

1.4.28 **Potentially hazardous noise levels:** Those levels at and above which persons exposed to them without protection are at risk of sustaining a noise induced hearing loss.

1.4.29 **Sound:** Energy that is transmitted by pressure waves in air or other materials and is the objective cause of the sensation of hearing.

1.4.30 **Sound pressure level:** A measure of sound level,  $L$ , on a logarithmic scale given by:

$$L = 20 \log_{10} \frac{(p)}{(p_0)} .dB$$

where:  $p$  = rms value of measured sound pressure between  
20 Hz and 20 kHz

$p_0 = 20 \times 10^{-6}$  pascal (the reference level).

1.4.31 **Steady noise:** A sound where the level fluctuates through a total range of less than 5 dB(A) as measured on the "slow" response of a sound level meter in one minute.

1.4.32 **Voyages of short duration:** Voyages where the ship is not generally underway for periods long enough for seafarers to require sleep, or long off-duty periods, during the voyages.

## CHAPTER 2 – MEASUREMENT

### 2.1 General

On completion of the construction of the ship, or as soon as practicable thereafter, measurement of noise levels in all spaces specified in Chapter 4 should take place under the operating conditions specified in 2.2 and 2.3 and should be suitably recorded as required by 4.3.

### 2.2 Operating conditions at sea

2.2.1 Measurements should be taken with the ship in the loaded or ballast condition.

2.2.2 The main propulsion machinery should be run at normal design service shaft speed. Controllable pitch and Voith-Schneider propellers, if any, should be in the normal seagoing position.

2.2.3 All auxiliary machinery, navigation instruments, radio and radar sets, etc., normally, or likely to be, in use at any one time should operate throughout the measurement period.

2.2.4 Measurements in spaces containing emergency diesel engine-driven generators, fire pumps or other emergency equipment that would normally be run only in emergency, or for test purposes, should be taken with the equipment operating. Adjoining spaces need not be measured with such equipment operating, however, unless it is likely that the equipment will be operated for periods other than those mentioned above.

2.2.5 Mechanical ventilation and air-conditioning equipment should be in normal operation, taking into account that the capacity should be in accordance with the design conditions.

2.2.6 Doors and windows should in general be closed but they should be open in spaces where this is the normal condition, for instance in the navigating bridge where the door on the lee side is normally open.

2.2.7 Spaces should be furnished with all necessary equipment. Measurements without soft furnishings may be made but no allowance should be made for their absence.

2.2.8 Ships fitted with bow thrusters, stabilizers, etc., may be subject to high noise levels when in operation. Measurements should be taken at positions around such machinery when in operation and in adjacent accommodation spaces and duty stations.

### **2.3 Operating conditions in port**

2.3.1 Measurements as specified in 2.3.2, 2.3.3 and 2.3.4 should be taken with the ship in port condition.

2.3.2 Measurements should be taken with the ship's cargo handling equipment in operation, in those areas and accommodation spaces affected by its operation. Noise originating from sources external to the ship should be discounted as indicated in 2.4.3.

2.3.3 Where the ship is a vehicle carrier and noise during loading and discharging originates from vehicles, the noise level in the cargo spaces and the duration of the exposure should be measured. This exposure should be considered in conjunction with Chapter 5.

2.3.4 It will be necessary to take measurements in machinery spaces with the auxiliary machinery operating in the port condition if the provisions of 5.3.1 in respect of ear protection are to be met in lieu of the provisions of 4.2.1.1 during maintenance, overhaul or similar port conditions.

### **2.4 Environmental conditions**

2.4.1 The depth of water under the ship's keel and the presence of large reflecting surfaces in the ship's vicinity may affect the readings obtained, and should, therefore, be noted in the noise survey report.

2.4.2 The meteorological conditions such as wind and rain, as well as sea state, should be such that they do not influence the measurements. Wind force 4 and sea state 3 should not be exceeded. If this cannot be achieved, the actual conditions should be reported.

