

## Noise/Sound

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Repeated exposure or continued exposure to excessively high noise levels can result in irreversible damage. Noise is measured in the logarithmic decibel scale and can be measured by devices ranging from those that can be easily measured by those in the workplace to sophisticated equipment requiring specialist skills.

The following general guidelines to control damaging and nuisance noise apply to all performing arts workplaces:

- To preserve hearing, exposure for each noise should be kept below 80 decibels on average per day.
- Peak sound pressure levels should not exceed 140 decibels.
- Nuisance noise such as high pitch, unexpected or distracting noises shall be minimised.

To do this, the following strategies may be employed:

- 1) Identify or isolate sources of noise and measure these to determine the amount of noise being generated.
- 2) In workshops, use quiet machines and make sure they are well maintained.
- 3) Enclose or isolate noisy equipment where possible.
- 4) Separate noisy and quiet work.
- 5) Use sound absorbing materials in the workplace (e.g. ceilings and screening e.g. baffling) where possible.
- 6) Use of personal hearing protectors (when all other methods have failed).

When choosing hearing protectors, the pitch (frequency) of the noise must be taken into account. Different types of protective equipment have maximum damping effects in certain frequency ranges. Data on the characteristics of hearing protectors can be obtained from the suppliers. In order to encourage the use of hearing protectors, personal preferences in comfort must be taken into account. Different types of ear protectors should therefore be made available.

It is important that those operating high-risk noise devices such as firearms and weapons are made aware of the potential to create instantaneous deafness with inappropriate handling and use.

They aim to protect workers from the risk of hearing damage due to excessive noise. How do these regulations affect theatre personnel?

*See also Noise/sound appendix*

### Noise/Sound in Theatres

- 1) Hearing damage is cumulative and the effects of hearing damage are often not noticed until many years later when loss of hearing due to aging exposes the damage. Hearing damage is also irreversible. However, hearing does fluctuate due to colds and other illnesses, and loud sounds may produce a temporary threshold shift with no permanent after effects (e.g. after a rock concert). Apart from extremely loud sounds, which can cause immediate injury, the acceptable level of noise exposure depends on the level of the noise and the time of exposure. Sound level and exposure level are usually measured exponentially in decibels (dB). A 10dB increase in level increases the exposure level by 10dB and each doubling of the time exposure

increases the exposure level by 3dB. For example, exposure to 90dB(A) for 8hours is equivalent to exposure to 99dB(A) for 1 hour.

- 2) The trigger point for action is "when any employee is likely to be exposed to the first (or peak) action level or above"
  - a) UK code of practice guides suggest that as a rough guide, if two people have to shout or have difficulty communicating when standing 2m apart, a noise assessment should be made. This assumes that the sound level is constant for a normal working day. In the theatre the sound levels are very rarely constant for a working day and it is difficult to make a simple rough guide.
  - b) Areas for concern are sound technicians working long hours preparing sound effects or amplified music, musicians in pits and pyrotechnics.
- 3) Once a noise assessment has been made it should be reviewed when the work assessed changes. This means that the assessment may need to be repeated for each new production, and even during production periods. There is no provision to 'drop out' from assessment once an assessment has been made although there is not a requirement to actually measure for each assessment.
- 4) Measurements can be made using 'clip-on' noise dose meters or integrating sound level meters. Because of the varied nature of the sound levels, movement of staff and working hours, an assessment will require more than simply making measurements. For varied activities, a noise 'dose' can be established for each activity and these levels combined.
  - a) Making an assessment will probably involve a specialist who can interpret results and advise on any necessary actions.
  - b) This need not exclude a sound technician from actually making measurements, both for the assessment and to ensure compliance.
- 5) When a production tours, noise measurements made in one theatre may not be the same as in another. This will depend on the size of the auditorium, the amount of backstage space, the reverberation times of stage and auditorium, and the size of the pit if in use.
- 6) If an assessment is made, theatres may benefit from applying for exemption from daily levels to weekly levels in borderline cases. For example, if a single performance has an LEP,d of 87dB(A) on matinee days the LEP,d will be 90dB(A), the second action level. Over a week of 8 performances the LEP,w will be 89dB(A).
- 7) Measurement methods for peak action levels are not clearly defined although a rough check can be made using a fast reading sound level meter (not integrating, as required for LEP,d measurements). If a reading over 125dB(A) is made further measurement is necessary. Peak action levels may be exceeded when pyrotechnics are used or in drum booths.
- 8) Where action levels are exceeded, most theatres will wish to reduce noise exposure without compromising the noise levels set during the design process.
  - a) The best method of doing this is by managing the noise. This can be done by:
    - i) Placing loudspeakers so that employees are not exposed to louder levels than the audience.
    - ii) Ensuring that as few staff as possible are on stage when the production is noisy.
    - iii) Rotating staff duties so that they are not exposed to loud noises each performance.
    - iv) Ensuring that staff involved in noisy work has quiet breaks.

