

NOISE LEVELS ON BOARD SHIPS

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ANNEX
CODE ON NOISE LEVELS ON BOARD SHIPS
CONTENTS

PREAMBLE

CHAPTER 1 - GENERAL

- 1.1 Scope
- 1.2 Purpose
- 1.3 Application
- 1.4 Definitions

CHAPTER 2 - MEASUREMENT

- 2.1 General
- 2.2 Operating condition at sea
- 2.3 Operating conditions in port
- 2.4 Environmental conditions
- 2.5 Safe measurement conditions
- 2.6 Measurement procedures
- 2.7 Calibration
- 2.8 Measurement positions

CHAPTER 3 - MEASURING EQUIPMENT

- 3.1 Equipment specifications
- 3.2 Use of equipment

CHAPTER 4 - MAXIMUM ACCEPTABLE SOUND PRESSURE LEVELS

- 4.1 General
- 4.2 Noise level limits
- 4.3 Survey report

CHAPTER 5 - NOISE EXPOSURE LIMITS

- 5.1 General
- 5.2 Hearing conservation and use of ear protectors
- 5.3 Limits of exposure of seafarers to high noise levels
- 5.4 24 hour equivalent continuous sound level limit
- 5.5 Hearing conservation Programme

CHAPTER 6 - ACOUSTIC INSULATION BETWEEN ACCOMMODATION SPACES

- 6.1 General
- 6.2 Sound insulation index
- 6.3 Erection of materials

CHAPTER 7 - EAR PROTECTION AND WARNING INFORMATION

- 7.1 General
- 7.2 Recommendation for ear protectors
- 7.3 Selection and use of ear protectors
- 7.4 Warning notices
- 7.5 Miscellaneous equipment

APPENDIX 1 FORMAT FOR NOISE SURVEY REPORT

APPENDIX 2 INSTRUCTIONS TO SEAFARERS AND RESPONSIBILITY

APPENDIX 3 SUGGESTED METHODS OF CONTROLLING NOISE EXPOSURE

PREAMBLE

- 1 The Code on Noise Levels on Board Ship (hereinafter referred to as the Code) has been developed to provide guidance to Administrations on principles of noise control on board ships in general. Its purpose is to stimulate and promote noise control at a national level within the framework of internationally agreed guidelines.
- 2 Guidance to Administrations on maximum noise levels and noise exposure limits should be considered as the main objectives of the Code.
- 3 The recommendations on procedures and programmes should be regarded as an attempt to establish international uniformity rather than to set strict rules to be followed.
- 4 The Code has been developed having regard to conventional passenger and cargo ships. While certain types and sizes of ships have been excluded from application, it should be recognized that full application to ships which differ appreciably from the conventional types of ships regarding design or operations might need specific consideration.
- 5 The Code is not intended for direct incorporation by reference or reproduction in national legislation although it could provide a basis for such legislation.
- 6 The Organization adopted a recommendation on methods of measuring noise levels at listening posts with resolution A.343(IX). This recommendation related to interference by shipborne noise with the proper reception of external audible navigation signals and although the methods of measuring noise levels in accordance with resolution A.343(IX) and with the Code are different, these documents are considered compatible inasmuch as the Code is concerned primarily with the effect of noise on health and comfort.

CHAPTER 1 - GENERAL

1.1 Scope

1.1.1 The Code is designed to provide standards to prevent the occurrence of potentially hazardous noise levels on board ships and to provide standards for an acceptable environment for seafarers.

1.1.2 Recommendations are made for :

- .1 protecting the seafarer from the risk of noise-induced hearing loss under conditions where at present it is not feasible to limit the noise to a level which is not potentially harmful;
- .2 measurement of noise levels and exposure;
- .3 limits on acceptable maximum noise levels for all spaces to which seafarers normally have access.

