

## Sound Advice Note 5

### Noise risk assessment

This is the full text of the **Sound Advice** Working Group recommendations on noise risk assessment. It may help you to identify who is at risk, and how. It contains information that you may be referred to from other Sound Advice web pages or advice notes.

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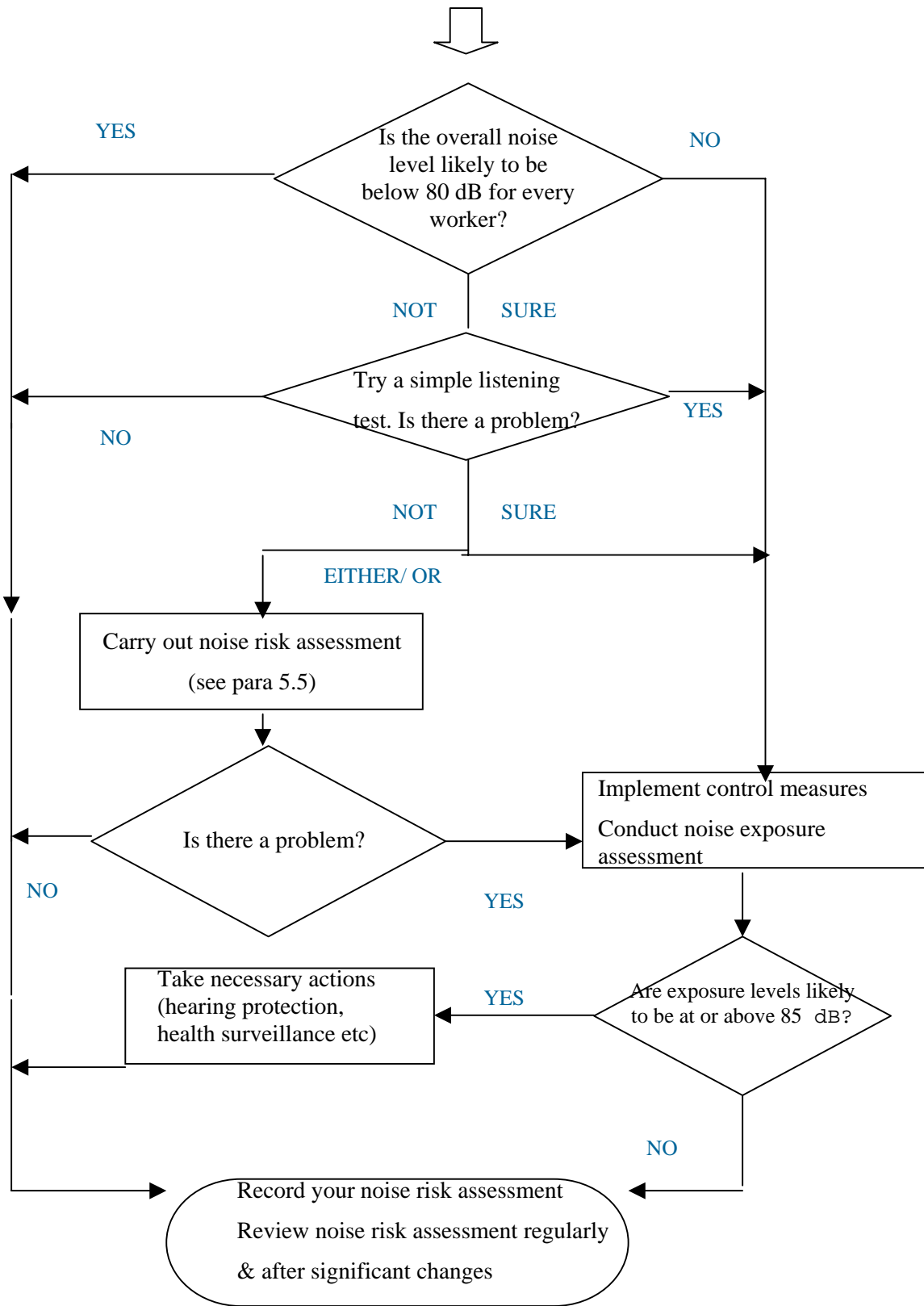
#### The process

5.1 If the answer to any of the questions in Sound Advice Note 1 *Hearing loss* (in the section 'Is there a noise problem at work?') is "yes" then an assessment of the risks is needed to decide whether any further action is necessary. A noise risk assessment must be carried out if the noise exposure is likely to reach the Lower Exposure Action Value (80 dB).

5.2 A flow chart representing the process of noise risk assessment is shown overleaf.

5.3 Note that in addition to carrying out a noise risk assessment, employers must carry out a general risk assessment of the workplace as required by the Management of Health and Safety at Work Regulations 1999. It may also be necessary to carry out specific noise risk assessments as required by other legislation.

5.4 The aim of the noise risk assessment is to help decide what measures are necessary to ensure the health and safety of employees who are exposed to noise. It is more than just taking measurements of noise – sometimes measurements may not even be necessary. A responsible manager should be able to carry out simple listening tests. If the simple tests show that no potentially harmful noise levels are likely, no further action is necessary other than recording this assessment.



