CONTROL OF NOISE

1 Summary

Noise can be defined as unwanted sound. The "unwanted" aspect of noise may be because of many reasons, such as damage to hearing or annoyance. Excessive exposure to noise at work can cause deterioration in the sensitivity of the ear and hearing can become irretrievably damaged, resulting in noise induced hearing loss (NIHL). The risk of developing NIHL depends on both the sound level and the length of exposure to the sound.

The Health and Safety at Work, etc Act 1974 (HSW Act) contains general duties on employers to ensure, as far as is reasonably practicable, the health, safety and welfare of employees. This is a wide duty which extends to the duty to control noise. Noise is dealt with specifically by the Noise at Work Regulations 2005 (NAWR). There is not an Approved Code of Practice (ACOP) accompanying the NAWR, however Health and Safety Executive (HSE) guidance, in the form of Noise Guides, go into detail about how to comply with the Regulations.

NAWR gives clear guidance about how priorities should be decided and emphasise that many approaches may be valid. The Regulations set out the ways in which employers are required to control the exposure of their employees to noise in the workplace. Employers should assess the noise levels to which their employees are exposed, where they believe that exposure reaches or exceeds the action levels defined in the Regulations.

It must be ensured that a competent person makes an adequate noise assessment which identifies employees at risk and provides information on the steps to be taken which may be appropriate to reduce noise levels. Records should be kept of the assessment and reviewed periodically. Noise levels should be reduced to the lowest level reasonably practicable in an order of priority set out in NAWR. Any equipment supplied to reduce noise exposure should be adequately maintained and regularly tested.

Employers must also provide the necessary information, instruction and training to employees so that they are aware of the risk of damage to hearing from noise, methods of working to minimise this risk, how to obtain personal ear protectors and their duties under NAWR.

2 Noise at Work

2.1 Properties of noise
The two most important qualities of noise are frequency and intensity. These qualities are important because the degree of hearing loss an employee may suffer depends on several factors including:
- overall intensity of noise
- duration of exposure
- frequency characteristics
- individual susceptibility.
Frequency determines the number of vibrations over a period of time, usually seconds, made by sound in the air and is measured in Hertz (Hz). Intensity determines the strength with which sound vibrates the ear drum and is measured in decibels (dB).

Note: Most sound level meters are adjusted to adapt to the fact that the majority of hearing damage is caused by exposure to high frequencies. This adjustment is known as “A-weighting” and is characterised as dB(A).

2.2 Noise exposures at work

Many jobs involve exposure to noise. Any activity where it is suspected that noise levels reach the action levels set out in NAWR will require a proper assessment. The range of noise levels that may be encountered at work is vast from a 20 dB whisper in a hospital ward at night to a 120 dB hydraulic press one metre away. Intensive noises of a very short duration, such as loud explosive noises, for example from guns, cartridge operated fixing tools or drop forges, can cause damage even though total exposure time may be very limited.

Many jobs involve machinery that create noise. As a rough guide, if there is a need to shout to be clearly heard by someone two metres away, or if a ringing sound in the ears is experienced after leaving the workplace exposure levels may be too high.

2.1.1 Noise intensity is expressed on a logarithmic scale and measured in decibels (dB). The decibel scale runs from 0 - 160 dB. Example noise intensities are as follows:

- 10 dB  Rustle of a leaf
- 30 dB  Whisper
- 60 dB  Normal conversation
- 90 dB  Heavy goods vehicle
- 100 dB Factory floor
- 110 dB  Grinding machine
- 120 dB  Propeller aircraft
- 130 dB Riveting hammer
- 140 dB Jet engine

2.1.2 Noise level meters incorporate three weighting filter networks (A, B and C). The most common weighting is A which tends to filter out the lowest frequencies of sound (inaudible to the human ear) and attaches greater importance to values obtained in the sensitive frequencies. Measurements taken using the A filter are expressed in dB(A).

2.1.3 Noise intensity measurement is of most use when taken over a period of time to allow for fluctuations in level. Daily average noise level is expressed as (LEP, d).
2.3 Assessment of Noise Exposure

Action levels and daily personal noise exposure
There are three action levels. The first action level establishes a daily personal noise exposure of 80 dB(A) and the second action level establishes a daily personal noise exposure of 85 dB(A).

"Daily personal noise exposure" (designated LEP,d), is the total exposure over the whole working day, taking into account the varying noise levels in the working environment and how long a person is exposed to them. In calculating the level of LEP,d, no account is taken of any ear protectors being worn. The third defined level is a peak action level of 135 dB(A)(lower level), 137dB(A) (upper level) and is likely to be linked with the use of cartridge operated tools, shooting guns and similar loud explosive noises. This action level is most likely to be important where workers are subject to a small number of loud impulses during an otherwise quiet day.