1.2 Purpose

1.2.1 The purpose of the Code is to limit noise levels and to reduce exposure to noise, in order to:

- .1 provide for safe working conditions by giving consideration to the need for speech communication and for hearing audible alarms, and to an environment where clear-headed decisions can be made in control stations, navigation and radio spaces and manned machinery spaces;
- .2 protect the seafarer from excessive noise levels which may give rise to a noise-induced hearing loss;
- .3 provide the seafarer with an acceptable degree of comfort in rest, recreation and other spaces and also provide conditions for recuperation from the effects of exposure to high noise levels.

1.3 Application

1.3.1 The Code applies to new ships of 1,600 tons gross tonnage and over.

1.3.2 The provisions relating to potentially hazardous noise levels contained in the Code should also apply to existing ships of 1,600 tons gross tonnage and over, as far as reasonable and practicable, to the satisfaction of the Administration.

1.3.3 The Code should apply to new ships of less than 1,600 tons gross tonnage, as far as reasonable and practicable, to the satisfaction of the Administration.

1.3.4 The Code does not apply to:

- dynamically supported craft;
- fishing vessels;
- pipe-laying barges;
- crane barges;
- mobile offshore drilling units;
- pleasure yachts not engaged in trade;
- ships of war and troopships;
- ships not propelled by mechanical means.

1.3.5 For ships designed for and employed on voyages of short duration, or on other services involving short periods of operation of the ship, sections 4.2.3 and 4.2.4 may be applied only with the ship in the port condition, provided that the periods under such conditions are adequate for seafarers' rest and recreation.

1.3.6 The Code applies to ships in service, i.e. in port or at sea with seafarers on board.

1.3.7 The Code is not intended to apply to passenger cabins and other passenger spaces except in so far as they are work spaces and are covered by the provisions of the Code.

1.4 Definitions

For the purpose of the Code the following definitions apply. Additional definitions are given elsewhere in the Code.

1.4.1 Accommodation spaces: Cabins, offices (for carrying out ship's business), hospitals, mess rooms, recreation rooms (such as lounges, smoke rooms, cinemas, libraries and hobbies and games rooms) and open recreation areas to be used by seafarers.

1.4.2 Auxiliary machinery: Machinery other than main propelling machinery that is in service when the ship is in normal service, e.g. auxiliary diesel engines, turbo-generators, hydraulic motors and pumps, compressors, boiler ventilation fans, gear pumps.

1.4.3 A-weighted sound pressure level or noise level: The quantity measured by a sound level meter in which the frequency response is weighted according to the A-weighting curve (see IEC publication 651).

1.4.4 Continuously manned spaces: Spaces in which the continuous or prolonged presence of seafarers is necessary for normal operational periods.

1.4.5 Crane barge: A vessel with permanently installed cranes designed principally for lifting operations.

1.4.6 Duty stations: Those spaces in which the main navigating equipment, the ship's radio or the emergency source of power are located or where the fire recording or fire control equipment is centralized and also those spaces used for galleys, main pantries, stores (except isolated pantries and lockers), mail and specie rooms, workshops other than those forming part of the machinery spaces and similar such spaces.

1.4.7 Dynamically supported craft: A craft which is operable on or above water and which has characteristics different from those of conventional displacement ships. Within the aforementioned generality, a craft which complies with either of the following characteristics:

- .1 the weight, or a significant part thereof, is balanced in one mode of operation by other than hydrostatic forces;
- .2 the craft is able to operate at speeds such that the function $\frac{v}{\sqrt{gL}}$ is equal to or greater than 0.9, where "v" is the maximum speed, "L" is the water-line length and "g" is the acceleration due to gravity, all in consistent units.

1.4.8 Ear protector: A device worn to reduce the level of noise heard by the wearer.

1.4.9 Effective sound level $L_{ef(x)}(H)$: A notional continuous sound level which is calculated from the various A-weighted sound levels and duration at these levels with an XdB exchange rate. The exchange rate is the number of dB decrease in noise level which would allow doubling of exposure time. $L_{ef(x)}(H)$ is equal to $L_{eq}(H)$. In instances of fluctuating noise and intermittent exposures 5 dB is often used for X. "H" represents the time period concerned expressed in hours.