- 9) Zoning and hearing protection may be required where pyrotechnics or very loud sound effects are required. Legally and practically, they are a last resort. They also trigger a requirement for training and information. Where pyrotechnics must be operated with line of sight, there may be no alternative. If hearing protectors are used, octave band analysis of the noise hazard will need to be made.
- 10) The production period is not well covered by the provisions, as the work is not repetitive. It is common practice to keep production periods as quiet as possible and this should be encouraged.
  - a) Where possible noisy work should be scheduled to minimise general exposure and all unnecessary staff encouraged to leave the noisy area.
- 11) Musicians, including freelancers are definitely employees and covered by the regulations. Employers' duties include freelance staff and people employed elsewhere, so consideration should be made, for example, of musicians employed by a theatre in the evening but teaching or playing all day as well. If musicians set their own monitoring level, care should be taken that this will not exceed action levels. Research has found a difference in hearing between violinists' left and right ears, so it should not be assumed that it is only brass, percussion and electric instruments that can cause high exposure levels.
- 12) There is no agreed method for measuring noise dose from headphones although broadcasters are beginning to limit headphones to 'safe working levels'. Headphones are available with built-in limiters (e.g. Canford Audio).
- 13) Employers also have a duty where employees visit other sites and this includes riggers, touring and maintenance crews who visit different sites, even in the same day. Apart from equipping all staff with personal dose meters, it is difficult to see how such a varied work load can be monitored.
- 14) Sound engineers should be particularly careful when preparing sound effects. Listening at high level should be kept to an absolute minimum.
  - a) Spreading the work, so that work is not all done on the same day, can help to reduce exposure. A loud sound effect at a level of 110dB (a baby crying can make that noise!) can be listened to for only five minutes before exceeding the second action level.
- 15) HSE in the UK have published a 'Pop Concert Guide' which states that although the audience is not covered by their regulations, suggests a maximum of 106dB for the audience.
  - a) Note: this does not exempt members of the audience who are 'at work' e.g. ushers, artists, production staff, sound engineers or (?) critics.
- 16) Engineer controls. In an orchestra, a major source of high intensity sound is created by the brass and percussion sections. Therefore, effort should go into deflecting and decreasing the noise from these instruments. Methods include erecting plexiglass shields in front of these sections to provide a partial barrier or building risers for the rear section of the orchestra. Sound baffles on individual musicians' chairs may also deflect high intensity sound.

## **Summary**

Sound technicians should be aware of the risk of hearing damage and of the regulations. They may be asked to take, or assist in the taking of, measurements for a noise assessment. Where possible, timetable and equipment planning should avoid prolonged exposure to loud sound levels. Where the second action level is exceeded, hearing protectors must be worn. Assessments must be made by 'competent persons' and need to be reviewed when productions change.

Sound technicians should seek information from suppliers of equipment likely to cause sounds over the first or peak action level. One practical way to manage sound exposure levels in the theatre may be to create a database of noise exposure for different tasks and productions.

Finally it should be remembered that many theatres' workload varies considerably, some on an annual pattern, but the regulations are based on daily exposures although a weekly exposure may be used with written permission.

OSH has prepared the following table for exposure for unprotected ears:

**Duration of exposure per day**

8	4	2	1	30	15	8	4	2	1	30
Hours	Hours	Hours	Hour	Min	Min	Min	Min	Min	Min	Sec
85	88	91	94	97	100	103	106	109	112	115
db (a)	db (a)	db (a)	db (a)	db (a)	db (a)	db (a)	db (a)	db (a)	db (a)	db (a)

Initial sound checks and audio tuning should be scheduled when other cast and crew members are not present