Flow chart representing the process of noise risk assessment

5.5 If the simple listening test indicates there may be a potential risk then a suitable noise risk assessment should be carried out. The purpose of the risk assessment is to establish whether the exposure is 80 dB or more. Noise risk assessments should:

- Be carried out by a competent person. The level of competency necessary will vary depending on the complexity of the situation; a competent person should suggest cost-effective and appropriate control measures
- Identify where there may be a risk from noise and those likely to be affected
- Contain a reliable estimate of the noise exposure and compare the exposure with the exposure action and limit values
- Identify what needs to be done
  - o Whether noise control measures are needed and if so, which and where
  - o Whether hearing protection is required, and, if so, what and for whom
- Identify any employees who need to be provided with health surveillance and whether any employees are at particular risk
- Specify the compliance and effectiveness checks that will apply
- Be recorded, and be published to performers and other affected staff
- Become part of a knowledge database for future assessments and, within reason, be shared with others
- Be monitored to ensure their effectiveness

5.6 It is essential that the estimate of employees' exposure is representative. It should take account of:

- The work being carried out or likely to be carried out
- The ways in which the work is being done
- How the work varies during the day (for instance, in a nightclub or bar the loudest noise would probably be when it is crowded and music is being played)
- How the work may vary from one day to the next
- How long the work will take
- All sources of noise at work, including for instance the noise from patrons and machinery, not just the music

5.7 When in any doubt it is sensible to assume that control measures are necessary when noise is present and that hearing protection will be required until the control measures are sufficient to reduce the employees' exposure to below the Upper Exposure Action Value. In general terms if music is to be played, there is no need to take measurements until after the necessary control measures have been implemented. An example of a pre-event noise risk assessment for a pop festival is on page 8 of this advice note.

#### Example

If an employee works behind the bar in a noisy nightclub, it is reasonable to assume that exposure will be greater than the Upper Exposure Action Value and therefore the necessary control measures should be implemented. In this situation noise measurements are only needed to demonstrate that the exposure is lower than the Upper Exposure Action Value after the necessary measures have been taken.

## Noise exposure assessment

5.8 The noise exposure level ('noise dose') takes account of both the level of the sound and its duration. Both the possible noise levels and the length of exposure have to be assessed.

5.9 The Noise Regulations require specific action when noise exposure reaches certain action values (see below). To assess a worker's noise exposure, reliable information is needed on:

- the average noise level to which the worker is exposed
- the amount of time the worker spends in the noise

5.10 The noise level is combined with the duration of exposure to determine the noise exposure. Noise exposure is based on the mathematical relationship between the average noise level and the duration of the exposure. Daily (and weekly) exposure can be calculated using the ready-reckoner (see page 17 of this advice note) or the on-line calculator (available on <http://www.hse.gov.uk/noise/calculator.htm>) or the equations in Schedule 1 Part 2 of the Noise Regulations.

### *Determine the noise level*

5.11 The estimate of the noise level must be based on reliable information. This may include:

- Noise measurements at the workplace
- Information from other similar workplaces
- Information from other sources – for instance this guidance

5.12 Measurements will be necessary when a reliable estimate of employees' exposure cannot be made in other ways. Measurements may also be used to demonstrate that the noise exposure is below a particular value so that the employer, and others, can be assured that the requirements of the Noise Regulations have been met, and, where confirmation is necessary, to verify that the control measures in place have reduced exposure sufficiently.

5.13 Reliable estimates or an actual measurement of the noise level should be made for each task undertaken. For instance noise levels in rehearsal and performance may well be different and noise levels for different performers can also differ. If any information used is not based on noise measurement in the work situation, then it will be necessary to demonstrate that the estimate is representative.

5.14 General advice on measuring noise is given on page 21 of this advice note. More detailed advice is given in L108.

### *Determine the duration of exposure*

5.15 One way of determining how long people are exposed to levels of noise is to observe the work going on and discuss with employees, supervisors etc. If the noise level varies during the day, the duration of the worker's exposure to each noise level needs to be recorded or estimated.

### *Exposure action values and exposure limit values*

5.16 The Noise Regulations establish noise exposure levels at which employers must take specific actions. There is an overriding requirement to reduce noise levels to as low as reasonably practicable. Where excessive noise levels may be present, control measures must be taken to limit the exposure of workers so that their health is not placed at risk.

5.17 Table of exposure action values and exposure limit values \*

EXPOSURE ACTION VALUES AND EXPOSURE LIMIT VALUES			
	Daily or weekly personal average noise exposure	Peak sound level	Actions
Lower Exposure Action Values	80 dB (A-weighted)	135 dB (C-Weighted)	<ul style="list-style-type: none"> <li>Undertake risk assessment. If any employees are identified as being particularly susceptible to noise, health surveillance should be implemented</li> <li>Make hearing protection available</li> <li>Establish a maintenance programme for equipment supplied to reduce noise risk such as noise limiters and hearing protection</li> <li>Provide training</li> </ul>
Upper Exposure Action Values	85 dB (A-weighted)	137 dB (C-weighted)	<ul style="list-style-type: none"> <li>Establish and implement a programme of control measures</li> <li>If these measures are not sufficient to reduce exposure below 85 dB (A) then:– <ul style="list-style-type: none"> <li>Suitable hearing protection must be worn and</li> <li>Health surveillance programme implemented</li> </ul> </li> </ul>
Exposure limit values	87 dB (A-weighted)	140 dB (C-weighted)	<ul style="list-style-type: none"> <li>Reduce to below Limit Values (Allowed to take hearing protection into account)</li> </ul>
* For an explanation of these terms see <i>Useful terms</i> .			