1.4.10 Equivalent continuous sound level $L_{eq}(H)$: A notional level which would in the course of a given time period (H) cause the same A-weighted sound energy to be received as that due to the actual sound over the period. "H" represents the time period concerned expressed in hours.

$$L_{eq} = 10 \log_{10} \frac{1}{T} \int_0^T \frac{(p_a(t))^2}{p_0^2} dt$$

where: T = measurement time

$p_a(t)$ = A-weighted instantaneous sound pressure

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

1.4.11 Fishing vessel: A vessel used commercially for catching fish, whales, seals, walrus or other living resources of the sea.

1.4.12 Fluctuating noise: Noise which is varying in level rising and falling. For the purpose of this Code it may be taken to mean fluctuations in excess of the steady noise as defined in 1.4.31 and excludes impulse noise as defined in 1.4.14.

1.4.13 Hearing loss: Hearing loss is evaluated in relation to a reference auditory threshold defined conventionally in ISO Standard 389 (1975). The hearing loss corresponds to the difference between the auditory threshold of the subject being examined and the reference auditory threshold. ISO Standard 1999 (1975)* takes an average loss of 25 dB calculated at frequencies 500, 1,000 and 2,000 Hz.

1.4.14 Impulse noise: Noise of less than one second's duration which occurs as an isolated event, or as one of a series of events with a repetition rate of less than 15 times per second.

1.4.15 Integrating sound level meter: A sound level meter designed or adapted to measure the level of the mean squared time averaged A-weighted sound pressure.

1.4.16 ISO noise rating (NR) number: The number found by plotting the octave band spectrum on the NR curves given in ISO Standard R 1996-1967 and selecting the highest noise rating curve to which the spectrum is tangent.

1.4.17 Machinery spaces: All spaces containing propulsion machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air-conditioning machinery and similar spaces, and trunks to such spaces.

1.4.18 Mobile offshore drilling unit: A vessel capable of engaging in drilling operations for the exploration for, or exploitation of, resources beneath the sea-bed, such as liquid or gaseous

1.4.19 Navigating bridge wings: Those parts of the ship's navigating bridge extending towards the ship's sides.

1.4.20 Noise: For the purpose of the Code all sound which can result in hearing impairment, or which can be harmful to health or be otherwise dangerous.

1.4.21 Noise induced hearing loss: A hearing loss, originating in the nerve cells within the cochlea, attributable to the effects of sound.

1.4.22 Noise level: See A-weighted sound pressure level (1.4.3).

1.4.23 Normal service shaft speed: The shaft speed specified for the ship's acceptance on initial delivery, or after being modified, as applicable.

1.4.24 Occasional exposures: Those exposures typically occurring once per week, or less frequently.

1.4.25 Passenger: Any person on board other than the master and members of the crew or other persons employed or engaged in any capacity on board a ship on the business of that ship.

1.4.26 Pipe-laying barge: A vessel specifically constructed for, or used in conjunction with, operations associated with the laying of submarine pipelines.

1.4.27 Port condition: The condition in which all machinery solely required for propulsion is stopped.

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:

$$L = 20 \log_{10} \frac{p}{p_0} \text{ dB}$$

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

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

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.

* Recommendation for sound level meters.

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.

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

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 ± 1 dB(A) and with an industrial grade meter about ± 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 ± 0.3 dB(A), and for use with industrial grade meters accurate to within ± 0.5 dB(A).

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:

4.2.1 Work spaces (see 5.1)	dB(A)
.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**	9

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

4.2.2 Navigation spaces	dB(A)
.1 Navigation 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

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

4.2.3 Accommodation space	dB(A)
.1 Cabins and hospitals	60
.2 Mess rooms	65
.3 Recreation rooms	65
.4 Open recreation areas	75
.5 Offices	65

4.2.4 Service spaces	dB(A)
.1 Galleys, without food processing equipment operating	75
.2 Serveries and pantries	75

4.2.5 Normally unoccupied spaces*	dB(A)
Spaces not specified (see 5.1)	90

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

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.

