

NOISE, VIBRATION AND OTHER PHYSICAL AGENTS

34.1 General Advice

34.1.1 A physical agent is an environmental factor such as noise, vibration, optical radiation and electromagnetic fields that may damage the health of those exposed to them.

34.1.2 The employer's risk assessment will identify where personnel are working in the presence of physical agents hazardous to health or safety, and evaluate any risks from exposure (see Chapter 1). Appropriate measures should be taken to remove, control or minimise the risk (see section 34.2).

34.1.3 Employers should instruct and inform personnel so that they know and understand the risks arising from their work, the precautions to be taken and the results of any monitoring of exposure.

34.1.4 The risk assessment will also provide information to determine whether health surveillance is appropriate (see Chapter 2).

34.1.5 Where exposure to a physical agent arises from the use of a particular piece of equipment, reference should be made to any instructions and operating data supplied by the manufacturer of that equipment. Reference may also be made where appropriate to any publications on the subject issued by the Health and Safety Executive.

34.2 Prevention or control of exposure to a physical agent

34.2.1 The first consideration should always be to prevent risk by removing exposure to the physical agent concerned.

34.2.2 Where this is not reasonably practicable, prevention or control of exposure may be achieved by any combination of the following means:

- (a) total or partial enclosure of equipment concerned;
- (b) use of plant, processes and systems of work which minimise exposure to the physical agent;
- (c) keeping the number of persons who might be exposed to a physical agent to a minimum, and reducing the period of exposure;
- (d) the designation of areas which may be subject to hazardous levels of exposure to a physical agent and the use of suitable and sufficient warning signs;
- (e) use of appropriate procedures for the measurement of hazardous levels of exposure to a physical agent, in particular for the early detection of abnormal exposures resulting from an unforeseeable event or an accident;
- (f) the taking of individual/collective protection measures; and
- (g) where appropriate, having plans in place to deal with emergency situations which could result in abnormally high exposure to physical agents.

34.2.3 These measures should be applied to reduce the risk to personnel to the minimum, but where they do not adequately control the risk to health, appropriate personal protective equipment should be provided in addition.

34.2.4 Employers should take reasonable steps to ensure that any control measures are properly used and maintained. Where appropriate, exposure levels should be monitored and recorded.

34.2.5 Personnel should comply fully with the control measures in force.

34.2.6 For certain physical agents specific control measures apply; eg noise and vibration. In cases where failure of the control measures could

result in risk to health and safety, or where their adequacy or efficiency is in doubt, the exposure of personnel should be monitored and a record kept for future reference.

34.3 Consultation

34.3.1 Ship safety representatives and workers should be consulted about proposals to manage risks from exposure to physical agents and other health problems arising from such exposure. Consultation should cover the results of the risk assessment, proposals for control, for providing information and training for employees and for any health monitoring system.

34.4 Worker information and training

34.4.1 Employers should provide workers with sufficient information and training to ensure that they are aware of potential risks to their health from exposure to physical agents. Such information and training must in a language understood by the worker and include:-

- the nature of such risks;
- details of the measures taken in order to eliminate or reduce to a minimum the risks from the physical agent;
- any exposure limit values and the exposure action values;
- the results of the risk assessment carried out;
- the correct use of personal protective equipment where required;
- the circumstances in which workers are entitled to health surveillance;
- safe working practices to minimise exposure to mechanical vibration;
- how to detect and report signs of injury;
- and the importance of detecting and reporting signs of injury.

34.4.2 Ship safety representatives and workers should be consulted about proposals to manage potential risks from exposure to physical agents. Consultation should cover results of risk assessments, proposals for control, and procedures for providing information.

NOISE

34.5 Introduction

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Note

34.5.1 When exposed to harmful noise - sounds that are too loud or loud sounds that last a long time - sensitive structures in the inner ear can be damaged, causing hearing loss. This section gives advice on the assessment of noise in the workplace, and steps to prevent any associated problems it may cause.

34.6 Assessing exposure to noise

34.6.1 As a simple guide there may be a problem if:

- workers have to shout to be clearly heard by someone only 2 metres away;
- workers' ears are still ringing after leaving the workplace;
- workers are using equipment which causes loud explosive noises such as cartridge-operated tools or guns;
- workers are exposed to high level impact noise from hammering on metal benches; chipping machines or metal endplates on the decks of Ro-Ro vessel ramps;
- there is machinery such as a diesel engines, generators etc running in a confined space such as a ship's engine room;
- workers, not engaged in the provision of entertainment (e.g. waiters), have to enter or remain in noisy areas such as discos, nightclubs etc on cruise ships whilst carrying out their duties.