### *Weekly averaging*

5.18 Normally average noise exposure is calculated on a daily basis. However, the Noise Regulations allow the calculation of exposures over a week rather than over a day in circumstances where noise exposure varies markedly from day to day. It is only likely to be appropriate:

- Where daily exposure on one or two working days in a week is at least 5 dB higher than the other days;
- Or the week comprises three or fewer days of exposure.

5.19 When considering whether to use weekly averaging it is important to:

- Ensure there is no increase in risk to health. It would not, for example, be acceptable to expose workers to very high noise levels on a single day without providing them with hearing protection
- Remember there is an overriding requirement to reduce the risk to as low a level as is reasonably practicable
- Consult with the workers concerned and their safety or employee representatives on whether weekly averaging is appropriate

### *Consultation*

5.20 If noise risk assessments are to be carried out in venues where there is formal recognition of unions, the Safety Representatives must be fully consulted about the process. Where there is no formal representation, employers should endeavour to liaise with the local Musicians Union and Equity representatives or employee representative groups. The results of any assessments should be made available to the staff along with details of any control measures.

### *Action plan*

5.21 The employer should record in an action plan:

- What has been identified as being necessary to comply with the law
- What has already been achieved
- What additional action is intended to further reduce exposure, for example, any capital works, including the timetable for the improvement and stating who will be responsible for the work
- Arrangements for regular checks and monitoring
- Arrangements for regular reviews

5.22 Records of noise risk assessments and noise measurements should be retained. These may be held electronically, for instance on a database.

### *Regular monitoring*

5.23 Employers must establish and maintain monitoring systems. Active monitoring reveals how effectively the health and safety management system is functioning.

5.24 Regular checks are essential to make sure that the noise conditions have not changed and that the control measures are effective and to identify any further actions necessary. Any incidents should be investigated to ascertain the immediate and any underlying causes and remedial action taken.

5.25 After the first noise risk assessment a competent person should carry out further assessments, for example during the first rehearsal/warm up of each event and at the first performance. Thereafter, a noise risk assessment, and a noise measurement if required, should be carried out if any change(s) occur in the workplace (such as changes to the set design, seating layout or the type of music performed) which affect noise exposure.

5.26 The results of monitoring should be recorded.

### *Reference positions*

5.27 Specific noise measurements conducted in the workplace can help identify the main sources of noise and therefore make it easier to assess where further controls are necessary and when periods of wearing compulsory hearing protection are required.

5.28 It may be helpful to have one or two judiciously positioned sound-level meters or noise dosimeters to estimate noise exposures, for example within the orchestra/band or on the dance floor. It may also be useful to establish reference position(s) to enable quick measurements to be made using a simple meter to verify that sound levels are under control. The reference position(s) should be selected with care to ensure the difference between the reference position and other locations within the venue can be considered constant. Post-exposure, this information should be recorded and compared with the assessment, and any relevant lessons applied to future assessments. Examples of locations for reference positions are included in Sound Advice Note 12 *Amplified live music*; Sound Advice Note 13 *Pubs and clubs*; and Sound Advice Note 17 *Studios*.

#### *Regular review*

5.29 Reviews should ensure that the noise risk assessment continues to apply and should ascertain whether there are any changes that might affect the noise exposure and what actions, if any, are required. Review should establish priorities for necessary remedial action discovered as a result of monitoring to ensure that suitable action is taken in good time and is completed.

5.30 The noise risk assessment should be reviewed regularly to make sure that all that is reasonably practicable is being done to control the noise risks. Even if it appears that nothing has changed the risk assessment should not be left for more than about two years without a review.

5.31 The results of reviews should be recorded.

## 5A1 Pre-event noise risk assessment

An example of pre-event noise risk assessment for a pop festival.