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 $Leq(24)$ 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 $Leq(24)$ 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 $Leq(24)$ 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.

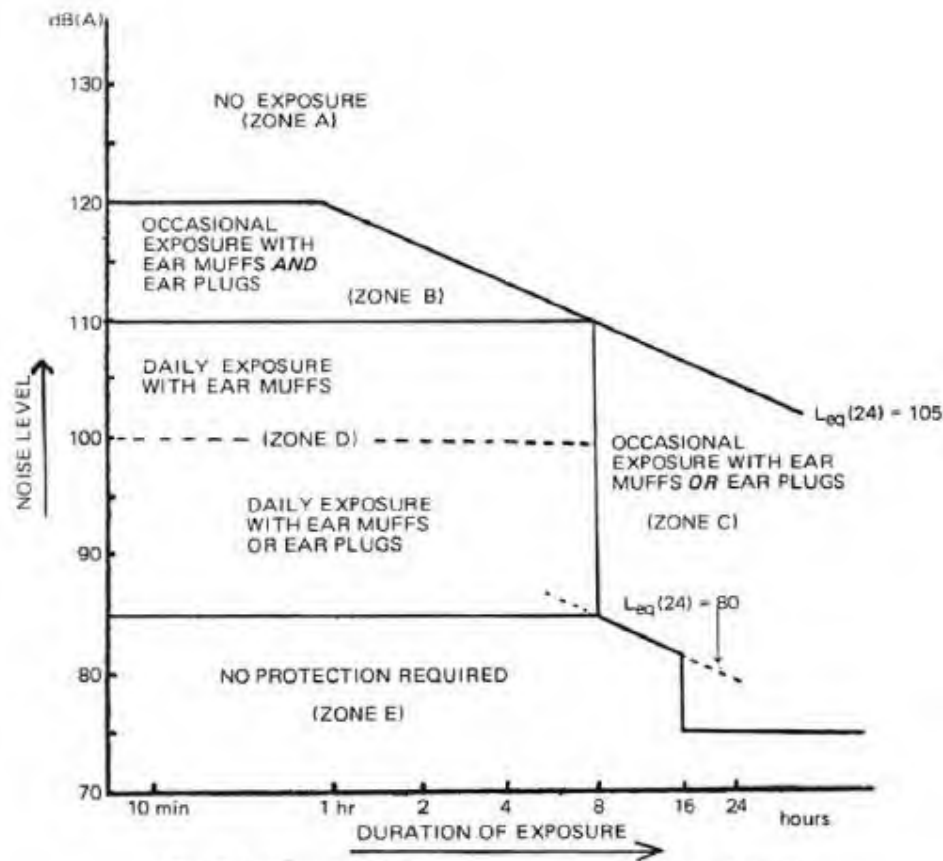


Fig. 5.1 Allowable daily and occasional noise exposure zones

5.4 24 hour equivalent continuous sound level limit

As an alternative to compliance with the provisions of 5.3 (fig. 5.1), no unprotected seafarer should be exposed to a 24 hour equivalent continuous sound level greater than 80 dB(A). Each individual's daily exposure duration in spaces requiring the use of ear protectors should not exceed 4 hours continuously or 8 hours in total. In those cases, where the Administration determines that exposures are intermittent, no unprotected seafarer should be exposed to an equivalent effective sound level which in the case of a 5 dB exchange rate would be $L_{(eq)(5)}(24)$ equal to 77 dB(A).