Irrespective of action levels, the risk of damage to hearing from exposure to noise must be reduced to the lowest level reasonably practicable.

2.4 Assessing exposure
Adequate arrangements for the assessment of exposure where this is likely to be at or above either the first or peak action levels must be gauged. The assessments should be made by a competent person who could probably advise on any action needed to comply with other requirements or on the need for further specialist advice.

Exposure is defined to mean only exposure at work and therefore no account needs to be made of an individual's possible leisure exposure.

2.5 Recording exposure
Noise assessments must be reviewed when there has either been a significant change in the work to which the assessment relates or wherever there is reason to suspect that the assessment is no longer valid. Employers must ensure that an adequate record of the assessment and/or any review is kept.

2.6 Noise surveys

Carrying out a noise survey
The best way in establishing an accurate assessment of exposure and therefore to ensure that suitable controls are set up (ultimately preventing the risk of any noise induced hearing loss (NIHL)) is to carry out a noise survey.

Although the first and second action levels are expressed in terms of an eight hour exposure, it is not usually necessary to carry out measurements of an individual’s exposure for a full eight hours in order to make an adequate assessment. In the simplest cases, where exposure is to a continuous steady noise for an eight hour shift then two or three measurements of Leq, each over a period of two or three minutes, will normally be sufficient. In actual practice these sorts of conditions are usually only found in the textbooks. Most operators will have a variable exposure over a period of a day.

Actually carrying out the survey and making an assessment of exposure requires a mixture of measurements, observation and information. The initial stage of the survey
usually involves going round the complete area with a sound level meter set to read the sound pressure level directly, and identifying the areas in which it is unlikely that the exposure will approach the first action level and areas that will require more detailed surveying and assessment.

In certain cases it may be advantageous to actually carry out measurements of exposure over a complete shift using personal dosimeters (ie sound measuring equipment attached to an operator). It must be remembered, however, that an individual whose exposure is variable during the course of one shift is likely to have an exposure that is extremely variable from shift to shift as well. In other words, measurement of exposure during one shift is not going to help in predicting future exposure, and is therefore pointless. In such cases, the main use of the information from a personal noise dosimeter is to identify the times and operations which contribute to the exposure and the measures which will be effective in controlling exposure.

2.7 Control of Noise in the Workplace

Reducing the risk of hearing damage and reducing noise exposure
The Regulations do not prescribe precise methods of noise control but recognise that many approaches will be valid depending on the circumstances. Some methods that could be used in your workplace are discussed below.

2.7.1 Control of noise at source

Vibration isolation
Noise is generated by vibration of a surface or a fluid flow. Any modification of this vibration will modify the noise generated. The first stage is therefore to identify the vibrations which are causing the most significant contribution to the noise.

For instance, the stiffness of a vibrating surface can be modified if the structure is altered by bolting or welding ribs on the surface. The size of the surface can also be reduced or the surface can be isolated from the remaining structure.

2.7.2 Damping
Damping treatments include coating the surface of sheet metal or bonding two sheets with the use of rubber-like or plastic materials. Also, structures which are bolted together rather than welded are usually more rigid and quieter.

2.7.3 Silencers
Where the noise is caused by turbulent air or liquid flow in ductwork or at air exhausts or jets, these can be modified by reducing the velocity, fitting silencers, limiting pressures and flows to the minimum required. Doubling the air flow rate within a duct can increase the noise levels by up to 15 dB(A).

Aerodynamic noise can be generated by fans and air jets. The basic control technique here is to reduce the speed of the fan or the air jet causing the air turbulence which is the source of the noise. However, with simple fan noise it is often most economic to install a silencer.

2.7.4 Maintenance
Fans, even in small equipment such as office printers, may become dirty and so get out of balance and vibrate. Adequate lubrication is important because, apart from reducing wear, the wetting of surfaces in contact can reduce noise generation.
Mechanical handling equipment such as component sorting, counting, transport and packaging often involves repeated impact. The use of plastics or rubber, which do not vibrate as readily as metal, can reduce noise.

2.7.5 New machinery
When selecting new machinery it is important to select that which is least noisy. Ideally, this will have been a primary consideration at the planning and design stage. The purchaser should liaise with the supplier before installing any equipment and between them agree on appropriate noise specifications.

2.7.7 Controlling noise at source: checklist of techniques
1. Adequate and regular maintenance of machinery.
2. Substitute a quieter machine or process.
3. Isolate/coat vibrating parts.
4. Apply coatings to vibrating panels.
5. Use mufflers or silencers on noisy air jets.

