	5	Y
3	C	Security Staff (FOH)	Indoor Hall	94.3	134.1	5	Y
3	C	Security Staff (Pit)	Indoor Hall	92.8	138.8	5	Y
3	C	Security Staff (pit exit)	Indoor Hall	89.8	144.2	5	Y
3	C	Security Staff (pit exit)	Indoor Hall	89.2	137.1	5	Y
5	C	Stage Manager	Outdoors	98	134	9	Y
5	C	Radio Production	Outdoors	93.4	137.9	10.5	Y
5	C	Stage Tech	Outdoors	90.8	133	8	Y
6	C	Film Crew	Indoors	100.3	143.1	1.5	Y
6	C	Film Crew	Indoors	98	139.4	1.5	Y
7	C	Acoustic Consultant	Outdoors	92.2	135	13.5	Y
9	C	Security - Stage right	outdoors	99	142	11	Y
9	C	Security - pit	outdoors	99.6	138.7	11	Y
9	C	Security - golden circle	outdoors	90.8	144.3	8	Y
9	C	Security - Hospitality	outdoors	85	145.5	9	Y
9	C	Security - Stage rear	outdoors	91	143.6	8	Y
9	C	Security - Supervisor	outdoors	95.5	145.9	11	Y
1	C	Pit Security	outdoor arena	101.8	146	8	Y
1	C	Security - side of stage	outdoor arena	87.3	140.1	8	Y
1	C	Security - side of stage	outdoor arena	96.3	143.3	9	Y
1	C	Security - edge of bowl	outdoor arena	93.1	146.3	9	Y
1	C	Camera Operator	outdoor	100.2	137.4	6	Y
1	C	Security	outdoors	90.2	136.7	8	Y
1	C	Pit Security Manager	outdoors	91.6	136.3	8	Y

Table 5.3a – Table 5.3a illustrates those personnel that are required to remain in the arena throughout the event (Category C)

Category C - Needed in hall/stage area all the time							
	Category	**Occupation**	**Venue type**	**LEP,d**	**LCpk**	**Duration (hours)**	**Hearing protection used?**
1	C	Monitor Engineer	Indoor Arena	103.9	146.8	12.5	N
1	C	FOH sound Engineer	Indoor Arena	98.9	139.3	14	N
2	C	FOH sound Engineer	Stadium	100.4	145.7	10.5	N
2	C	Monitor Engineer	Stadium	96	136	10.5	N
9	C	Delay tower engineer	outdoors	93.1	125.3	8	N

Table 5.3b – Table 5.3b illustrates those personnel that are required to remain in the arena throughout the event, but generally do not wear hearing protection (Category C).

Many sound engineers feel that it is a creative requirement that they do not wear hearing protection and should be exempt from the requirements to wear it. The noise exposure of a dedicated band engineer can be restricted to the set length of approximately an hour and a half but this would mean that he still would be likely to exceed the upper exposure action value of 85 dB(A). Even if the band engineer's access to front of house (FOH) to the period immediately preceding his set and he wore hearing protection up until he started to mix, his exposure would still exceed the upper exposure action value.

The levels recorded on the dosemeters demonstrate that job rotation is not a practical remedy. Nearly all the $L_{ep,d}$ values calculated are above 97 dB. Where the average noise level in an environment is 97 dB(A) it takes only 30 minutes to receive an allowable dose.

More often than not, system engineers are required to stay at FOH for the duration of the concert. Sometimes they will 'mix' the lesser known bands that precede the main act. It is very difficult to 'rotate' a system engineer. They will be present for the system check, sound checks and the main concert. This also applies to monitor engineers.

Although some engineers do wear hearing protection, the majority do not. Not one band sound engineer interviewed felt that they could do their job whilst wearing hearing protection.

To enable someone who works in the live music sector to ascertain whether they are likely to require hearing protection a flow chart may be helpful. This does not replace the requirement for a proper risk assessment to be carried out.