5.5 Hearing conservation programme

5.5.1 A hearing conservation programme may be provided for seafarers exposed to the noise levels referred to in 5.3.3 in order to train them in the hazards of noise and use of ear protection, and to monitor hearing acuity. Some elements of a hearing conservation programme are as follows:

- .1 Initial and periodic audiometric tests administered by a trained and appropriately qualified person, to the satisfaction of the Administration.
- .2 Instruction of exposed persons on the hazards of high and long duration noise exposures and on the proper use of ear protectors (see Appendix 2).
- .3 Maintenance of audiometric test records.
- .4 Periodic analysis of records and hearing acuity of individuals with high hearing loss.

An optional element of a hearing conservation programme is to control the 24 hour equivalent continuous or effective sound level to which individuals working in high noise level spaces are exposed. Such control requires calculation of the 24 hour equivalent continuous or effective sound level based upon the measurement of exposure durations for steady noise levels in accordance with 2.6.5 or the equivalent continuous sound level measurement for fluctuating noise in accordance with 2.6.4. If this 24 hour level does not meet the limits, the duration of exposure should be controlled or ear protectors used at appropriate times to bring the individual's exposure within the limit.

CHAPTER 6 - ACOUSTIC INSULATION BETWEEN ACCOMMODATION SPACES

6.1 General

Consideration should be given to the acoustic insulation between accommodation spaces in order to make rest and recreation possible even if activities are going on in adjacent spaces, e.g. music, talking, cargo-handling, etc.

6.2 Sound insulation index

6.2.1 The airborne sound insulation properties for bulkheads and decks within the accommodation should comply at least with the following airborne sound insulation index (l_a) according to ISO Standard R717*:

Cabin to cabin $l_a = 30$

Messrooms, recreation rooms
to cabins and hospitals $l_a = 45$

*ISO Standard R717 - Rating of Sound Insulation for Dwellings.

6.2.2 The airborne sound insulation properties should be determined by laboratory tests in accordance with ISO Standard R140 Pt III**, to the satisfaction of the Administration.

**ISO Standard R140 Pt III - Laboratory Measurements of Airborne Sound Insulation and of Building Elements.

6.3 Erection of materials

Care should be taken in the erection of materials and in the construction of accommodation spaces to ensure to the greatest practicable extent that the attenuation values specified in 6.2 are not significantly impaired.

CHAPTER 7 - EAR PROTECTION AND WARNING INFORMATION

7.1 General

When the application of means for controlling sound at source does not reduce the noise level in any space to that specified in 4.1.3, seafarers who are required to enter such spaces should be supplied with effective ear protection on an individual basis. The provision of ear protectors should not be considered to be a substitute for effective noise control. Appendix 3 summarizes current noise abatement methods which may be applied on new ships.

7.2 Recommendation for ear protectors

7.2.1 Ear protectors should provide at least the attenuation listed in table 7.1. The attenuation to be compared with that in the table should be the result of the average value of the ear protector attenuation minus the standard deviation measured in accordance with ISO Standard (DIS 4869) or similar standard acceptable to the Administration.

7.2.2 For the purpose of developing the criteria specified in Chapter 4 and section 5.3, ear protectors have been assumed to provide approximately the following insertion loss:

- .1 ear plugs - 20 dB(A)
- .2 ear muffs - 30 dB(A)
- .3 ear plugs and ear muffs - 35 dB(A)

Therefore, care should be exercised when using ear plugs in very high noise areas (i.e. over 100 dB(A)) unless the attenuation of the plug used sufficiently exceeds the values of table 7.1 or appropriate attenuations at individual frequencies are known.

TABLE 7.1 - REAL EAR ATTENUATION OF EAR PROTECTORS - dB

Type of ear protector	Octave band centre frequency - Hz							
	125	250	500	1000	2000	3150	4000	6300
Ear plugs	0	5	10	15	22	22	22	22
Ear muffs	5	12	20	30	30	30	30	30

7.3 Selection and use of ear protectors

Seafarers should be instructed in the proper use of ear protectors in accordance with Appendix 2.

