12 NOISE, VIBRATION AND OTHER PHYSICAL AGENTS

12.1 General advice

12.1.1 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.

12.1.2 The Company'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, Managing occupational health and safety). Appropriate measures should be taken to remove, control or minimise the risk (see section 12.2).

12.1.3 The risk assessment will also provide information to determine whether health surveillance is appropriate (see Chapter 7, Health surveillance).

12.1.4 The Company should provide information and relevant training to personnel so that they know and understand the risks from any physical agents arising from their work, the precautions to be taken and the results of any monitoring of exposure.

12.1.5 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.

12.1.6 Reference may also be made where appropriate to any publications on the subject issued by the Health and Safety Executive (HSE) or other appropriate body.

12.2 Prevention or control of exposure to a physical agent

12.2.1 The first consideration should always be to prevent risk by removing exposure to the physical agent concerned (elimination).

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

- Use of plant, processes and systems of work that minimise exposure to the physical agent.
- Total or partial enclosure of the equipment concerned.
- Keeping the number of persons who might be exposed to a physical agent to a minimum, and reducing the period of exposure.
- The designation of areas that may be subject to hazardous levels of exposure to a physical agent, and the use of suitable and sufficient warning signs.
- Use of appropriate procedures for the measurement of hazardous levels of exposure to a physical agent, particularly for the early detection of abnormal exposures resulting from an unforeseeable event or an accident.
- Taking collective or individual protection measures.
- Where appropriate, having plans in place to deal with emergency situations that could result in abnormally high exposure to physical agents.

12.2.3 These measures should be applied to reduce the risk to seafarers as much as reasonably practicable but, where they do not adequately control the risk to health, appropriate personal protective equipment (PPE) should be provided.

12.2.4 The Company should take reasonable steps to ensure that all control measures are properly used and maintained. Seafarers should comply fully with the control measures in force.

12.2.5 For certain physical agents, specific control measures apply, e.g. 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 seafarers should be monitored and a record kept for future reference.

12.3 Consultation

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

12.4 Seafarer information and training

12.4.1 The Company should provide seafarers with sufficient information and training to ensure that they are aware of potential risks to their health from exposure to physical agents. Such information should be provided in the working language of the ship. Training should be in a language understood by the seafarer and should 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 (ELVs) and the exposure action values (EAVs) or action levels (ALs);
- the results of the risk assessment carried out;
- safe working practices to minimise exposure to physical agents;
- the correct use of PPE where required;
- the circumstances in which seafarers are entitled to health surveillance;
- how to detect and report signs of injury; and
- the importance of detecting and reporting signs of injury.

12.5 Noise: introduction

12.5.1 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 levels of noise in the workplace, and steps to prevent any associated problems they may cause.

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12.5.2 Noise may also be a safety hazard at work, interfering with communication and making warnings harder to hear.

12.6 Assessing exposure to noise

12.6.1 Noise is measured in decibels (dB). An 'A-weighting', sometimes written as dB(A), is used to measure average noise levels and a 'C-weighting', or dB(C), to measure peak, impact or explosive noises. Because of the way our ears work, a 3 dB change in noise level is not very noticeable. Yet every 3 dB doubles the noise level, so what might seem like small differences in the numbers can be quite significant.

12.6.2 Annex 12.2 provides guidance on daily exposure to different sound levels and the recommended maximum limits for different areas on board ship.

12.6.3 The following table describes the lower and upper noise exposure values, noise exposure limits and, where appropriate, action required to reduce that exposure.

	Daily/weekly exposure (dB(A))	**Peak exposure (dB(C))**	**Required action**
Lower exposures action values	80	135	Seafarers should be provided with personal hearing protection that complies with the requirements of the Merchant Shipping and Fishing Vessels (Personal Protective Equipment) Regulations 1999.
Upper exposures action values	85	137	Seafarers are required to use personal hearing protection that complies with the requirements of the Merchant Shipping and Fishing Vessels (Personal Protective Equipment) Regulations 1999. Seafarers are entitled to have their hearing examined by a doctor, or a suitably qualified person under the supervision of a doctor. Companies should establish and implement a programme of measures to reduce the

			exposure to noise.
Exposure limit values	87	140	This limit must not be exceeded.

12.6.4 For further information on personal hearing protection, see Annex 12.3.

12.6.5 Seafarers should not be charged for either personal hearing protectors or hearing examinations as a result of risks at work.

12.6.6 When determining noise exposure action levels, no account is to be taken of the effects of using hearing protection. However, account may be taken of the reduction achieved by hearing protection in the case of ELVs.