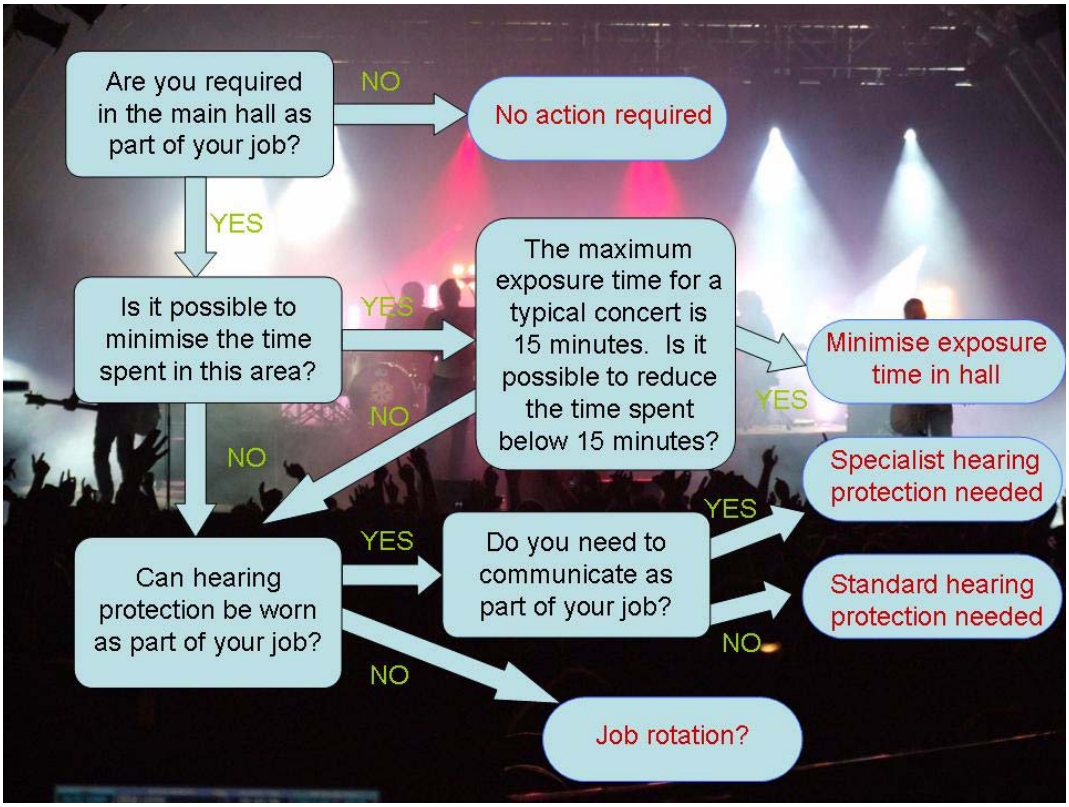


Figure 5.1 - Flow chart to identify the need for hearing protection

The weekly noise exposure calculator below shows that for the weekly dose to remain below the Exposure Limit value the daily dose would have to remain below 92 dB $L_{EP,d}$. It can be seen from the typical levels shown in Tables 5.1 to 5.3 that this is unrealistic.

Weekly Noise Exposure Calculator		
	Daily exposure ($L_{EP,d}$ dB)	
Day 1	92	
Day 2		
Day 3		
Day 4		
Day 5		
Day 6		
Day 7		
$L_{EP,w}$	**85**	**dB**

Table 5.4 – Weekly noise exposure calculator (ref: http://www.hse.gov.uk/noise/calculator.htm)

The L_{Cpeak} levels measured on the dosemeters are almost without exception very high and generally fall above the upper exposure action value. The results shown in the table have been modified to take account of error. (microphone cable or microphone impact). This modification was done by comparing the L_{Aeq} for the same period to see whether an equivalent high level prevailed.

Despite this modification of results, the L_{Cpeak} levels do seem disproportionately high in some instances, especially when compared with the levels recorded by the fixed sound level meters. Nevertheless it is clear that the L_{Cpeak} levels do on many occasions exceed the upper exposure action value and must be taken into account when specifying hearing protection.

The A-weighted levels recorded using the fixed sound level meters were consistent with those recorded by the dosemeters. The data collected was used to verify the results obtained from the dosemeters. The frequency data obtained also highlights the need for the hearing protection to be tailored for an environment where low frequencies predominate.

Similar noise levels were obtained at FOH and at the side of the stage adjacent to the monitor engineer indicating that the relative exposure at these levels is the same.

It is possible that some performances are at unnecessarily high levels. The levels could in some cases be reduced without affecting the quality of the act. It is suggested that this aspect be evaluated and perhaps a maximum level measured as a $L_{Aeq,15min}$ be specified as a level that must not be exceeded regardless of the venue or type of act. This would also contribute to reduced exposure for the audience.

Whilst personnel were being fitted with their dosemeters a brief informal interview was performed when possible. The results of these interviews demonstrated that few of the interviewees were aware of the dangers of exposure to high noise levels. A relatively small proportion wore hearing protection regularly and of those that did very few were aware of the correct way to wear it. They did not for example realise that removing an ear plug to talk to someone, substantially reduced the protection provided.

The results of the questionnaires sent to the local authorities (Appendix E) showed a mixed response. The only common theme from those that replied is that enforcement is a low priority and lack of resources is the main reason for the deficiency in enforcement.

The local authorities that responded demonstrated that they are aware of the changes to the legislation and the need for enforcement. A 54% response to the questionnaire was slightly disappointing especially as many of those that did not respond were those authorities in whose areas large events take place on a regular basis.