34.6.2 Annex 34.3 provides guidance on daily exposure to different sound levels and the recommended maximum limits for different areas on board ship

34.6.3 The following table describes the lower and upper noise exposure values, noise exposure limits and where appropriate, action required to be taken to reduce that exposure. A detailed formula for calculating Daily Exposure Levels can be found in Annex 34.2

	Daily/Weekly Exposure	Peak Exposure dB(C)	Action to be taken
Lower Exposures Action Values	80	135	Workers must be provided with personal hearing protection, complying with the requirements of the Merchant Shipping and fishing Vessels personal Protective Equipment) Regulations 1999.
Upper Exposure Action Values	85	137	Workers are required to use personal hearing protection complying with the requirements of the Merchant Shipping and Fishing Vessels (Personal Protective Equipment) Regulations 1999 Workers are entitled to have their hearing examined by a doctor, or a suitably qualified person under the supervision of a doctor. Employers must establish and implement a programme of measures to reduce the exposure to noise
Exposure Limit Values	87	140	This limit must not be exceeded.

34.6.4 Annex 34.3 provides guidance on daily exposure to different sound levels and the recommended maximum limits for different areas on board ship

34.6.5 For further information on Personal Hearing Protection, see annex 34.4

34.6.6 Workers may not be charged for either personal hearing protectors or for hearing examinations.

34.6.7 When determining noise exposure action levels, no account is to be taken of the effects of using hearing protection. Account may however be taken of hearing protection in the case of exposure limit values.

34.6.8 Although being aware of decibel levels is an important factor in protecting one's hearing, distance from the source of the sound and duration of exposure to the sound are equally important. A good rule of thumb is to avoid noises that are "too loud" and "too close" or that last "too long."

34.7 Risk Assessment – Noise

34.7.1 If there is considered to be a problem arising from exposure to noise a risk assessment should be undertaken by a competent person.

34.7.2 If any worker is likely to be exposed to noise exceeding the lower exposure action values set out in paragraph 34.6.3, employers must arrange for a competent person to assess the actual level of noise exposure.

34.7.3 The employer should

- keep a record of the noise assessment;
- regularly review the noise assessment whenever there is a change in the work being undertaken or when new equipment is introduced which may alter noise levels;
- use the assessment to develop an action plan for introducing noise control measures.

34.7.4 It is good practice to review the assessment every two years, as noise levels can change over time as, for example, machinery wears out or working practices change

34.8 Health Surveillance – Noise

34.8.1 If there is considered to be a problem as a result of exposure to noise, the employer is required to provide health surveillance of the workers at risk in accordance with Chapter 2.

34.8.2 Health surveillance can include

- regular hearing checks to measure the sensitivity of hearing over a range of sound frequencies;
- informing employees about the results of their hearing checks
- keeping records;
- encouraging workers to seek further advice from a doctor where hearing damage is suspected.

34.8.3 As cases differ from situation to situation, the person/organisation responsible for the carrying out of health surveillance must decide on the most appropriate form of health surveillance in each case.

34.8.4 It is good practice for employers to arrange regular hearing checks on all workers whose daily personal noise exposure exceeds the second action level, and to encourage them to attend their appointments

34.9 Noise arising from Music and Entertainment

34.9.1 A Code of Conduct has been drawn up by the Health and Safety Executive (HSE) and industry representatives from the music and entertainment sector. The Code enables those sectors to meet the requirements of HSE's Noise Regulations. The provisions of the HSE Code are equally relevant to the provision of music and entertainment on ships, including vessels on inland waterways, although the applicable legislation for ships will be the Merchant Shipping and Fishing Vessels (Control of Noise at Work) Regulations 2007 and not HSE's regulations. The Code of Conduct can be found on HSE's website at www.soundadvice.info or a copy can be purchased from HSE quoting ISBN 9780717663071

Vibration

34.10 Types of vibration and their effects

34.10.1 Hand-arm vibration is comes from the use of hand held power tools or other vibrating equipment. Regular and frequent exposure to hand-arm vibration can lead to permanent health effects. Occasional exposure is unlikely to cause ill health.

34.10.2 Whole-body vibration occurs through the shaking or jolting of the body through a supporting surface, for example when controlling or riding on a vessel at high speed in choppy seas or standing next to a ship's main engines or generators.. Whole body vibration can also be made worse by poor design of working environment, incorrect worker posture, and

exposure to shocks and jolts. A primary symptom of whole body vibration is back pain.