7.4 Warning notices

Where the noise level in machinery spaces (or other spaces) is greater than 85 dB(A), entrances to such spaces should carry a warning notice comprising symbol and supplementary sign as prescribed by the Administration. If only a minor portion of the space has such noise levels the particular location(s) or equipment should be identified at eye level, visible from each direction of access.

7.5 Miscellaneous equipment

Where hand tools, galley and other portable equipment produce noise levels above 85 dB(A) in normal working conditions warning information should be provided.

APPENDIX 1

FORMAT FOR NOISE SURVEY REPORT

1 Ship particulars

- .1 Name of ship
- .2 Port of registry
- .3 Name and address of shipowner, managing owner or agent
- .4 Name and address of shipbuilder
- .5 Place of build
- .6 Builder's number
- .7 Gross tonnage
- .8 Type of ship
- .9 Ship's dimensions
 - length
 - breadth
 - depth
 - maximum draught (summer load line)
- .10 Displacement at maximum draught
- .11 Date of keel laying
- .12 Date of delivery

2 Machinery particulars

- .1 Propulsion machinery
 - Manufacturer: Type: Number of units:
 - Maximum cont. rating - power kW
 - Normal designed service shaft speed: r.p.m.
 - Normal service rating - power: kW
- .2 Auxiliary diesel engines
 - Manufacturer: Type:
 - Output: kW Number of units:
- .3 Main reduction gear:
- .4 Type of propeller (fixed propeller, controllable pitch propeller, Voith-Schneider propeller)
 - Number of propellers: Number of blades:
 - Designed propeller shaft speed: r.p.m.

3 Measuring instrumentation

- .1 Instrumentation
 - Make Type Serial No.
 - Sound level meter
 - Microphone
 - Filter
 - Windscreen
 - Calibrator
 - Other equipment
- .2 Calibration of sound level meter Date Calibration Start Finish
-at survey by competent authority

4 Conditions during measurement

- .1 Date of measurement: Starting time: Completion time:

- .2 Vessel's position during measurement
- .3 Type of voyage
- .4 Conditions during measurement
 - Draught forward
 - Draught aft
 - Depth of water under keel
- .5 Weather conditions
 - Wind force
 - Sea state
- .6 Ship speed
- .7 Actual propeller shaft speed: r.p.m.
- .8 Propeller pitch:
- .9 Propulsion machinery speed: r.p.m.
- .10 Propulsion machinery power: KW
- .11 Number of propulsion machinery units operating:
- .12 Number of diesel auxiliary engines operating:
- .13 Number of turbogenerators operating:
- .14 Other auxiliary equipment operating:

5 Measuring data	Noise limits dB(A)	Measured sound pressure levels dB(A)
Machinery spaces:		
Control rooms		
Workshops		
Propulsion machinery:		
Turbocharger		
Top propulsion machinery		
Auxiliary diesel engines/ Turbogenerators		
Reduction gear		
Non-specified workspaces		
Accommodation and other spaces		
Messes		
Recreation rooms		
Offices		
Galleys		
Serveries and pantries		
Cabins		

Note: Those spaces and areas where noise rating numbers are calculated are indicated by * and the data will be found in the Attachment.

Noise limits Measured sound
dB(A) pressure levels
 dB(A)

Navigation spaces
 Bridge
 Chart room
 Radar room
 Radio room
 Navigating bridge wings

Open recreation area

6 Main noise abatement measures (list measures taken)

7 Remarks (list any exceptions to the Code)

.....
Name

.....
.....
Address

.....
Place Date Signature

ATTACHMENT

PAGES OF FREQUENCY ANALYSIS

Note: Those spaces and areas where noise rating numbers are calculated are indicated by * and the data will be found in the Attachment.