APPENDIX A

GLOSSARY OF TERMS - DEFINITIONS AND UNITS

'A' weighting dB(A)	A-weighting of the audible frequencies designed to reflect the response of the human ear to noise. The ear is more sensitive to noise at frequencies in the middle of the audible range than it is to either very high or very low frequencies. Noise measurements are often A-weighted (using a dedicated filter) to compensate for the sensitivity of the ear.
Attenuation	Noise reduction, measured in decibels.
'C' weighting dB(C)	A weighting of the audible frequencies often used for measurement of peak sound pressure level. The A-weighting is not appropriate at the very high noise levels; as the ear is better able to hear low and high frequency. C-weighting has an almost flat (or linear) response across the audible frequency range. (Note for normal measurements of peak noise, C-weighting should be used, but if the peak noise contains a large proportion of the low - or high - frequency sound, then the use of C-weighting may give erroneous results).
Calibration	A check of the function of a sound level meter by comparing the meter reading with a known sound pressure level.
Daily personal noise exposure ($L_{EP,d}$)	A measure of the average noise energy a person is exposed to during a working day. The $L_{EP,d}$ is directly related to the risk of hearing damage.
Decibel	The units of sound level and noise exposure measurement. The range of audible sound pressures is approximately 0.00002 Pa to 200 Pa. Using decibel notation presents this range in a more manageable form, 0 dB to 140 dB. Mathematically: Sound pressure Level (dB) = 20 log (p_t / p_o), where $p_o = 2 \times 10^{-5}$ Pa
Earmuff	Ear protection consisting of a cup enclosing the outer ear.
Earplug	Ear protection in the form of a plug which is inserted into the entrance to the ear canal.
Equivalent continuous sound pressure level (L_{Aeq})	A measure of the average sound pressure level during a period of time, in dB. It is a notional steady sound level which would cause the same A-weighted sound energy to be received as that due to the actual, possibly fluctuating, sound level over a given period of time (T).
Exposure limit value	The level of daily or weekly personal noise exposure or of peak sound pressure set out in Regulation 4 which must not be exceeded.
Frequency (Hz)	The pitch of the sound, measured in Hertz.
Frequency analysis	Analysis of a sound into its frequency components.
Hearing protection	A term used to cover all forms of ear protection.
Hearing protection zone	An area where a person is likely to be exposed to the upper action level or above or to the peak action level or above, which has to be demarcated with a suitable sign to conform with Regulation 7.

Hz	Hertz, the unit of frequency.
Integrating sound level meter	A sound level meter which can accumulate the total sound energy over a specified period and computes an average (in dB(A)). Used for measuring a fluctuating sound level.
$L_{A,fast\ max.}$	Maximum value of the A-weighted sound pressure level, measured using the fast (F) time weighting (in dB(A)).
$L_{C,peak.}$	Maximum value of the C-weighted sound pressure level, measured using the peak time weighting.
Lower exposure action value	The lower of two levels of daily or weekly personal noise exposure or of peak sound pressure as ascertained in accordance with the Regulations.
Noise exposure	A measure of the total sound energy a person is exposed to. It is dependent on both the sound pressure level to which the person is exposed and the time over which the exposure occurs.
Noise spectrum	A noise represented by its frequency components.
Noise refuge	An operator enclosure in which a person can work away from the source of noise.
Octave-bands	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit. The width of the octave-bands increases at higher frequencies.
Octave-band centre frequency	The frequency at the centre of an octave band.
Pa	Pascal, unit of measurement of sound pressure.
Peak sound pressure level	The maximum value reached by the sound pressure at any instant during a measurement period (in dB, usually with either C or linear frequency weighting).
Pink noise	Pink noise is acoustical energy distributed uniformly by octave throughout the audio spectrum. The total sound power in each octave is equal.
Sound level meter (SLM)	Instrument for measuring various noise parameters.
Sound pressure level (SPL)	The basic measure of noise loudness, expressed in decibels, usually measured with an appropriate frequency weighting (e.g. the A-weighted SPL in dB(A)).
Tinnitus	Involuntary noises in the ear such as ‘ringing’ often associated with hearing loss.
Upper exposure action value	The higher of the two levels of daily or weekly personal noise exposure or of peak sound pressure as ascertained in accordance with the Regulations.
Weekly personal noise exposure	The level of weekly personal noise exposure.