34.11 Exposure limits set by the Vibration Regulations

34.11.1 The following table describes the Daily Exposure Action Value and Limits for Hand Arm, and Full Body vibration.

	Hand Arm Vibration (Standardised to eight hour reference period)	Whole Body Vibration	
Daily Exposure Action Value	2.5 m/s ² A(8)	0.5 m/s ² A(8)]	Above this limit, employers are required to reduce exposure of vibration to workers
Daily Exposure Limit Value	5 m/s ² A(8)	1.15 m/s ² A(8)	Maximum amount of vibration an employee may be exposed to on any single day

34.12 Determining vibration levels

34.12.1 Employers are required to control the risks from hand-arm and whole-body vibration. In most cases it is simpler to make a broad assessment of the risk rather than try to assess exposure in detail.

34.12.2 During the assessment, attention should be paid to

- which, if any, processes/operations involve regular exposure to vibration including that emanating from the vessel itself;
- whether there are any warnings of vibration risks in equipment handbooks;
- any symptoms which might be caused by hand-arm or whole-body vibration and whether the equipment being used, or the vessel itself, produces high levels of vibration or uncomfortable strains on hands and arms or is causing back pain.

34.12.3 If, there is considered to be a problem caused by vibration, a risk assessment should be undertaken by a competent person who has read and understood the Vibration Regulations and MGN 353 and who has a good knowledge of the work processes used on the vessel.

34.12.4 As an alternative an employer may choose either to use available vibration data or to have measurements made to estimate exposures if they want to be more certain of whether the risk is high, medium or low.

34.12.5 Employers may be able to get suitable vibration data from the equipment handbook, or from the equipment supplier. Should such data be reasonably representative of the way equipment is used on the vessel, it should be suitable for use in estimating workers' exposure.

34.12.6 It is also necessary to note how long a workers are exposed to vibration. Once the relevant vibration data and exposure times have been collected it will be necessary to calculate each employee's daily exposure. This could be by means of an exposure calculator such as the one on HSE's vibration web pages at www.hse.gov.uk/vibration) or alternatively the simple 'exposure points' system table below.

Tool vibration (m/s^2)	3	4	5	6	7	10	12	15
Points per hour (approximate)	20	30	50	70	100	200	300	450

34.12.7 Multiply the points assigned to the tool vibration by the number of hours of daily 'trigger time' for the tool(s) and then compare the total with the exposure action value (EAV) and exposure limit value (ELV) points.

- 100 points per day = exposure action value (EAV)
- 400 points per day = exposure limit value (ELV)

34.13 Mitigation - Vibration

34.13.1 If there is considered to be a problem arising from vibration, the employer is required to do all that is reasonable to minimise it.

34.13.2 Employers should be group work activities according to whether they are high, medium or low risk. Action plans should be prioritised for workers at greatest risk. As a general guide, the controls described in section **34.2** should be followed.

34.13.3 Alternative work methods which eliminate or reduce exposure to vibration should be sought.

34.13.4 Employers should design workstations to minimise the load on employees' hands, wrists, arms and backs and, where appropriate, use devices such as jigs and suspension systems to reduce the need to grip heavy tools tightly.

34.13.5 Employers must ensure equipment selected for tasks is suitable and can do the work efficiently. Select the lowest vibration tool that is suitable and can do the work efficiently and limit the use of high-vibration tools wherever possible.

34.13.6 When work equipment requires replacement because it is worn out, employers must choose replacements which are suitable for the work to be carried out, efficient and of lower vibration. It is recommended that employers have a policy on purchasing suitable equipment, taking account of vibration emission, efficiency and any specific requirements.

34.13.7 Appropriate maintenance programmes for equipment must be drawn up, to prevent avoidable increases in vibration through the use of blunt or damaged equipment or consumable items

34.13.8 Workers using equipment which can cause vibration must be provided with appropriate training and instruction on its correct use.

34.13.9 Employers should plan tasks to avoid workers being exposed to vibration for long, continuous periods.

34.13.10 Workers must be provided with protective clothing where appropriate. Whilst gloves can be used to keep hands warm, they will not themselves provide protection from vibration.

34.13.11 Safety signs must be displayed in any area of the ship where workers are likely to be exposed to noise (for further information, see Chapter 28 – Use of Safety Signs)

34.14 Additional guidance

BSI PUBLICATIONS

ISO standard 5349-1 - 2001 - Mechanical vibration - Measurement and evaluation of human exposure to hand-transmitted vibration Part 1: General Requirements;

ISO standard 5349-2 - 2001 - Mechanical vibration - Measurement and evaluation of human exposure to hand-transmitted vibration - Part 2: Practical guidance for measurement at the workplace;

ISO 2631-1 - 1997 - Mechanical vibration and shock - Evaluation of human exposure to whole-body vibration - Part 1: General requirements.