PRE-EVENT NOISE RISK ASSESSMENT	
<b>Name of Event</b> The Big Festival	<b>Date of assessment</b> July 10th 2006
<b>Assessment completed by</b> Anne Onymouse	
<b>What are the noise sources?</b> Stage PA systems Instruments and backline Traders' sound systems	
<b>Are sources liable to produce a level above the Lower Exposure Action Value?</b> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	
<b>What area(s) may be affected at this level?</b> <ul style="list-style-type: none"> <li>• The stage platform (including side wings)</li> <li>• The stage pit area</li> <li>• Concession and other stands within the main arena</li> <li>• Medical and welfare tent by side of stage</li> <li>• Backstage bar/hospitality facilities</li> </ul>	
<b>Action to be taken to protect staff in these areas</b> <p>1. The stage platform (including side wings)</p> <p>Area to be clearly signed as a Hearing Protection Zone where ear protection is mandatory</p> <p>Operating times of the PA system to be closely managed by Stage Manager and PA contractor</p> <p>Advance discussions to be conducted with bands to minimise backline noise / promote use of in-ear monitoring</p> <p>Disposable hearing protection to be available at entry points to stage</p> <p>Stage Manager to monitor &amp; enforce use of PPE onstage</p> <p>2. The stage pit area</p> <p>Stage pit to be signed as a mandatory Hearing Protection Zone.</p> <p>All pit staff to be advised in advance of show of need to wear appropriate PPE during their shift.</p> <p>Disposable PPE to be available at entry to pit SL and SR</p> <p>Pit security team to be briefed to refuse entry to anyone not wearing PPE (photographers, guests etc.)</p> <p>Security contractor to ensure staff are rotated to quiet areas during their shift period</p> <p>Security Supervisor to monitor and enforce wearing of PPE</p> <p>3. Concession and other stands within the main arena</p> <p>Site to be set out to avoid stalls and other infrastructure in direct line of speakers</p> <p>Where possible elevate speakers using flown systems</p>	



Inform all stall/concession holders of the likely exposure to loud noise and the need to ensure their staff are briefed and have access to appropriate hearing protection

4. Medical and welfare tent by side of stage

Position medical and welfare facilities as far as reasonably practicable from speakers

Make PPE available to all medical and welfare staff

Request medical and welfare providers to make arrangements to rotate staff to quiet duties during their shift

5. Backstage bar/hospitality facilities

Locate the bar as far as practicable from the stage itself

Limit the hours of operation of the bar PA system

Reduce the level of PA systems in the bar and hospitality areas

Contact bar manager to ensure bar staff are briefed on risks of working in high noise area

Ensure bar contractor makes appropriate PPE available to their own staff

**Noise monitoring plan**

Integrating Sound level meter to be rented and a range of 15 minute Leq samples to be taken by the Event Safety Officer during the weekend to establish the geographic limits of the High Noise Zone

Dosemeter to be worn by Stage Manager to get sample on-stage exposure levels

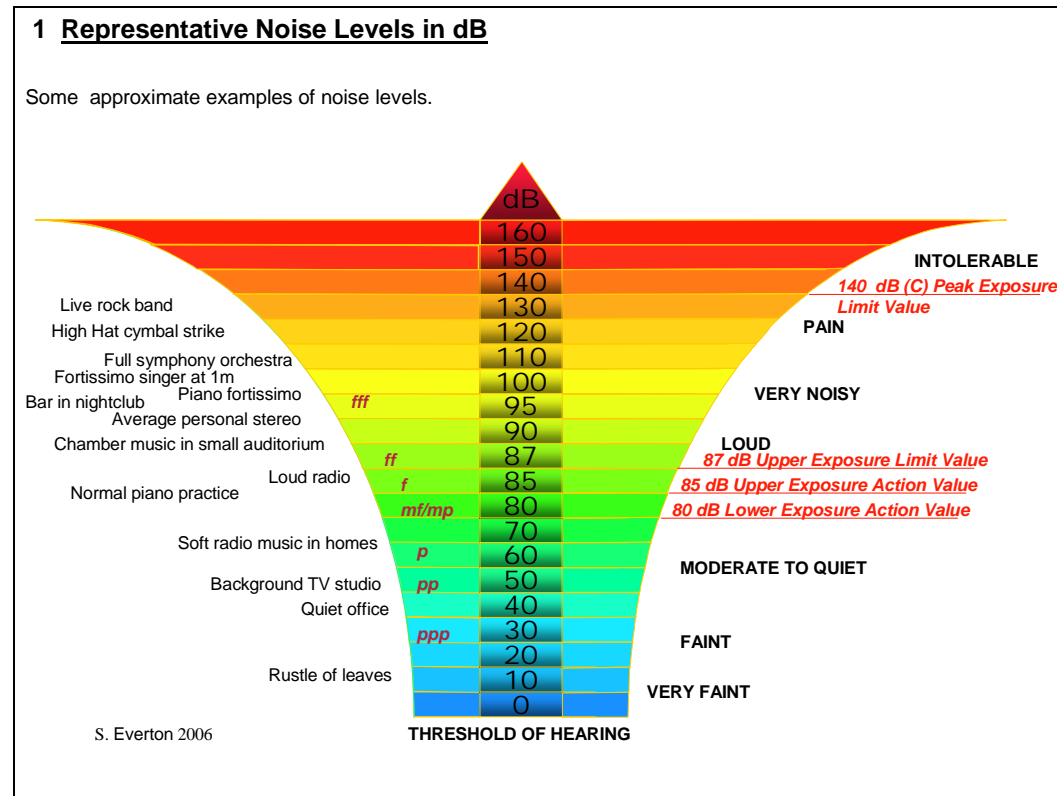
Local Authority will be on site to conduct front of house noise sampling to assess compliance with Licence conditions.