APPENDIX B

TABLE SHOWING RESULTS FROM DOSEMETERS

	Occupation	Venue type	LEP'd	LCpk	Duration (hours)
1	Monitor Engineer	Indoor Arena	103.9	146.8	12.5
1	Production Manager	Indoor Arena	101.3	146.0	13
1	Keyboard Tech	Indoor Arena	100.7	144.6	12.5
1	FOH sound Engineer	Indoor Arena	98.9	139.3	14
1	Promoters Rep	Indoor Arena	95.6	144.0	12.5
2	Pit Supervisor	Stadium	101.7	140.3	11
2	FOH sound Engineer	Stadium	100.4	145.7	10.5
2	Promoters Rep	Stadium	99.8	146.2	11.5
2	Stage Manager (main act)	Stadium	98.1	137.2	11.5
2	Monitor Engineer	Stadium	96	136.0	10.5
2	Stage Manager (support)	Stadium	94.5	136.1	11
2	Lighting Chief	Stadium	94.4	146.2	11
3	Security Staff (Pit)	Indoor Hall	100.2	146.3	5
3	Security Staff (FOH)	Indoor Hall	94.3	134.1	5
3	Security Staff (Pit)	Indoor Hall	92.8	138.8	5
3	Catering Staff	Indoor Hall	91.2	134.0	8
3	Security Staff (pit exit)	Indoor Hall	89.8	144.2	5
3	Security Staff (pit exit)	Indoor Hall	89.2	137.1	5
4	Fire Officer	Indoor Hall	100.9	144.0	8
4	Cashier	Indoor Hall	89.1	131.0	8
4	events manager	Indoor Hall	86.8	136.9	8
4	Assistant operations manager	Indoor Hall	85.1	134.4	8
5	Stage Manager	Outdoors	98	134.0	9
5	Radio Production Assistant	Outdoors	93.4	137.9	10.5
5	Stage Tech	Outdoors	90.8	133.0	8
5	Crew Catering Chef	Outdoors	87.4	135.0	11
5	Merchandise Manager	Outdoors	85.1	126.5	9.5
6	Film Crew	Indoors	100.3	139.4	1.5
6	Merchandise Staff	Indoors	99.5	134.0	8
6	Film Crew	Indoors	98	143.1	1.5
6	Secondary Bar staff	Indoors	97	131.0	5
6	Main Bar staff	Indoors	96.6	135.7	5
6	Main Bar staff	Indoors	95.5	132.5	5
6	Venue Manager	Indoors	91	137.4	8
6	Promotions manager	Indoors	90.3	131.0	3
6	Cloakroom Staff	Indoors	90.2	144.7	5
6	Bar Staff - outside main hall	Indoors	80.2	117.6	8
7	Consultant	Outdoors	92.2	135.0	13.5
7	Fairground staff	outdoors	97.6	145.5	13.5
7	Merchandise Staff	outdoors	93.8	130.0	14.5
8	Drummer	Indoors	104.7	144.1	6.5
8	Guitarist	Indoors	103.3	145.7	6.5
8	Bass Guitarist	Indoors	100.9	133.4	6

9	Security - Stage right	outdoors	99	142.0	11
9	Security - pit	outdoors	99.6	138.7	11
9	Security - golden circle	outdoors	90.8	128.0	8
9	Delay tower engineer	outdoors	93.1	125.3	8
9	Security - Hospitality	outdoors	85	122.5	9
9	Security - Stage rear	outdoors	91	143.6	8
9	Security - Supervisor	outdoors	95.5	139.0	11
10	St Johns Ambulance	outdoor arena	87.9	127.0	8
10	St Johns Ambulance	outdoor arena	90.2	124.0	8
10	Pit Security	outdoor arena	101.8	144.0	8
10	Security - side of stage	outdoor arena	87.3	140.1	8
10	Security - side of stage	outdoor arena	96.3	143.3	9
10	Security - edge of bowl	outdoor arena	93.1	146.3	9
10	St Johns Ambulance (moving)	outdoor arena	93.7	127.0	8
11	Bar Manager	outdoor festival	85.5	127.5	5.5
11	Market Stall Staff	outdoor festival	101.5	145.8	5.5
11	Camera Operator	outdoor festival	100.2	137.4	6
11	Site Manager	outdoor festival	86.5	129.2	8
12	Security manager(moving)	outdoors	90.2	126.5	8
12	Red Cross (moving)	outdoors	87.5	131.2	7.5
12	Red Cross (Van)	outdoors	87.2	132.5	7.5
12	Pit Security Manager	outdoors	91.6	136.3	8

APPENDIX C

GLOSSARY OF TERMS COMMONLY USED IN THE LIVE ENTERTAINMENT INDUSTRY

BACKLINE TECH
By day, the backline tech sets up, tunes, and fixes the drums (drum tech), guitars (guitar tech), basses (bass tech) or keyboards (keyboard tech). During a show the tech will scramble out on stage to replace a pick or stick, swap a guitar if a string has broken or on rare occasions, a guitar tech may operate an effect, such as a pedal, for the artist in real time.

CAMERA OPERATORS
The camera operators' shots make up the live video feed of the show that the audience views in the arena.

DELAY TOWER ENGINEER
The engineer is required to control levels and enhance the sound that is being produced by the delay loud speakers. He will work alongside the front of house engineer, however positioned at the delay tower post.

FRONT OF HOUSE
Control position situated within the audience area from where the FOH engineer mixes.