APPENDIX 2

INSTRUCTIONS TO SEAFARERS AND RESPONSIBILITY

1 Instruction to seafarers

1.1 Seafarers should be instructed in the hazards of high and long duration noise exposures and the risk of noise induced hearing loss. Instruction should be given to all seafarers on initial employment and periodically thereafter to those regularly working in spaces with noise levels in excess of 85 dB(A). Instruction in the provisions of the Code should include:

- .1 noise exposure limits of Chapter 5 and the use of warning notices in complying with the criteria;
- .2 the types of ear protectors provided, their approximate attenuation and their proper use, fitting, and risk effects experienced when first wearing such protection;

- .3 any hearing conservation programme which may be available if working in spaces covered by warning notices;
- .4 some of the possible signs of hearing loss such as ringing in the ear, dead ear, or fullness in the ear.

1.2 Appropriate seafarers should receive such instruction as is necessary in the correct use and maintenance of machinery and silencers or attenuators in order to avoid the production of unnecessary noise.

2 Responsibility of shipowners

2.1 The shipowner should be responsible for ensuring that means for noise reduction and control are applied and maintained such that the requirements of the Code are met.

2.2 Where noise levels in any space exceed the limit of 85 dB(A), shipowners should ensure that:

- .1 the space is identified and the warning notice described in 7.4 of the Code is displayed;
- .2 the master and senior officers of the ship are notified as to the importance of controlling entry into the space and the importance of the use of suitable ear protectors;
- .3 suitable ear protectors are provided in sufficient numbers for distribution on an individual basis;
- .4 an instruction is issued to the master, senior officers and any safety officer of the ship pointing out the desirability of providing the instruction outlined in 1.1 and 1.2 to seafarers.

3 Responsibility of seafarers

3.1 Seafarers should be responsible for ensuring that:

- .1 measures adopted for noise control are used;
- .2 defective noise control equipment is reported to a responsible person;
- .3 suitable ear protectors are normally worn when entering areas in which their use is required by warning notices and that these protectors are not removed, even for short periods; and
- .4 ear protectors provided for use are not damaged or misused and are maintained in a clear condition.

APPENDIX 3

SUGGESTED METHODS OF CONTROLLING NOISE EXPOSURE

1 General

1.1 In order to obtain a noise reduction on board ships to comply with the recommended limits given in Chapters 4 and 5 of the Code careful consideration should be given to means of such reduction. This Appendix is intended to provide guidance for the design of a ship in this respect.

1.2 Design and construction of noise control measures should be supervised by persons skilled in noise control techniques.

1.3 Some of the measures which can be taken to control the noise level or reduce the exposure of seafarers to potentially harmful noise are indicated in sections 2 to 10 of this Appendix. It is emphasized that it will not be necessary to implement all or any of the measures recommended in this Appendix on all ships. This Code does not provide detailed technical information needed for putting

constructional noise control measures into effect, or for deciding which measures are appropriate in particular circumstances.

1.4 In applying noise control measures, care should be taken to ensure that rules and regulations concerning ship structure, accommodation and other safety matters are not infringed and the use of sound reduction materials should not introduce fire or health hazards.

1.5 The need for noise control should be taken into account at the design stage when deciding which of different designs of engines and machinery are to be installed, the method of installation and the siting of machinery in relation to other spaces, and the acoustic insulation and siting of the accommodation spaces.

1.6 Due to the normal method of ship construction it is most probable that noise originating from machinery and propellers reaching the accommodation and other spaces outside the machinery spaces will be of the structure-borne type.

1.7 When designing efficient and economic measures for noise control of machinery installations in existing ships, the measurement of sound produced in terms of A-weighted sound level may need to be supplemented by some form of frequency analysis.

2 Isolation of sources of noise

2.1 Where practicable any engines or machinery producing noise levels in excess of the limits set out in 4.2 of the Code should be installed in compartments which do not require continuous attendance (see also 6.1 of this Appendix).

2.2 Accommodation should be sited both horizontally and vertically as far away as is practicable from sources of noise such as propellers and propulsion machinery.

2.3 Machinery casings should, where practicable, be arranged outside superstructures and deckhouses containing accommodation spaces. Where this is not feasible, passageways should be arranged between the casings and accommodation spaces, if practicable.