**Additional considerations**

Review of High Noise Area and the type of PPE provided to be conducted once measurements are taken during the event.

Continue advance discussions with PA supplier to identify means of reducing on-stage noise and spill into backstage/medical/welfare areas

## 5A2 Representative range of noise and exposure levels



<b>2. REPRESENTATIVE NOISE LEVELS</b>		
<b>NOISE SOURCE</b>	<b>DB</b>	<b>Peak</b>
<b>Single musicians</b>		
Violin/viola (near left ear)	85 – 105	116
Violin/viola	80 – 90 *	104
Cello	80 – 104 *	112
Acoustic bass	70 – 94 *	98
Clarinet	68 – 82 *	112
Oboe	74 – 102 *	116
Saxophone	75 – 110 *	113
Flute	92 – 105 *	109
Flute (near right ear)	98 – 114	118
Piccolo	96 – 112 *	120
Piccolo (near right ear)	102 – 118*	126
French Horn	92 – 104 *	107
Trombone	90 – 106 *	109
Trumpet	88 – 108 *	113
Harp	90	

<b>3. REPRESENTATIVE NOISE LEVELS</b>		
<b>NOISE SOURCE</b>	<b>DB</b>	<b>Peak</b>
Timpani & Bass Drum	74 – 94 *	106
Percussion (High hat near left ear)	68 – 94	125
Percussion	90 - 105	
Amplified guitar (on stage using in-ear monitors)	100 – 106 *	118
Amplified guitar (on stage with wedge monitors)	105 – 112 *	124
Singer	70 – 85 *	94
Soprano	105 - 110	
Choir	86	
Normal piano practice	60 – 90 *	105
Loud piano	70 – 105 *	110
Keyboards (electric)	60 – 110 *	118
Drummer at indoor music festival	105	144
Guitarist at indoor music festival	103	146
Bass guitarist at indoor music festival	101	133
<b>Several musicians</b>		
Chamber music (classical)	70 – 92 *	99
Symphonic music	86 – 102 *	120 – 137
Amplified rock music	102 – 108 *	140 +
In-ear headphones such as i-Pods @ volume 6	94	110 – 130 <sup>1</sup>
In-ear headphones such as i-Pods @ full volume	105	110 – 142 <sup>1</sup>
<b>Opera Orchestra Pit +</b>		
Violin	84 – 90	
Viola	87	
Cello	86	
Double Bass	86	
Trumpet	93	
Trombone	90	
Horn	91	
Piccolo/Flute	90	
Clarinet/Bass Clarinet	88	
Oboe/Bassoon	87	
Percussion	85	
Conductor	82	
All instruments	88	

<b>4. REPRESENTATIVE NOISE LEVELS</b>		
<b>NOISE SOURCE</b>	<b>DB</b>	<b>Peak</b>
<b>MUSIC TEACHING</b>		
Group practice		
Saxophone: Tutor	93 – 95	
Saxophone: Students	94 – 96	
<b>Music Teaching: individual lessons: tutor exposure</b>		
Violin with piano accompaniment (small practice room)	82	
Violin with piano accompaniment (large practice room)	76	
Violin	84	
Flute	89	
Electric guitar	88	
Saxophone	95	
Trombone	90	
Piano	82	
Singing (piano accompaniment)	85	
<b>School Orchestra Practice</b>		
Tutor conducting	94	
Student trombones (back row)	94	
Student percussion	92	
Student trumpet soloist with orchestra	96	
Student saxophone (back row)	91	
Student clarinet (front row)	95	
Student flute (front row)	98	
Staff tuba	92	
<b>Legend</b>		
* at 3 metres		
<sup>1</sup> Depends upon earphone used		
+ Quoted as average/light exposure. Other work in progress.		

<b>5. REPRESENTATIVE EXPOSURE LEVELS</b>		
<b>OCCUPATION</b>	<b>DB</b>	<b>Peak</b>
<b>Indoor/Stadium Music Festivals</b>		
Monitor Engineer	96 – 104	147
Production Manager	101	146
Keyboard Technician	101	145
FOH Sound Engineer	99 – 100	139/145
Promoter's representative	96 – 100	146
Pit Supervisor	102	140
Stage Manager	96 – 98	137
Lighting Chief	94	146
Security staff (depending on location)	89 – 94	137/146
Security – Pit	100	146
Catering Staff	91	134
Fire Officer	101	144
Cashier	89	131
Events Manager	85 – 87	137
Film Crew	98 – 100	139/143
Merchandise staff	100	134
Bar staff	96 – 97	131/136
House managers	80 – 91	131/137
Cloakroom staff	90	145
<b>Outdoor Music Festivals ('Pop Concerts')</b>		
Stage Manager	98	134
Technicians	91 – 93	133/138
Catering	87	135
Merchandising	85 – 101	127/146
Security – Pit	91 – 101	136/144
Security staff (depending on location)	85 – 100	122/146
Ambulances	88 – 94	124/133
Bar Staff	86	128
Site Manager	87	129
Camera operator	100	137
Delay tower engineer	93	125

<b>6. REPRESENTATIVE EXPOSURE LEVELS</b>		
<b>OCCUPATION</b>	<b>DB</b>	<b>Peak</b>
<b>Clubs</b>		
Bar staff -	89 - 99	
Glass collectors	90 – 100	
Waiters	102	
DJs	93 – 99	
Lighting technician	104	
Security	97	
Door	84	
Dance floor	94 - 104	

## 5A3 Estimating noise exposure using the points system

### Daily noise exposure

1. Daily noise exposure can be calculated using the ready-reckoner overleaf, the on-line calculator available on <http://www.hse.gov.uk/noise/calculator.htm> or the equations in Schedule 1 Part 2 of the Noise Regulations.