FRONT OF HOUSE ENGINEER
The front of house engineer, also known as the sound engineer, controls and enhances the sound that the audience hears using a mixing console. The sound engineer is a powerful and esteemed position; an engineer can stay with a band for years.

FIRE OFFICER
The Fire Officer has to make sure all exits are kept clear and that the fire safety of the venue is kept up to date. He may also be involved if pyrotechnics are used during a performance.

LIGHTING DIRECTOR
The lighting director runs the lights during the show. Operating from a lighting design, the lighting director also tells the spot operators where to shine their spotlights.

LIGHTING TECH
The lighting tech, also referred to as an electrician, sets up, focuses and maintains the band's lighting system.

LINE CHECK
A test to make sure the audio signals from the stage are reaching the front of house channel inputs cleanly.

LOAD IN/BUILD UP
The time prior to the event where equipment (stage, PA, lighting etc) is loaded in to the venue and then constructed

MONITOR ENGINEER
The monitor engineer controls and enhances the sound that the band hears on stage. They must approximate what each band member will need to hear to produce the best sound in-time and in-

tune. The monitor console is positioned on the side of the stage, so the monitor engineer can keep an eye on all the members of the band who may communicate changes in their monitor settings.

PINK NOISE
Pink noise is acoustical energy distributed uniformly by octave throughout the audio spectrum. The total sound power in each octave is equal.

PRODUCTION MANAGER
Production managers work closely with the tour manager to put the production together (e.g., procuring sound, lights, video, trucking, etc.). Scheduling both the touring crew and the local stagehands, production managers are also responsible for the day-to-day running of the production.

PROMOTER REP
The promoter’s rep helps the promoter with all the promotional duties and acts as the promoter's on-site representative on the day of the show. The rep helps the band with whatever they may need to put on the show.

SECURITY STAFF
Are required to control the safety and comfort of the audience.

SOUND TECH
The sound tech sets up and maintains the band's PA system.

STAGE MANAGER
The stage manager controls the ebb and flow of the load-in (set up) and load-out (tear down). He or she directs the local crew unloading the trucks, then manages the flow of equipment and people on and off the stage. The stage manager acts as the production manager's right hand, and makes sure the show starts and finishes on time.

TOUR MANAGER
The tour manager manages the entire tour; he or she is responsible for putting it together as well as running it on a day-to-day basis. Once a tour manager is hired by an artist’s management, their responsibilities may also include the travel arrangements and accounting (if there is no tour accountant).

APPENDIX D

LOCAL AUTHORITY QUESTIONNAIRE

HSE Noise in the live entertainment industry questionnaire.

1 What are the advantages and disadvantages of considering likely noise levels at music and entertainment venues as part of the process for applying for a licence?

2 In your experience, what are the top four cost-effective solutions that can be put in place at music and entertainment events to reduce sound levels to those agreed with the LA.

3 Are there any barriers to LA's in enforcing the agreed noise levels and if so what are they?

4 Do you currently carry out any Noise at Work monitoring at live music events within your area? If not, why not?

5 When the new regulations (Control of Noise at Work Regs) come into force for the entertainment industry, do you think your monitoring will increase?

6 What steps (if any) are you taking to warn people in the entertainment sector of the reduced action levels?

APPENDIX E

RESPONSES FROM LOCAL AUTHORITIES TO QUESTIONNAIRE

HSE Noise in the live entertainment industry questionnaire.

1 What are the advantages and disadvantages of considering likely noise levels at music and entertainment venues as part of the process for applying for a licence?

This question is not clear. I assume it relates to the protection of the work force only as the survey relates to the noise at work regs.

The Licensing Act 2003 is not designed to protect the health and safety of those employed at premises. There is however a licensing objective "public safety" aimed at ensuring the safety of those attending venues. Considering the likely noise levels at a venue may be useful in helping to reduce noise induced hearing loss. There is little merit in forcing internal restrictions on volume to protect peoples hearing as in reality people who attend venues do so at their own discretion and if they feel it is too noisy can leave at any time.

What may be useful is to consider internal music noise levels and ensure premises owners or promoters issue warning on tickets / website flyers etc so that the customer is aware of the risks before entering a given venue and can make an informed choice.

Cannot be enforced through licence conditions as specific health and safety legislation applying.