2.4.3 Care should be taken to see that noise from extraneous sound sources, such as people, construction and repair work, does not influence the noise level on board the ship at the positions of measurement. If necessary, readings may be corrected for steady state background noise according to the energy summation principle.

## 2.5 Safe measurement conditions

With the meter set to "fast response" spot checks should be made at positions of high noise level to ensure the safety of a person taking measurements.

## 2.6 Measurement procedures

2.6.1 During noise level measurement, only seafarers necessary for the operation of the ship and persons taking the measurements should be present in the space concerned.

2.6.2 Sound pressure level readings should be taken in decibels using an A-weighting filter (dB(A)) and if necessary also in octave bands between 31.5 and 8,000 Hz, in order to determine the ISO noise rating (NR) number, as required by Chapter 4.

2.6.3 The meter should be set to "slow" response and the readings made only to the nearest decibel. A measuring time of at least 5 seconds should be allowed. If a meter fluctuates in level within a range of no more than 5 dB(A) maximum to minimum, an estimate of the level should be made by averaging the excursions of the needle by eye.

2.6.4 If the range fluctuations are in excess of 5 dB(A), or the sound is cyclic, irregular or intermittent in operation an integrating meter should be used set to A-weighting. Integration should be made over a period of at least 30 seconds.

### 2.6.5 *Exposure measurement*

In addition to the steady state and fluctuating noise level measurements, the noise exposure of seafarers may be measured as allowed by 4.1.2, if necessary.

## 2.7 Calibration

The sound level meter should be calibrated with the calibrator referred to in 3.2.2 before and after measurements are taken.

## 2.8 Measurement positions

### 2.8.1 *Points of measurement*

If not otherwise stated, measurements should be performed with the microphone at a height of between 1.2 m and 1.6 m from the deck. The distance between two measurement points should be at least 2 m, and in large spaces not containing machinery, measurements should be taken at intervals not greater than 7 m throughout the space including positions of maximum noise level. In large cargo holds no more than three measurements need be taken. In no case should measurements be taken closer than 0.5 m from the boundaries of a space. The microphone positions should be as specified in 2.8.2 to 2.8.8.

### 2.8.2 *Accommodation spaces*

One measurement should be made in the middle of the space. The microphone should be moved slowly horizontally and/or vertically over a distance of 1 m and the mean reading recorded. Additional measurements should be performed at other points if appreciable differences, i.e. greater than 10 dB(A), in the level of sound inside the room occur, especially near the head positions of a sitting or lying person.

### 2.8.3 *Machinery spaces*

2.8.3.1 Measurements should be made at the principal working and control stations of the seafarers in the machinery spaces and in the adjacent control rooms, if any, special attention being paid to telephone locations and to positions where voice communication and audible signals are important.

2.8.3.2 Readings should not normally be taken closer than 1 m from operating machinery, or from decks, bulkheads or other large surfaces, or from air inlets. Where this is not possible, measurement should be taken at a position midway between the machinery and adjacent reflecting surface.

2.8.3.3 Measurements from machinery which constitutes a sound source should be taken at 1 m from the machinery. Measurement should be made at a height of 1.2 m to 1.6 m above the deck, platform or walkway as follows:

- .1 at a distance of 1 m from, and at intervals not greater than 3 m around, all sources such as:
  - main turbines or engines at each level
  - main gearing
  - turbo-blowers
  - purifiers
  - electrical alternators and generators
  - boiler firing platform
  - forced and/or induced draught fans
  - compressors
  - cargo pumps (including their driving motors or turbines)

(In order to avoid an unnecessarily large and impractical number of measurements and recordings in the case of large engines and of machinery spaces where the measured sound pressure level in dB(A) at the intervals above does not vary significantly, it will not be necessary to record each position. Full measurement at representative positions and at the positions of maximum sound pressure level should, however, be made and recorded, subject to at least four measurements being recorded at each level.);

- .2 at local control stations, e.g. the main manoeuvring or emergency manoeuvring stand on the main engine and the machinery control rooms;

- .3 at all other locations not specified in .1 and .2 which would normally be visited during routine inspection, adjustment and maintenance;
- .4 at points on all normally used access routes, unless covered by positions already specified above, at intervals not greater than 10 m;
- .5 in rooms within the machinery space, e.g. workshops.