The above Standards can be obtained from:

British Standards Institution,

BSI House,

389 Chiswick High Road,

London W4 4AL

Tel: 020 8996 9000

Fax: 020 8996 7001

HSE PUBLICATIONS

The Health and Safety Executive have produced guidance on their related Regulations, which may be of assistance to employers of seafarers on ships. Details of such publications can be found on the HSE website at “<http://www.hse.gov.uk/vibration/>” and may in some cases be downloaded from that site or alternatively can be obtained from:-

HSE Books

PO Box 1999

Sudbury

Suffolk

CO10 2WA

Tel : 01787 881165

Fax: 01787 313995

or through good booksellers

ANNEX 34.1

EXAMPLES OF TYPICAL DB(A) LEVELS

Examples of noise levels in different locations are given below in order to enable personnel to appreciate when and where a potentially harmful noise exposure may exist:

120 dB(A)	60 metres from a jet aircraft taking off. Between 2 running 1800 rpm diesel generators.
110 dB(A)	1 metre from a riveting machine. In a small ship engine room with 900 rpm diesel main engines and 1550 rpm diesel generator.
105 dB(A)	1 metre from cylinder tops of a slow speed (120 rpm) main diesel engine.
100 dB(A)	Between 2 running diesel generators (600 rpm).
95 dB(A)	In a slow speed (120 rpm) diesel main engine room at the after end on the floor plate level or in an open side flat.
90 dB(A)	Noisy factory, machine shop, quieter parts of ships' engine rooms.
80 dB(A)	15 metres from a pneumatic drill.
70 dB(A)	Noisy domestic machinery (vacuum cleaner at 3 metres).
60 dB(A)	Inside large public building (e.g. supermarket).
50 dB(A)	Inside a house in a suburban area during daytime.
40 dB(A)	Quiet city area outdoors at night. Library whisper at 1 metre.
25-30 dB(A)	Countryside at night with no wind. Quiet church.
0	Threshold of hearing of young persons of normal hearing.

These levels are only illustrative and noise levels can vary between similar locations. This is especially true of engine rooms as engine noise can vary considerably with the type of installation.

ANNEX 34.2

PART I

Daily Personal Noise Exposure Levels

1. The daily personal noise exposure level, LEP,d , which corresponds to $LEX,8h$ defined in international standard ISO 1999: 1990 clause 3.6, is expressed in decibels and is ascertained using the formula:

$$L_{EP,d} = L_{Aeq,T_e} + 10 \log_{10} \left(\frac{T_e}{T_0} \right)$$

where—

T_e is the duration of the person's working day, in seconds;

T_0 is 28,800 seconds (8 hours); and

L_{Aeq,T_e} is the equivalent continuous A-weighted sound pressure level, as defined in ISO 1999: 1990 clause 3.5, in decibels, that represents the sound the person is exposed to during the working day.

2. If the work is such that the daily exposure consists of two or more periods with different sound levels, the daily personal noise exposure level (LEP,d) for the combination of periods is ascertained using the formula:

$$L_{EP,d} = 10 \log_{10} \left[\frac{1}{T_0} \sum_{i=1}^{i=n} \left(T_i 10^{0.1(L_{Aeq,T_i})} \right) \right]$$

where—

n is the number of individual periods in the working day;

T_i is the duration of period i ;

$(L_{Aeq,T})_i$ is the equivalent continuous A-weighted sound pressure level that represents the sound the person is exposed to during period i ; and

$\sum_{i=1}^{i=n} T_i$ is equal to T_e , the duration of the person's working day, in seconds.

PART 2

Weekly Personal Noise Exposure Levels

The weekly personal noise exposure, $L_{EP,w}$, which corresponds to $\bar{L}_{EX,8h}$ defined in international standard ISO 1999: 1990 clause 3.6 (note 2) for a nominal week of five working days, is expressed in decibels and is ascertained using the formula:

$$L_{EP,w} = 10 \log_{10} \left[\frac{1}{5} \sum_{i=1}^{i=m} 10^{0.1(L_{EP,d})_i} \right]$$

where—

m is the number of working days on which the person is exposed to noise during a week; and

$(L_{EP,d})_i$ is the $L_{EP,d}$ for working day i .

PART 3

Peak Sound Pressure Level

Peak sound pressure level, L_{Cpeak} , is expressed in decibels and is ascertained using the formula:

$$L_{Cpeak} = 20 \log_{10} \left[\frac{P_{Cpeak}}{p_0} \right]$$

where—

P_{Cpeak} is the maximum value of the C-weighted sound pressure, in Pascals (Pa), to which a person is exposed during the working day; and

p_0 is 20 μ Pa.