12.6.7 Although being aware of decibel levels is an important factor in protecting hearing, distance from the source of the sound and duration of exposure to the sound are equally important.

12.6.8 As a simple guide, there may be a problem if:

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

12.7 Risk assessment: noise

12.7.1 If exposure to noise may be a problem, a risk assessment should be undertaken by a competent person.

12.7.2 If any seafarer is likely to be exposed to noise exceeding the lower EAVs set out in section 12.6.3, the Company should arrange for a competent person to assess the actual level of noise exposure.

12.7.3 The Company 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 that may alter noise levels; and
- use the assessment to develop an action plan for introducing noise control measures.

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

12.7.5 Safety signs should be displayed in all areas of the ship where seafarers are likely to be exposed to noise. (For further information, see Chapter 9, Safety signs and their use.)

12.8 Health surveillance: noise

12.8.1 Where risk assessment shows that exposure to noise may be causing problems, the employer is required to provide health surveillance of the seafarers at risk in accordance with Chapter 7, Health surveillance.

12.8.2 Health surveillance should 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; and
- encouraging seafarers to seek further advice from a doctor when hearing damage is suspected.

12.8.3 The organisation responsible for the carrying out of health surveillance should use the most appropriate form of health surveillance in the circumstances.

12.8.4 Companies should arrange regular hearing checks for all seafarers who are regularly exposed to potentially harmful noise levels.

12.8.5 Further guidance is available in the Maritime and Coastguard Agency (MCA)'s official guide to complying with the Merchant Shipping and Fishing Vessels (Noise at Work) Regulations 2007.

12.9 Noise arising from music and entertainment

12.9.1 A code of conduct has been drawn up by 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.

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Vibration

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12.10 Types of vibration and their effects

12.10.1 Hand–arm (or hand-transmitted) vibration 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.

12.10.2 Whole-body vibration occurs through the shaking or jolting of the body through a supporting surface, e.g. when controlling or riding on a vessel at high speed in choppy seas, using mobile equipment or standing next to a ship's main engines or generators. Whole-body vibration can also be made worse by poor design of the working environment, incorrect seafarer posture, and exposure to shocks and jolts. A primary symptom of whole-body vibration is back pain.

12.11 Exposure limits set by the vibration regulations

The following table describes the daily EAVs and ELVs 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/s² A(8)	0.5 m/s² A(8)	Above this limit, Companies are required to reduce seafarer's exposure to vibration.
Daily exposure	5 m/s² A(8)	1.15 m/s² A(8)	The maximum amount of

limit value			vibration an employee may be exposed to on any single day.

12.12 Determining vibration levels

12.12.1 The Company is 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.

12.12.2 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; and
- any symptoms that 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.

12.12.3 If exposure to vibration is causing problems, a risk assessment should be undertaken by a competent person who has read and understood the vibration regulations.

12.12.4 As an alternative, the Company 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.

12.12.5 The Company may be able to get suitable vibration data from the equipment handbook or 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 seafarers' exposure.

12.12.6 It is also necessary to note how long seafarers are exposed to vibration. Once the relevant vibration data and exposure times have been collected, it will be necessary to calculate each seafarer's daily exposure. This could be by means of an exposure calculator such as HSE's one on vibration at work available from its website or, alternatively, by using the simple exposure points system table below.

Tool vibration	3	4	5	6	7	10	12	15

(m/s²)								
Points per hour (approximate)	20	30	50	70	100	200	300	450

12.12.7 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 EAV and ELV points:

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

12.13 Mitigation

12.13.1 If exposure to vibration is causing problems, the Company is required to do all that is practicable to eliminate the risk or minimise it.

12.13.2 The Company should group work activities according to whether they are high, medium or low risk. Action plans should be prioritised for seafarers at greatest risk. As a general guide, the controls described in section 12.2 should be followed.

12.13.3 Alternative work methods that eliminate or reduce exposure to vibration should be sought.

12.14 Mitigation: hand–arm vibration

12.14.1 The Company should design workstations to minimise the load on seafarers' hands, wrists and arms and, where appropriate, use devices such as jigs and suspension systems to reduce the need to grip heavy tools tightly.

12.14.2 The Company should ensure equipment provided for tasks is suitable and can do the work efficiently. The tool causing the lowest vibration level that is suitable and can do the work efficiently should be selected. The use of high-vibration tools should be avoided wherever possible.

12.14.3 When work equipment requires replacement because it is worn out, the Company should choose replacements that are suitable for the work to be carried out, efficient and, wherever possible, cause lower vibration levels. It is recommended that the Company has a policy on purchasing suitable equipment, taking account of vibration emission, efficiency and any specific requirements.