Advantages

- **i) Considering likely noise levels as part of the process of licensing can be used as a means of control. Information can be sought prior to events, functions, etc and previous breaches can be referred to for consideration. Licences can be granted subject to conditions being imposed, revoked for breach of conditions or refused due to unsuitability of venue/premises or where the applicant is judged to be not a fit and proper person.**
- **ii) Likely to protect the health, safety and welfare of employees.**
- **iii) Reduce the likelihood of complaints from adjacent residents, businesses and patrons.**
- **iv) Protect the health of non-employees e.g. concert-goers, performers and enforcement officers.**

Disadvantages

- **i) Difficult to obtain information about predicted noise levels where different bands/performers are playing or different equipment is being used.**
- **ii) Enforcement powers are limited or difficult for one-off or transient events.**
- **iii) A considerable number of children, including toddlers and babies, accompanied their parents to a recent large music event. A major disadvantage of not considering noise levels as part of the licensing process at such an event is that there is no control over the age of children attending. The potential for hearing damage where young children and babies are exposed to live music noise levels needs to be assessed. Licensing authorities should be aware of the greater risk to young children and babies and should undertake research prior to considering what the acceptable noise levels for live music events should be.**
- **iv) Training, guidance, competency and availability of enforcement officers.**

Presuming that we are considering employee noise at work issues this may not be lawful; requirements which can required using other legislation should not be added as conditions on a Premises Licence.

The advantages:

1. Deals with potential noise impacts proactively, and aiming to avoid problems before they arise
2. Applicants are usually so keen to get their Licence, any works will be completed without delay.
3. Saves time in the long run
4. Achieves a higher standard than simply the avoidance of nuisance

Disadvantages:

If you ask for things to be done, and it doesn't work, and there is a noise problem, then its your fault.

Cannot be enforced through licence conditions as specific health and safety legislation applying.

We apply noise levels in the licence as recommended by the Noise Council CoP but not the Noise at Work Regs

2 In your experience, what are the top four cost-effective solutions that can be put in place at music and entertainment events to reduce sound levels to those agreed with the LA.

Again, not a clear question. My answer is based upon protection of the work only.

These views are more from an academic perspective rather than hands on experience of controlling music noise levels internally for health and safety purposes.

a. **Reduce the volume**. This is perhaps the cheapest method. Does not involve any direct costs however may have knock on effects such as fewer customers if the volume of the music is not sufficient to be "enjoyed"
b. **Ear defenders**.
c. **Length of shifts / management of working in noisy areas**. Shifts and the length of time people work in a particular area cannot be restricted to ensure that the noise exposure limits are not exceed.
d. **Screening / enclosures. ,** some staff can work in areas screened from the main noise source and thereby reducing exposure. Not particularly practical from entertainment venues though as most staff i.e bar staff, glass collectors and security will all be positioned in areas where music is being played.

Reduce sound levels in venue.
Provision of working areas for staff i.e. bars with lower sound levels.
Alternation of job tasks between higher and lower exposure areas to reduce overall noise exposure
Hearing protection.

- **Repositioning, redirecting or insulation of speakers.**
- **Isolation of equipment.**
- **Acoustic absorption for indoor venues.**
- **Noise limiting devices.**

Very little experience of dealing with employee noise issues.

We did carry out a employee noise survey some years ago aimed at DJ's and bar workers. We found that chilling areas, limited noise exposure periods seemed to help in reaching action levels.

1) Sound limiter
2) Entrance Lobbys
3) Lockable double glazed windows
4) Restricted opening hours

Reduce sound levels in venue.
Provision of working areas for staff ie bars with lower sound levels.
Alternation of job tasks between higher and lower exposure areas to reduce overall noise exposure
Hearing protection.

We do ask our promoters to carry out assessments. Rotation of staff & ear plugs/defenders are the most popular

3 Are there any barriers to LA's in enforcing the agreed noise levels and if so what are they?

Resource availability within the LA and the practicalities of being able to make a significant difference.

Resources to focus on this activity. Competing priorities mean this may come down list of priority activities.

The timing of live music events tends to be late at night or at weekends, which could be resource intensive and could divert resources from "normal" enforcement activity due to recovery time, etc.,

None at all; as long as legislation is clear and enforceable and LA has provided adequate resources

There needs to be consistency and joined-up-thinking between the Licensing and Environmental Health agencies

Resources to focus on this activity. Competing priorities mean this may come down list of priority activities.

We find it difficult to supply staff to support large events up to 50K.

4 Do you currently carry out any Noise at Work monitoring at live music events within your area? If not, why not?

We carry out monitoring in response to complaints made to this office, but this is often as a result of a member of the public contacting us rather than an employee.

We are scheduled to carry out monitoring of certain venues in the forthcoming months to inform ourselves and the venue owners of the noise levels, and to identify where the problem areas are located in view of the new legislation.

No specific monitoring. It is duty of employer to ensure this is monitored and will investigate/prosecute if found to be in breach.

No, probably as a result of these events happening out of hours or lack of complaints from employees indicating that there is a problem.
Noise monitoring was undertaken when the original regulations came into force. This resulted in Improvement and Prohibition Notices being served. The onus is on the employer to undertake a noise at work assessment. Assessments are required on inspection or licensing visits and are reviewed by enforcement officers. If there is deemed to be a problem, monitoring would be considered.
Also, not all live events fall to LA control, many are HSE.
In addition, responsibility for enforcement officer health and safety needs to be considered, risk assessed and surveillance screening put in place.