ANNEX 34.3

DAILY EXPOSURE TO DIFFERENT SOUND LEVELS

In the circumstances that occur on board ship, where personnel move from one place to another and the length of time spent in each place may vary, they may be exposed to different levels of noise throughout the day. The following figures give a guide to the acceptable maximum daily noise doses for unprotected ears, based on dB(A) sound energy received.

less than	80 dB(A)		no limit (24 hours)
	82 dB(A)	for	16 hours
	85 dB(A)	for	8 hours
	90 dB(A)	for	2 hours
	95 dB(A)	for	50 minutes
	100 dB(A)	for	15 minutes
	105 dB(A)	for	5 minutes
	110 dB(A)	for	1 minute

As an alternative illustration and equivalent to the above figures, the maximum daily noise dose for unprotected ears is halved for each increase of 3 dB(A).

Recommended maximum limits for different areas on board ship

The limits below should be regarded as maximum levels, rather than desirable levels, and as appropriate take account of the attenuation (noise reduction) that can be achieved with ear protectors.

Area	Recommended Limit
Machinery spaces – general	90 dB(A)
Machinery spaces – unmanned	110 dB(A)
Machinery control rooms	75 dB(A)
Wheelhouse/bridge/chart room/radar room	65 dB(A)
Bridge wings	70 dB(A)
Radio room/communications centre	60 dB(A)
Galleys, serveries, pantries	75 dB(A)
Normally unoccupied spaces	90 dB(A)
Sleeping cabins, Day cabins, hospital	60 dB(A)
Offices, Conferences rooms etc	65 dB(A)
Mess rooms, recreation rooms recreation areas	65 dB(A)
Open deck areas	75 dB(A)
Corridors, changing rooms, bathrooms, lockers and similar spaces	80 dB(A)
Ship's whistle	110 dB(A)

ANNEX 34.4

PERSONAL HEARING PROTECTION

1. The Hearing protection required to be provided by virtue of the Merchant Shipping and Fishing Vessels (Control of Noise at Work) Regulations 2007 is a last resort to control noise exposure. It should only be used:-
 - as a short-term measure until other controls to reduce the noise exposure have been introduced; or
 - where all reasonably practicable measures have been taken and a risk to hearing remains.
2. Any hearing protection provided to workers is, as indicated in section 34.5 required to comply with the requirements of the Merchant Shipping and Fishing Vessels (Personal Protective Equipment) Regulations 1999. However not all hearing protectors are the same and different types may be more suitable for different workers or indeed the work being undertaken. In this respect the main types of hearing protection are:
 - earmuffs, which completely cover the ear - however the effectiveness of earmuffs may be reduced if the wearer is also wearing glasses;
 - earplugs, which are inserted in the ear canal; and
 - semi-inserts (also called 'canal caps'), which cover the entrance to the ear canal.
3. In choosing what form of hearing protection to provide, employers should use the results from their noise assessment and information from hearing protection suppliers to make the best choice of hearing protection for the particular work being undertaken. Whatever form of protection is chosen, It must:

- reduce employees' noise exposure to below 85 dB(A);
- be suitable for the employees' working environment - consider comfort and hygiene; and
- be compatible with other protective equipment used by the employee (eg hard hats, dust mask and eye protection).

Wherever possible, workers should be provided with a suitable range of effective hearing protection so they can choose the one that suits them best. Some workers may prefer a particular type, or may not be able to use some types of hearing protection because of the risk of ear infections. Particular consideration should be given to those workers who wear spectacles or wear eye protection similar to spectacles which have arms which go over the ear. In such cases ear muffs may not fit securely against the ear because of the presence of the spectacle arms and thus provide inadequate protection against noise. In such circumstances another form of ear protection may be more suitable.

Maintenance

7. Employers should ensure that hearing protection works effectively and check that:
 - its overall condition is still good and it is clean;
 - earmuff seals are undamaged;
 - the tension of the headbands is not reduced;
 - there are no unofficial modifications; and
 - compressible earplugs are soft, pliable and clean.

Supervision

8. Employers should ensure that workers use hearing protection when required to. In this context employers may want to:
 - include the need to wear hearing protection in their safety policy and put someone in authority in overall charge of issuing it and making sure replacement hearing protection is readily available;

- carry out spot checks to see that the rules are being followed and that hearing protection is being used properly. Consideration might perhaps be given to including failure hearing protectors when required to do so in the company disciplinary procedures; and
- ensure that all managers and supervisors set a good example and wear hearing protection at all times when in ear protection zones.