(In order to restrict the number of measurements and recordings, the number of recordings can be reduced as in .1, subject to a total of at least four measurements (including those specified in this paragraph) being recorded at each machinery space level up to upper deck.)

#### **2.8.4 Duty stations**

The noise level should be measured at all points where the work is carried out. Additional measurements should be performed in spaces containing duty stations if variations in noise level are thought to occur in the vicinity of the duty stations.

#### **2.8.5 Normally unoccupied spaces**

2.8.5.1 In addition to the spaces referred to in 2.8.2 to 2.8.4, measurements should be made in all locations with unusually high noise levels where seafarers may be exposed, even for relatively short periods, and at intermittently used machinery locations, for example cargo discharge pumps.

2.8.5.2 In order to restrict the number of measurements and recordings, noise levels need not be measured for normally unoccupied spaces, holds, deck areas and other spaces which are remote from sources of noise and where a preliminary survey shows that the noise levels are well below the limit specified in Chapter 4.

#### **2.8.6 Open deck**

Measurements should be taken in any areas provided for the purpose of recreation and additionally where a preliminary survey indicates that the limits specified in 5.3.1 may be exceeded.

#### **2.8.7 Intake and exhaust openings**

When measuring noise levels at the intake and exhaust of engines and near ventilation, air-conditioning and cooler systems, the microphone should, where possible, be placed outside the gas stream at a distance of 1 m from the edge of the intake or exhaust opening and at a 30° angle away from the direction of the gas stream and as far as possible from reflecting surfaces.

#### **2.8.8 Navigating bridge wings**

Measurements should be taken on both navigating bridge wings but should only be taken when the navigating bridge wing to be measured is on the lee side of the ship.

## CHAPTER 3 – MEASURING EQUIPMENT

### 3.1 Equipment specifications

#### 3.1.1 *Sound level meters*

Measurement of sound pressure levels should be carried out using precision grade sound level meters, industrial grade sound level meters, and integrating sound level meters subject to the requirements of paragraph 3.1.4. Such meters should be manufactured to the IEC Publication 651(1979)\* type 0, 1 or 2 standards as applicable, or to an equivalent standard acceptable to the Administration.

#### 3.1.2 *Octave filter set*

When used alone, or in conjunction with a sound level meter, as appropriate, an octave filter set should conform to IEC Publication 225(1966)\*\* or an equivalent standard acceptable to the Administration.

#### 3.1.3 *Measurement microphones*

Microphones should be of the random incidence type and should meet the standards of IEC Publication 179(1973), IEC Publication 651(1979) types I and II or an equivalent standard acceptable to the Administration.

#### 3.1.4 *Selection of equipment*

The main difference between the grades is in the tolerance band which is allowed on the A-weighting filter networks. The tolerances allowed are wider at low and high frequencies than at mid-frequencies. In consequence, for sound emitted by typical medium sized machines the accuracy of measurement with a precision grade meter is about  $\pm 1$  dB(A) and with an industrial grade meter about  $\pm 3$  dB(A). The industrial grade meter will tend to give lower readings than the precision grade. It is recommended that where noise levels are likely to be close to the limits given in the Code precision grade instruments should be used, and in any cases of dispute readings should be taken with a precision grade instrument.

### 3.2 Use of equipment

#### 3.2.1 *Measuring fluctuating noise*

When measuring fluctuating noise an integrating sound level meter should be used.

#### 3.2.2 *Calibration*

A suitable calibrator, approved by the manufacturer of the particular sound level meter, should be used. Calibrators for use with precision grade sound level meters should be accurate to within  $\pm 0.3$  dB(A), and for use with industrial grade meters accurate to within  $\pm 0.5$  dB(A).

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\* Recommendation for sound level meters.

\*\* Octave, half octave and third octave band-pass filters intended for the analysis of sounds and vibrations.