2.7.8 Noise control in the open
Enclosing the noise source is clearly the most effective means of noise control in the open. Screens or barriers can be used but their value is limited because noise does not travel in precisely straight lines, but tends to curve round obstacles. The effectiveness of a screen depends on its height and length in relation to its distance from the source and its distance from the receiver. In general, a screen will be effective only if:
   • it is higher than the source and higher than the receiver
   • the source is close to the screen or the receiver is close to the screen (or both for maximum benefit)
   • its length is greater than its distance from the source or the receiver (or both for maximum benefit).

The screen must be solid and continuous with no gaps or openings. A reflecting surface such as a high wall behind either the source or the receiver will reduce the effectiveness of the screen between them.

2.7.9 Control of the noise path
The next method of noise reduction to consider is to modify the route which the noise must take to get from the source to the operator. One of the problems with this approach is that, unless the work is being carried out in the open, there will be a number of routes by which the noise reaches the operator. If the operator is within two metres of the sound source then most of the noise is likely to be received directly. As the distance between the operator and the noise source increases, so does the importance of the indirect routes, eg noise reflected off the ceiling or from the wall behind the machine or any other hard surfaces.

This means that any point in the room will be subjected to direct noise from the machine and indirect noise released off the other surfaces. This reflection of noise is known as “reverberation”.

If the room has hard, flat surfaces and no openings, the reverberant level will be nearly constant over the whole room. Close to the machine most of the energy travels by the direct path from the machine so the presence of the room's walls and ceiling makes little difference. Further away, the reflected paths are more important and the total noise level approximates to a constant reverberant level. Inside a reverberant room a screen is likely to be of little value because noise energy, in
effect, just bounces back and forth until it gets round the screen. The only noise path interrupted is the direct path which carries only part of the total noise energy reaching the receiver. If a machine is completely enclosed in a brick building or steel box the noise level is increased inside the enclosure as a consequence of reverberation. This effectively reduces the noise insulating value of the enclosure.

2.7.10 Total or partial enclosure of noise source
The most obvious way of modifying the route from the noise source to the operator, and normally the most cost-effective approach, is to enclose, or partly enclose, the machine with a suitable sound absorbing material. This has the effect of reducing the direct noise which is normally the most important component. The more complete the enclosure, the more effective will be the noise attenuation.

2.7.11 Simple noise barriers
The background noise component of exposure can be modified by using absorbent materials on the ceiling and walls of the building and therefore reduce the amount of the noise which is radiated back from these surfaces. The effectiveness of this type of acoustic treatment will depend on a number of factors such as the reflectiveness of the existing surfaces, the importance of the background noise level in the overall noise, the frequencies of the noise produced and the size, shape and layout of the room.

This acoustic or absorptive treatment is only useful where reverberant noise is a problem as it does not control direct noise. It is generally useful in two types of situation.

1. In large work areas containing local noise sources. The noise level remote from the machines can be reduced considerably and local screens can also be used beneficially. This can apply in a workshop, a large office with office machinery at one end or a computer room where one part is required as a quiet work area.
2. In a large work area with many noisy machines distributed through it, the total reverberant noise level may then be higher than the direct noise level at the operative’s position beside each machine, so absorbent treatment is helpful.

2.7.12 Distance
If machines cannot be silenced then moving or re-siting the machinery so that it is further away from workers will help to reduce exposure levels. Arrangements can be made for pipework to be re-routed or for exhausts to be discharged well away from workstations.

Groups of noisy machines can be sited together or noisy processes segregated so that less people will be exposed to them, and the area can be designated as an ear protection zone. By segregating the sources of noise, using protective equipment and setting up a job rotation scheme, exposure times can be significantly reduced. Introducing the use of remote controls can also have a beneficial effect.

2.7.13 Basic noise control techniques: summary checklist
Presented with a noisy machine, the following steps could be followed.

1. Go round the machine, making observations as to where the noise is generated and how the energy is radiated into the air.
2. Take measurements of sound pressure levels round the machine, close to surfaces and further away.
3. Is it possible to modify the noisy machine in some way? If this is impracticable then it is generally necessary to employ one of the basic techniques of isolation, insulation or absorption.
3 Prevention of Noise Exposure

3.1 Ear protection

The Noise at Work Regulations 2005 (NAWR) make it clear that the use of hearing protection should be considered as a method of last resort or solely as an interim measure in protecting operators from noise.

When it is likely that exposure will be to the first action level or above in circumstances where the daily personal noise exposure is likely to be less than 85 dB(A), suitable and efficient personal ear protectors are available to those who request them. For exposures at or above the second or peak action levels, suitable ear protectors must be provided which when properly worn can be reasonably expected to reduce risk of hearing damage to below that caused by an unprotected exposure at these levels.