2. The ready-reckoner provides a simple way of working out the daily personal exposure of workers based on the level of noise and duration of exposure. It uses a system of exposure points. The Upper Exposure Action Value is equivalent to 100 points and the Lower Exposure Action Value is 32 points. The left section of the ready-reckoner shows how noise level and duration of exposure are combined to give noise exposure points. The right section is used to convert the total number of exposure points to daily personal exposure

### Weekly noise exposure

3. Weekly noise exposure ( $L_{EP,w}$ ) takes account of the daily noise exposure for the number of days worked in a week (up to a maximum of seven days).

4. The weekly noise exposure can be calculated using the electronic calculator which is available on <http://www.hse.gov.uk/noise/calculator.htm>, the equations in Schedule 1 Part 2 of the Regulations or by totalling the exposure points for seven days, calculated using the ready-reckoner overleaf, and applying the result to the adjacent table.

5. A worked example of weekly averaging using the HSE on-line calculator follows

WEEKLY AVERAGING	
Total exposure points	Weekly noise exposure, $L_{EP,w}$
5000	95
4000	94
3200	93
2500	92
2000	91
1600	90
1300	89
1000	88
800	87
630	86
500	85
400	84
320	83
250	82
200	81
160	80
130	79
100	78



DAILY NOISE EXPOSURE											
Sound pressure level, $L_{Aeq}$ (dB)	Duration of exposure (hours)								Total exposure points (EP)	Noise exposure $L_{EP,d}$ (dB)	
	¼	½	1	2	4	8	10	12			
105 <sup>1</sup>	320	600	1250							3200	100
100	100	200	400	800						1600	97
97	50	100	200	400	800					1000	95
95	32	60	125	250	500					800	94
94	24	50	100	200	400					640	93
93	20	40	80	160	320					500	92
92	16	32	65	120	250	500				400	91
91	12	24	50	100	200	400	500			320	90
90	10	20	40	80	160	320	400	470		250	89
89	8	16	32	65	130	250	310	380		200	88
88	6	12	24	50	100	200	250	300		160	87
87	5	10	20	40	80	160	200	240		130	86
86	4	8	16	32	65	130	160	190		100	85
85		6	12	25	50	100	125	150		80	84
84		5	10	20	40	80	100	120		65	83
83		4	8	16	32	65	80	95		50	82
82			6	12	25	50	65	75		40	81
81			5	10	20	40	50	60		32	80
80			4	8	16	32	40	48		24	79
79				6	13	24	32	38		20	78
78				5	10	20	24	30		16	77
75					5	10	12	15			

<sup>1</sup> Do all that is reasonably practicable to reduce the noise if it remains over 105 dB for more than 5 minutes; ensure hearing protection is used and provide health surveillance.

*EXAMPLE ONE: Bar staff*

6. Employees in a nightclub have a typical work pattern. They work for a total of 6 hours in the nightclub from 20:00 to 02:00 the following morning. During this shift they work;

- behind a bar for 2 hours where the noise level is 90 dB,
- collecting glasses for 2 hours where the noise level is 94 dB
- working in the cloakroom for 90 minutes where the noise level, determined using a simple listening test, suggests a level of approximately 80 dB
- in the staff room for 30 minutes where the noise level, determined using a simple listening test, suggests a level of approximately 80 dB

7. The calculation of the noise exposure is shown below:

Noise level	Duration	Notes	Exposure points
90 dB	2 hours	2 hour column and 90 dB row	80
94 dB	2 hours	2 hour column and 94 dB row	200
80 dB	2 hours	The exposure in the cloakroom and staff room are added to give a total of 2 hours	8
Total noise exposure points			288
$L_{EP,d}$			89 to 90 dB

8. This work pattern of noise exposure gives an daily exposure ( $L_{EP,d}$ ) of between 89 and 90 dB. Since the level is greater than the Upper Exposure Action Value [ $L_{EP,d}$  greater than 85 dB] (greater than 100 points) the Noise Regulations require:

- Plan and put into place technical and organisational noise control measures
- Protect workers with hearing protection
- Provide information, instruction and training about the risks, control measures, hearing protection and safe working practices
- Provide hearing health surveillance
- Maintain any noise control equipment and hearing protection.

9. The priority for noise control or risk reduction is the noise exposure whilst working behind the bar and whilst collecting glasses since these give the highest individual noise exposure points.