### 3.2.3 *Check of measuring instrument and calibrator*

The sound level measuring instrument and calibrator should be returned to the manufacturer or other competent organization capable of providing a calibration check traceable to a national standard laboratory at intervals not exceeding two years.

### 3.2.4 *Microphone wind screen*

A microphone wind screen should be used when taking readings outside, e.g. on navigating bridge wings or on deck, and below deck where there is any substantial air movement. The wind screen should not affect the measurement level of similar sounds by more than 0.5 dB(A) in "no wind" conditions.

### 3.2.5 *Measuring equipment for use in gas dangerous spaces*

Measuring equipment should not be used in areas where flammable gas/air mixtures may be present, unless such equipment has been certified intrinsically safe for such purposes.

### 3.2.6 *Industrial grade instruments*

In any situations where an industrial grade meter is used a factor of 3 dB(A) should be added to the readings to allow for the reduced accuracy of this type of instrument.

## CHAPTER 4 – MAXIMUM ACCEPTABLE SOUND PRESSURE LEVELS

### 4.1 General

4.1.1 The limits specified in this section should be regarded as maximum levels and not as desirable levels. Where reasonably practicable, it is desirable for the noise level to be lower than the maximum levels specified.

4.1.2 The limit specified for any work space may be assessed by steady, fluctuating, equivalent continuous or effective sound level measurement for the space. Where the equivalent continuous or effective sound level is used, it should include all the measurement locations required in Chapter 2. Where the 24 hour equivalent continuous or effective sound level is used as the basis for compliance with the Code, the limit for this level given in Chapter 5 should apply.

4.1.3 Personnel entering spaces with noise levels greater than 85 dB(A) should be required to wear ear protectors (see Chapter 5). The limit of 110 dB(A) given in 4.2.1.2 assumes that ear protectors giving protection meeting the requirements for ear muffs in Chapter 7 are worn.

4.1.4 Limits are specified in terms of A-weighted sound pressure levels (see 1.4.3 and 1.4.22).

4.1.5 In accommodation spaces where the dB(A) limits are exceeded and where there is a subjectively annoying low frequency sound or obvious tonal components the ISO noise rating (NR) number should also be determined. The limits specified may be considered as satisfied if the ISO noise rating (NR) number does not numerically exceed the specified A-weighted value minus 5.

4.1.6 In machinery spaces specified in 4.2.1.2, in which the operation of any equipment or machinery or part of machinery results in an emission of subjectively high frequency sound and in which the sound level of 105 dB(A) is exceeded, the ISO noise rating (NR) number should be determined. When NR 105 is exceeded the acceptability of this level should be determined by the Administration.

## 4.2 Noise level limits

Limits for noise levels are specified for various spaces as follows:

<b>4.2.1</b>	<b><i>Work spaces</i></b> (see 5.1)	<b><i>dB(A)</i></b>
.1	Machinery spaces (continuously manned)**	90
.2	Machinery spaces (not continuously manned)**	110
.3	Machinery control rooms	75
.4	Workshops	85
.5	Non-specified work spaces**	90
<b>4.2.2</b>	<b><i>Navigation spaces</i></b>	<b><i>dB(A)</i></b>
.1	Navigating bridge and chartrooms	65
.2	Listening post, including navigating bridge* wings and windows	70
.3	Radio rooms (with radio equipment operating but not producing audio signals)	60
.4	Radar rooms	65
<b>4.2.3</b>	<b><i>Accommodation spaces</i></b>	<b><i>dB(A)</i></b>
.1	Cabins and hospitals	60
.2	Mess rooms	65
.3	Recreation rooms	65
.4	Open recreation areas	75
.5	Offices	65

\* Reference is made to resolution A.343(IX) which also applies.

\*\* Ear protectors should be worn when the noise level is above 85 dB(A) (see 4.1.3).