There are various forms of hearing protection equipment available including ear plugs, ear muffs and helmets. Each form of protection has its own specific characteristics. However, all types should:

• be comfortable and safe to use
• be aesthetically acceptable
• not provoke a toxic reaction in the wearer
• not impair speech communication.

Ear protectors provided must comply with any relevant UK legislation and be compatible with other protective equipment worn simultaneously.

3.1.1 Ear plugs

Ear plugs are made of soft pliable material and fit in the ear canal. They may be separate or connected by a cord or neck band which can prevent loss. They can be permanent, disposable or reusable. Disposable ear plugs are probably the most commonly used and are generally made from plastic foam or glass wool covered in plastic. Their main advantage is that they will fit most people. Permanent ear plugs are made from rubber or plastic and come in a range of sizes so that they fit the individual ear more tightly. It is possible to obtain custom-made plugs.

Where reusable ear plugs are employed, the employer should have a system which ensures their regular cleaning and replacement. This may be important in hygiene sensitive areas, such as food preparation. Ear plugs are not suitable for all persons. If the user has experienced outer ear infection or irritation, care should be taken in their use and any medical opinion on suitability should be noted.

3.1.2 Ear muffs

Ear muffs usually consist of hard plastic cups that sit over the ears. A soft seal containing plastic foam or a viscous liquid limits noise leakage through to the ears and the inner surfaces. These are normally covered in noise absorbing materials, again often a soft plastic foam. Cotton covers can be used over the cup seals in particularly hot environments as an aid to comfort.

Various kinds of headband are used to hold the cups in place, the selection of which may depend on the situation the ear muffs will be used in. A simple sprung plastic or
Where head protection is necessary, it may be beneficial to use ear muffs directly attached to the helmet and many manufacturers produce this type. If spectacles of any type are worn at the same time they may interfere with the cup seals.

While it would be simplest in most organisations to provide a single type of hearing protection for all staff in all areas in which they are needed, it can be seen that such a solution is not always possible. Most organisations tend to offer a selection of suitable equipment for use in each area and leave it to the individual to choose which to use on the basis of comfort, etc. Even so it is seldom necessary for a company to provide more than two specific types of ear plugs and two types of ear muff.

### 3.2 Issue of PPE

Disposable and reusable ear plugs need no special procedure for their issue. They do have to be readily available, and instruction and training issues are as important as with the other forms of protection. They are especially useful for visitors or those infrequently exposed to noise. Any of the "permanent" type of plug should be fitted to individuals by someone trained in this process.

Ear muffs do not need specialist fitting but a check on complete coverage of the ears and completeness of the seal should be made.

#### 3.2.1 Maintenance

Hearing protectors must be in good condition to provide the designed noise reduction. Points that should be checked include:

- the condition of ear muff seals: they can become torn, detached and liquid seals can become hard or leak
- tension of headbands whether there has been unauthorised modifications, such as holes drilled in ear muff cups, noise-absorbing material removed or personal stereo speakers fitted
- general condition, resilience and softness of ear plugs and cleanliness.

These simple checks can be carried out by the users after suitable instruction and the use of a set of new protectors for comparison is good practice. Spare replaceable parts should be kept in stock and repair or replacement carried out immediately defects are discovered. Cleaning should be carried out regularly and scrupulous attention must be paid to this with reusable and permanent plugs. It is important to have clean hands when inserting plugs to prevent contamination of the outer ear canal during insertion. If ear muffs are to be re-issued to another person they must first be carefully cleaned and sanitised.

Proper facilities for storage must be provided to keep ear protectors secure. For plugs this could be a small plastic container in which they are often supplied; for ear muffs a locker or small individual container in a convenient location may need to be provided. Cleanliness of the storage facilities, eg the small plastic supply bags for ear plugs is also important in stopping infection.

#### 3.2.3 Training

The training in use of protectors will depend on the types in use but should include:
• the correct method of ear plug insertion
• importance of correctly fitting ear muffs, making sure the seals fit all around and that no protection is lost through wearing spectacles or other intrusions
• the importance of cleanliness and methods of cleaning
• the importance of use at all times of exposure to the noise environment.

Records of training and subsequent issue of protectors should, as with all PPE, be kept.

4 Ear protection zones
Any part of the premises where employees are likely to be exposed to the second action level or above, or to the peak action level or above as must be designated as an ear protection zone. Signage should include text indicating that this is an ear protection zone and that personal ear protectors must be worn whilst in the zone.

5 Provision of Information
Every employer must provide employees who are likely to be exposed to the first or peak action levels or above with adequate information, instruction and training on:
• the risk of hearing damage that exposure may cause
• possible actions to reduce that risk
• steps to be taken by employees in order to obtain personal ear protection
• employees’ obligations.