12.14.4 Appropriate maintenance programmes for equipment should be drawn up to prevent avoidable increases in vibration through the use of blunt or damaged equipment or consumable items.

12.14.5 Seafarers using equipment that can cause vibration should be provided with appropriate training and instruction on its correct use.

12.14.6 The Company should plan tasks to avoid seafarers being exposed to vibration for long, continuous periods.

12.14.7 Seafarers should be provided with protective clothing where appropriate. Whilst gloves can be used to keep hands warm, they may not in themselves provide protection from vibration.

12.14.8 Further guidance is available in the MCA's official guide to complying with the Merchant Shipping and Fishing Vessels (Control of Vibration at Work) Regulations 2007.

12.15 Mitigation: whole-body vibration

12.15.1 Vibration may be reduced by regular maintenance of engines and machinery, adjusting the speed of operation or other settings. Seafarers should be provided with information on how to minimise vibration in this way. Severe shocks or jolts should be avoided as far as possible.

12.15.2 When exposure to vibration is unavoidable, the risk of harm can be reduced by:

- scheduling work to avoid long periods of exposure to vibration in a single day;
- planning work so that seafarers do not have to sit in one position for too long;
- ensuring that seafarers maintain good posture while working, e.g. arranging tasks as far as possible to avoid twisting and stretching;
- where possible, adjusting seating to provide good lines of sight, adequate support to the back, buttocks, thighs and feet, and ease of reach for foot and hand controls;
- providing adequate rest periods, e.g. allow a short break between operations in small fast vessels or mobile machinery and manual handling, to give tired muscles time to recover before handling heavy loads;
- if working in cold and damp conditions, ensuring that seafarers wear warm, and (if necessary) waterproof clothing; cold exposure may accelerate the onset or worsen the severity of back pain.

When all reasonable steps have been taken to avoid exposure to vibration and to reduce the level of vibration, the final resort for compliance with the ELV is to limit the duration of exposure.

12.15.3 Marine guidance note MGN 436(M+F) gives guidance on mitigating the risks from whole-body vibration for those working in small, fast craft.

MGN 436(M+F)

12.15.4 Further guidance is available in the MCA's official guide to complying with the Merchant Shipping and Fishing Vessels (Control of Vibration at Work) Regulations 2007.

12.16 Health surveillance and health monitoring: vibration

12.16.1 If there is considered to be a potential risk of harm to seafarers from hand–arm vibration, health surveillance should be provided for vibration-exposed seafarers in accordance with Chapter 7, Health surveillance, of this Code. This will apply when seafarers:

- are likely to be regularly exposed above the EAV of 2.5 m/s^2 A(8);
- are likely to be exposed occasionally above the EAV and where the risk assessment identifies that the frequency and severity of exposure may pose a risk to health; or
- have a diagnosis of hand–arm vibration syndrome (HAVS) (even when exposed below the EAV).

12.16.2 Specific guidance on health surveillance for hand–arm vibration risks is available on the HSE website.

12.16.3 Monitoring symptoms of back pain may be useful for identifying health problems and intervening to prevent problems being caused or made worse by work activities. It can also provide information on the effectiveness of current control methods in place, and identify those who are particularly sensitive to whole-body vibration. Older seafarers, people with back problems, young seafarers and pregnant seafarers are at greater risk. Guidance on health monitoring for those at risk from whole-body vibration is available on the HSE website.

12.17 Additional guidance

Sources of additional guidance are listed in marine guidance note MGN 353(M+F).

MGN 353(M+F)

12.18 Other physical agents

Guidance on protection from artificial optical radiation and electromagnetic fields are listed in the Appendices.

ANNEX 12.1 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 two 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 a 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 two 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 because engine noise can vary considerably with the type of installation.

ANNEX 12.2 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.

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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, conference 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 12.3 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
- when all reasonably practicable measures have been taken and a risk to hearing remains.

2. Any hearing protection provided to seafarers is 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 seafarers 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 (see section 8.6.4);
   - earplugs, which are inserted in the ear canal (see section 8.6.3); 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, Companies 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, e.g. safety helmet, dust mask and eye protection.

Wherever possible, seafarers should be provided with a suitable range of effective hearing protection so they can choose the one that suits them best. Some seafarers 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 seafarers who wear spectacles or eye protection similar to spectacles, which have arms that go over the ear. In such cases, earmuffs 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.

4. Maintenance

Companies 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.

5. Supervision

Companies should ensure that seafarers use hearing protection when required to. In this context, Companies 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 that 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;
- consider whether failure to use hearing protectors when required to do so should be included in the Company's 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.