No, we do not.
i) Noise at Work is not a Topic Inspection theme,
ii) no perceived problem; no complaints received from employees.
iii) we set environmental noise levels, which may assist with employee risks.

No.
Reason – as ever – lack of resources. This would be seen as a non-essential statutory exercise. We just don't have time for proactive work.

No specific monitoring. It is duty of employer to ensure this is monitored and will investigate/prosecute if found to be in breach.

No,: lack of resources

5 When the new regulations (Control of Noise at Work Regs) come into force for the entertainment industry, do you think your monitoring will increase?

Yes, but in line with available resources.

No

A Capita Symonds staff member wore a dosimeter for the duration of the event. In the main, he was located at a work station within the main tent. This was part of the survey.

A distinction should be made, quite pointedly, between environmental noise control and health and safety noise control - the acceptable limits can differ considerably from one event to another. H&S limits are constant but environmental limits vary with location. The questionnaire does not lend itself to this distinction.

For live broadcast events the health and safety noise control is the responsibility of the HSE.

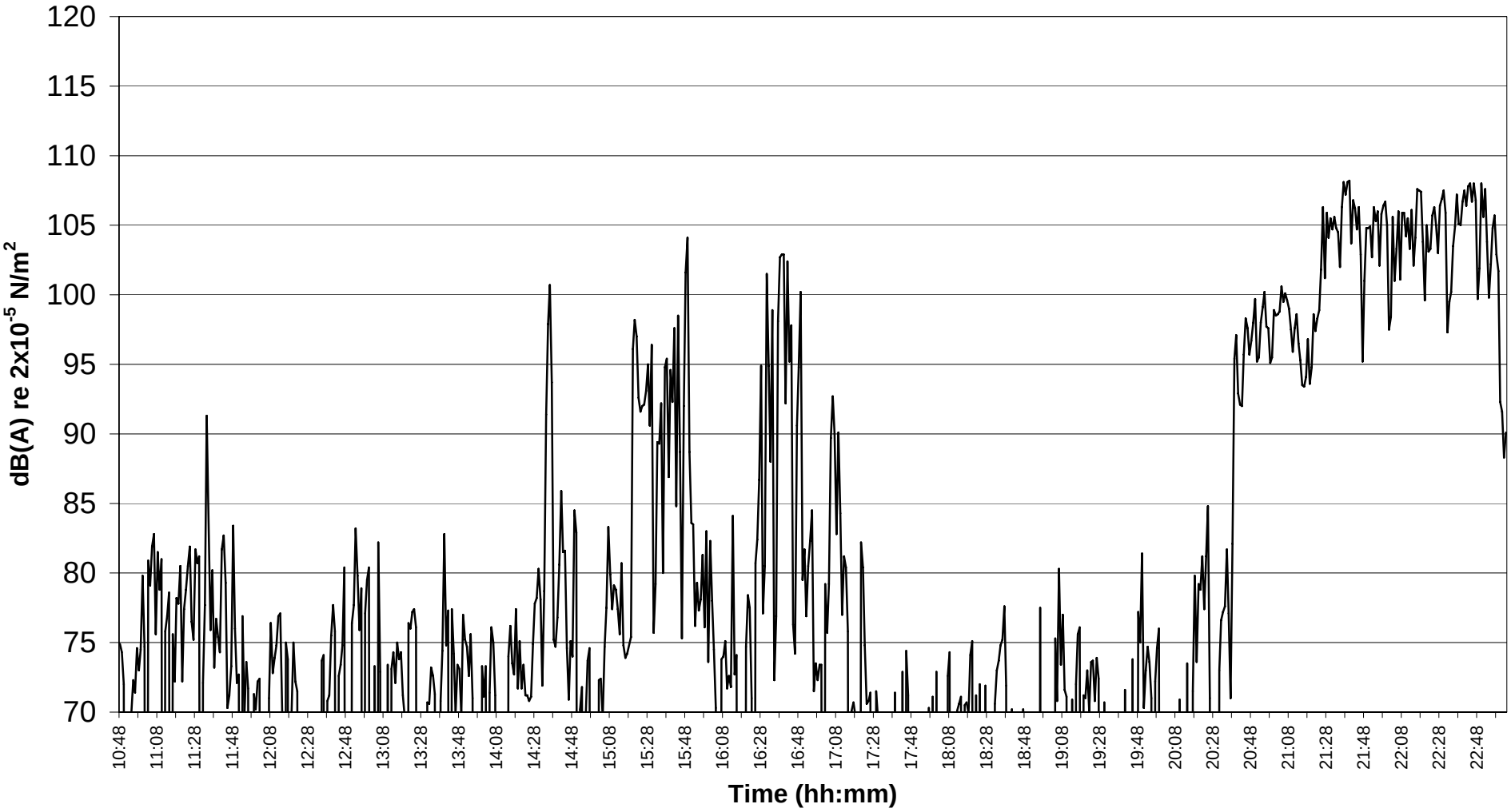
APPENDIX F

GRAPHS OBTAINED FROM DOSEMETERS

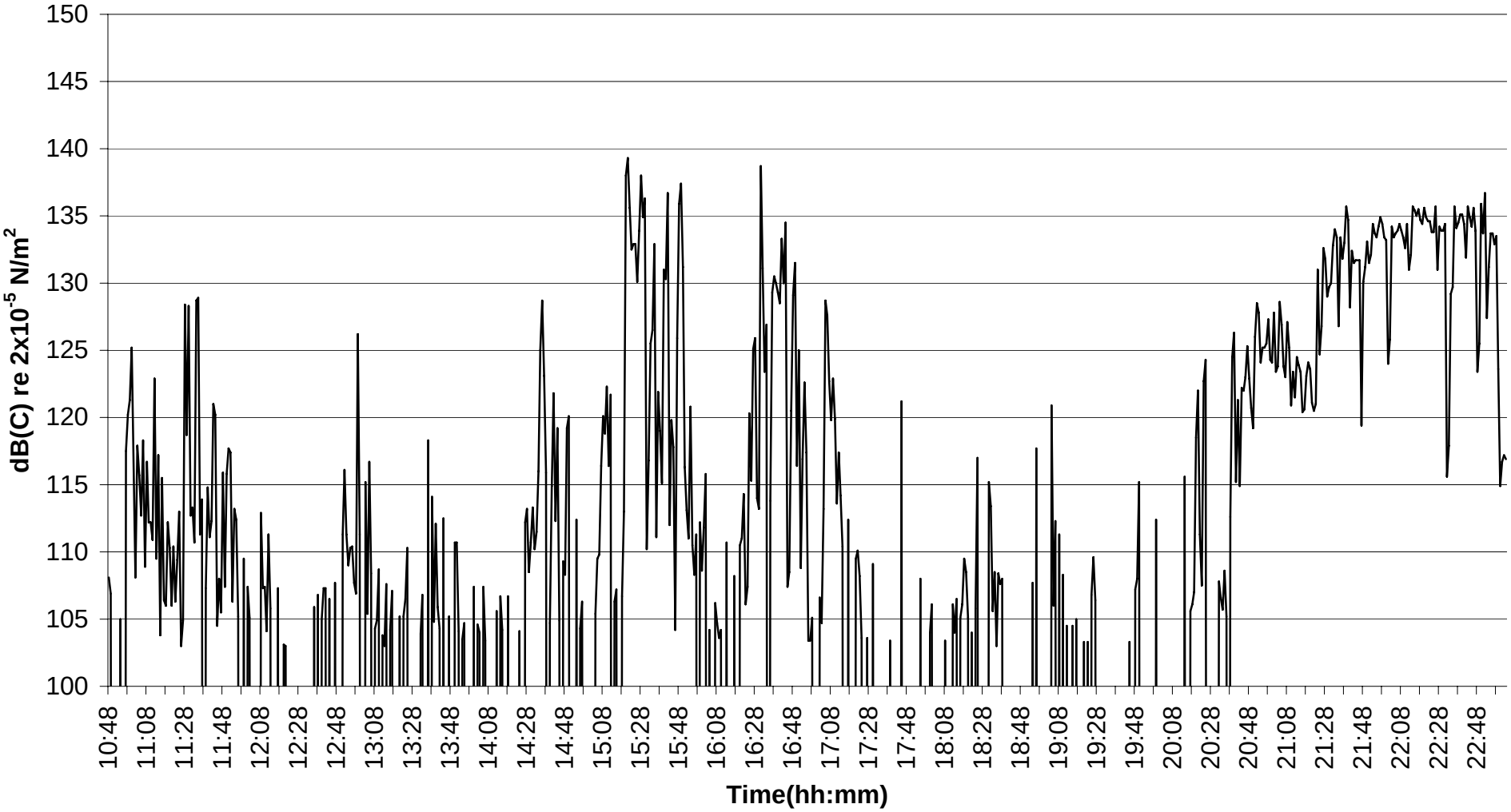
Appendix F contains all the graphs obtained from the dosemeters from every event. An explanation of how to interpret these graphs is contained in section 5 of the report, which shows an example. A complete list of all the personnel and numerical information relating to their noise exposure is contained in Appendix B.

These levels are typical and would be a useful starting point for the industry to use to identify personnel who may need hearing protection and the type of hearing protection that may be appropriate.

1. $L_{Aeq,1min}$ dosemeter readings obtained from a front of house sound engineer



1. $L_{C,peak}$ dosemeter readings obtained from a front of house sound engineer



1. $L_{Aeq,1min}$ dosemeter readings obtained from a keyboard tech