<b>4.2.4 Service spaces</b>	<b><i>dB(A)</i></b>
.1 Galleys, without food processing equipment operating	75
.2 Serveries and pantries	75
<b>4.2.5 Normally unoccupied spaces*</b>	<b><i>dB(A)</i></b>
Spaces not specified (see 5.1)	90

### 4.3 Survey report

4.3.1 A noise survey report should be made for each ship. The report should comprise information on the noise levels in the various spaces on board. The report should show the reading at each specified measuring point. The points should be marked on a general arrangement plan, or on accommodation drawings attached to the report, or should otherwise be identified.

4.3.2 A model format for noise survey reports is set out in Appendix 1.

4.3.3 The following particulars should be mentioned in the noise survey report:

- .1 Hull number, name, gross tonnage, main dimensions and type of ship.
- .2 The leading particulars of the ship's machinery.
- .3 Names of the builder and owner of the ship.
- .4 Date and time of the measurements.
- .5 The type of voyage, the meteorological conditions, sea state and the ship's position during the measurements.
- .6 The underkeel clearance during the measurements.
- .7 The main operating conditions as required by 2.2 and 2.3, including those items on the main machinery line which were operating and the operating condition.
- .8 The name and address of those carrying out the measurements.
- .9 The make, type and serial number of instrumentation used.
- .10 Details and date of calibration of instruments.
- .11 A list of the main noise abatement measures applied aboard the ship.
- .12 Other particulars of interest, including exceptions to the standard laid down in this Code.

4.3.4 Where the ship does not comply with Chapter 4 and where the use of ear protectors is required, a copy of the noise survey report should be carried on board.

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\* Ear protectors should be worn when the noise level is above 85 dB(A) (see 4.1.3).

## CHAPTER 5 – NOISE EXPOSURE LIMITS

### 5.1 General

The noise level limits as set out in Chapter 4 are designed to ensure that, if they are complied with, seafarers will not be exposed to an  $L_{eq}(24)$  exceeding 80 dB(A), i.e. within each day or 24 hour period the equivalent continuous noise exposure would not exceed 80 dB(A). In spaces with sound pressure levels exceeding 85 dB(A), it will be necessary to use suitable ear protection, or to apply time limits for exposure, as set out in this section, to ensure that an equivalent level of protection is maintained. Consideration should be given to the instruction of seafarers on these aspects, as recorded in Appendix 2.

### 5.2 Hearing conservation and use of ear protectors

In order to comply with the exposure criteria of this section, the use of ear protectors complying with Chapter 7 is permitted. In some instances when ear protectors are required for compliance with the Code, a hearing conservation programme and other measures may be implemented by the Administration.

### 5.3 Limits of exposure of seafarers to high noise levels

Seafarers should not be exposed to noise in excess of the levels and durations shown in figure 5.1 and described in 5.3.1 to 5.3.5.

#### 5.3.1 *Maximum exposure without protection (zone E, fig.5.1)*

For exposures of less than 8 hours, seafarers without ear protection should not be exposed to noise levels exceeding 85 dB(A). When seafarers remain for more than 8 hours in spaces with a high noise level, an  $L_{eq}(24)$  of 80 dB(A) should not be exceeded. Consequently, for at least a third of each 24 hours each seafarer should be subject to an environment with a noise level not exceeding 75 dB(A).

#### 5.3.2 *Maximum exposure with protection (zone A, fig.5.1)*

No seafarer even wearing ear protectors should be exposed to levels exceeding 120 dB(A) or to an  $L_{eq}(24)$  exceeding 105 dB(A).

#### 5.3.3 *Daily exposure (zone D, fig.5.1)*

If seafarers routinely work (daily exposure) in spaces with noise levels within zone D ear protectors should be worn and a hearing conservation programme may be considered.

#### 5.3.4 *Occasional exposure (zone B, fig.5.1)*

Only occasional exposures should be allowed in zone B and both ear muffs and ear plugs should be used unless the exposure duration is restricted to not more than 10 minutes when only ear muffs or plugs are required.

#### 5.3.5 *Occasional exposure (zone C, fig.5.1)*

In zone C only occasional exposures should be allowed and ear muffs or plugs should be required.