*EXAMPLE TWO: A Freelance Musician*

10. A freelance horn player practises for one hour in the morning, travels across town by public transport [45 minutes], teaches for three hours, travels across town again [30 minutes] grabs some lunch in a pub [30 minutes], and does a 3-hour rehearsal. After the rehearsal he eats and rests [2 hours] before the evening performance [2 hours], then travels home [45 minutes].

Noise level	Duration	Notes	Exposure points
87	1 hour	1 hour column and 87 dB row	20
79	0.75 hours	add ¼ and ½ hour columns and 79 dB row	0
88	3 hours	Add 2 and 1 hour columns and 88 dB row	74
78	0.5	½ hour column and 78 dB row	0
90	0.5	½ hour column and 90 dB row	20
89	3 hours	Add 2 and 1 hour columns and 89 dB row	97
65	2 hours	Insignificant	0
92	2 hours	2 hour column and 92 dB row	120
79	0.75 hours	add ¼ and ½ hour columns and 79 dB row	0
Total noise exposure points			331
$L_{EP,d}$			90 dB

### EXAMPLE THREE: WEEKLY AVERAGING using the HSE on-line calculator

11. Steve is a sound engineer who does an average of two shows a week. The remainder of his time is spent preparing and servicing equipment, paperwork and travel. Assessing his overall noise exposure on the basis of a single day's measurement would not be representative – it would either be too high on a show day, or too low on a warehouse day. The HSE website has both daily and weekly noise exposure calculators that allow input of sample measurements to give an average overall weekly exposure.

12. Let's begin with an average show day:

Activity	Duration	Average Noise Level ( $L_{A,eq}$ )
Travel to show	45 minutes	75 dB
Load-in and installation	2.5 hours	72 dB
System check	15 minutes	89 dB
Sound check	30 minutes	92 dB
Show	2.5 hours (inc. support act)	96 dB
Load-out and travel	1.5 hours	73 dB

13. Inputting these values into the Daily Exposure noise calculator gives an average personal exposure of 91 dB and an Exposure Point value of 436. [Note how insignificant the contribution is of the set-up and travel periods to overall exposure.]

INPUT SCREEN SHOT for Show Day Exposure calculation

14. For Steve, non-show days are usually of two types; office or warehouse. Office days present negligible noise exposure and the  $L_{ep,d}$  is below 70 dB.

15. Warehouse days are a bit more variable and may include running sound systems to check components, using of a compressor for spray painting and so on. If the same Daily Exposure process is adopted for a representative warehouse day, this gives the figures below.

Activity	Duration	Average Noise Level (LA,eq)
Stock check & equipment preparation	3.5 hours	68 dB
Loading/unloading vehicles	1.5 hours	78 dB
System operation check	15 minutes	92 dB
General admin and office	2.75 minutes	65 dB
Use of spray booth	30 mins	83 dB

16. Inputting these values into the Daily Exposure noise calculator gives an average personal exposure of 79 dB and an Exposure Point value of 24.

INPUT SCREEN SHOT for Warehouse Day exposure calculation

17. In order to establish a representative Weekly Exposure take these three exposure patterns and add them into the Weekly Exposure calculator. Steve does two shows and two warehouse days a week, and one office-only day.

18. Inputting these values into the Weekly Exposure noise calculator gives an average personal exposure of 87 dB.

INPUT SCREEN SHOT for Weekly exposure calculation

19. The results show that even with two relatively quiet warehouse days and one “very quiet” office only day, Steve’s exposure is above the Upper Exposure Action Value. The dose he receives on show days pushes him over the limit. Steps must be taken to limit exposure during the show and system and sound checks, anything else is just tinkering and will have negligible impact. Steve must wear hearing protection during the event (system check, sound check, and show.) The use of suitable hearing protection at the right time will protect Steve’s hearing and he could then even do more shows each week.

## 5A4 Measuring noise

1. This Appendix gives a brief overview of the techniques used to measure noise. It is aimed at providing supporting information rather than as a guide to competency. Fuller information can be found in L108.
2. Where a simple listening test suggests that noise levels may be too high, or if there is any doubt, a measurement of noise exposure may be carried out. Initial 'yardstick'<sup>1</sup> measurements may be made to establish whether a comprehensive noise dose assessment should be undertaken. These simple measurements could be made with an inexpensive averaging ( $LA_{eq}$ ) type 2 sound level meter. However, in some cases, inexpensive sound meters may not be sufficiently accurate to base decisions upon the control measures needed.
3. Noise measurements should be carried out by someone who is competent, that is someone who has the relevant skills, knowledge and experience to undertake measurements in the particular working environment.

### *Methods of measuring noise levels*

4. There are three monitoring methods by which noise levels be measured. These are influenced by the building arrangement, the intended use of the room, the type of events to be staged and the use to which the information gathered is to be put.
5. These methods can be referred to as fixed, static and personal.
6. They provide a progressively more accurate measurement of the appropriate noise level from which the personal noise exposure can be derived
7. Fixed monitoring entails a system built into a facility. This could involve microphones located in areas where employees are exposed to high sound levels linked through permanent wiring to a central monitoring position. Such a system might be useful in clubs and small venues where bands bring in their own equipment and would allow for noise monitoring, for example above the stage and in the bar area. Such measurement results will not provide dose values, these would need to be calculated based on the time spent in the various zones. It is also important to consider that noise monitoring at locations other than at the ear is likely to be less accurate. This monitoring method provides general information rather than accurate individual information.
8. Static monitoring involves the use of a hand held sound level meter (SLM) located in a specific position to measure the noise levels in the vicinity of an employee. For example, this could be an SLM on a tripod in an orchestra pit with the microphone located near to the musician's ear.
9. Such a measurement technique is capable of revealing very accurate noise measurements at the employee's ear (depending upon how close the microphone is.) This is

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<sup>1</sup> Yardstick ( $LA_{eq}$ ) measurements can be simply made by measuring representative sound levels in the vicinity of the worker during a period of noise exposure. If the measured sound level is below the numerical value specified for the lower exposure action values, then there is no requirement to perform any further assessment.

particularly suitable in orchestra sections. However, care should be taken to ensure that measurements taken in the middle of an orchestral section are not applied to everyone in that section – there could be differences between individuals that would need to be identified and quantified.

10. Personal monitoring (dosemeters) is the most satisfactory method of establishing personal noise dose values. The measurements are made using a piece of equipment known as a dosimeter. Such a device can either be a calculator-sized piece of equipment worn on a belt or in a pocket with a microphone attached via a cable, the microphone is usually mounted on clothing near to the ear; or a small cone shaped badge without cables or external controls, worn on the shoulder near the ear and operated by an infrared signal. The dosimeter measures the noise levels at the ear for any specified period of time – to give the measurements for the session, averaged out for the day or any peak levels. These are stored in a reader unit and can be transferred to a computer with appropriate software. Such devices may be purchased or be hired.

11. For the self-employed, wearing such devices allow the contributions from professional playing and teaching to be taken into account. They also provide the facility for education to wearers who can identify other non-performance areas of their lives where noise is contributing to their daily dose for example from busy roads.

12. To be effective dosimeters and sound level meters should be as close as possible to the player's ears. The environment surrounding the microphone affects measured sound levels.

13. Very often a combination of both noise dosimeters and fixed monitoring positions is desirable. The competent person employed to carry out the exposure assessment should be able to select the most appropriate measurement method. L108 provides more guidance on the measurement of exposure.

#### *Measurement of noise levels close to the ear*

14. When a person is receiving significant noise exposure from sources close to the ear such as communication headsets or in-ear monitors, special measurement techniques should be used. The methods used are very different from those where a measurement is made sufficiently far from the head of the exposed person to avoid the disturbed sound field. Measurements very close to the ear are complex and should only be carried out by those with the necessary expertise. See L108 for further information.

#### *What should be measured?*

15. The equivalent continuous A-weighted sound pressure level ( $LA_{eq}$ ) that represents the noise the person is exposed to during the working day has to be ascertained. The maximum C-weighted peak sound pressure level or levels to which the person is exposed has also to be ascertained. The  $LA_{eq}$  is combined with the duration of exposure during a working day to ascertain the daily personal noise exposure,  $L_{EP,d}$  using the formula defined in Schedule 1 Part 1 paragraph 1 to the Noise Regulations.

16. In practice it is common to break the working day into a number of discrete jobs or tasks, and to make sample measurements to determine a representative  $LA_{eq}$  for the job or task. The  $LA_{eq}$  for each job or task is then combined with its duration during the working day to ascertain the  $L_{EP,d}$ , using the formula defined in Schedule 1 Part 1 paragraph 2 to the Noise Regulations.

## Glossary

For a more detailed explanation of terms see Useful terms.

**Action values:** see EAV

**Competent person:** person who has such practical and theoretical knowledge and such experience as is necessary to carry out the work (see Useful terms).

**EAV:** exposure action values, levels of exposure to noise at which certain actions are required (see Useful terms).

**ELV:** exposure limit value (see Useful terms).

**Health surveillance:** assessment of the state of health of an employee as related to exposure to noise

**L108:** *Controlling noise at work – The Control of Noise at Work Regulations 2005*

**LEAV:** lower exposure action value (see Useful terms).

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**Noise exposure:** (the noise dose') takes account of both the actual volume of sound and the duration for which it continues. Noise exposure is not the same as a sound level which is the level of noise measured at a particular moment.

**Noise limiters:** sometimes known as volume regulatory device (VRD), controls noise exposure from amplified music.

**Noise measurements:** sound levels are measured in decibels (dB). A-weighting approximates to the frequency response of the human ear. C-weighting is used to measure peak, impact or explosive noise (see Useful terms).

**Reference position:** Standard location, usually static, selected to enable monitoring of noise levels to be conducted by measurements. (see Sound Advice Note 6 Noise control measures)

**Simple listening test:** where it is difficult to hold a normal conversation without shouting or where there is live amplified music it is probable that the noise is above the LEAV (see Useful terms).

**UEAV:** upper exposure action value (see Useful terms).

**VRD:** volume regulatory device, see noise limiter

## Bibliography

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### Other **Sound Advice** Working Group recommendations

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