2.4 Consideration should be given, where practicable, to the placing of accommodation spaces in deck houses not in superstructures extending to the ship's side.

2.5 Consideration may also be given where applicable to the separation of accommodation spaces from machinery spaces by unoccupied spaces, sanitary and washing rooms.

2.6 Suitable partitions, bulkheads, decks, etc. may be needed to prevent the spread of sound. It is important that these be of the correct construction and location in relation to the source of sound and the frequency of the sound to be attenuated.

2.7 Where a space, such as a machinery space, is being divided into noisy (not continually manned) and less noisy (capable of being continually manned) spaces, it is preferable to have complete separation*.

* In these cases it may be necessary to ensure the supervision of the plant by installing alarms in the less noisy compartments and to arrange means of escape so that seafarers may leave these compartments without danger.

2.8 It may be advisable to provide sound absorbing material in certain spaces in order to prevent increase of noise level due to reflection from partitions, bulkheads, decks, etc.

3 Exhaust and intake silencing

3.1 Exhaust systems from internal combustion engines, air intake systems to machinery spaces, accommodation spaces and other spaces should be so arranged that the inflow or discharge orifices are remote from places frequented by seafarers.

3.2 Silencers or attenuators should be fitted when necessary.

3.3 To minimize accommodation noise levels it is normally necessary to isolate exhaust systems and certain pipework and ductwork from casings, bulkheads, etc.

4 Machinery enclosure

4.1 In continuously manned spaces or spaces where seafarers might reasonably be expected to spend lengthy periods of time on maintenance or overhaul work, and where separation as detailed in section 2 of this Appendix is not practicable, consideration may have to be given to the fitting of sound insulating enclosures or partial enclosures to engines or machinery producing sound pressure levels in excess of the limits set out in 4.2 of the Code.

4.2 Where the noise level produced by engines or machinery installed in spaces as in 4.1 above falls within the criteria of 5.3.1 of the Code and zone A of figure 5.1, it is essential that noise reduction measures are provided.

4.3 When sound insulating enclosures are fitted, it is important that they entirely enclose the noise source.

5 Reduction of noise in the aft body

To reduce the noise influence in the aft body of the ship, especially to the accommodation spaces, consideration may be given to noise emission problems during the design procedures relating to the aft body, propeller, etc.

6 Enclosure of the operator

6.1 In most machinery spaces it would be desirable and advisable to protect operating or watchkeeping seafarers by providing a sound reducing control room or other similar space (see 2.1 of this Appendix).

6.2 In continuously manned machinery spaces of small ships and of existing ships where noise levels are in excess of 85 dB(A), it would be desirable to provide a noise refuge at the control station or manoeuvring platform where the watchkeeper might be expected to spend the major part of the time.

7 Controls in accommodation spaces

7.1 To reduce noise levels in accommodation spaces it may be necessary to consider the isolation of deckhouses containing such spaces from the remaining structure of the ship by resilient mountings.

7.2 Consideration may also be given to the provision of flexible connexions to bulkheads, linings and ceilings and the installation of floating floors within accommodation spaces.

7.3 The provision of curtains to sidescuttles and windows and the use of carpets within accommodation spaces assists in absorbing noise.

8 Selection of machinery

8.1 The sound produced by each item of machinery to be fitted should be taken into account at the design stage. It may be possible to control noise by using a machine producing less airborne, fluid-borne or structure-borne sound.

8.2 Manufacturers should be requested to supply information on the sound produced by their machinery and also to provide recommended methods of installation in order to keep noise levels to a minimum.

9 Inspection and maintenance

All items of machinery, equipment and associated working spaces should be regularly inspected with respect to noise by a competent person. Should such inspection reveal defects in the means for noise control, or other defects causing excessive noise, these should be rectified as soon as practicable.

10 Vibration isolation

10.1 Where necessary, machines should be supported on correctly designed and fitted resilient mountings.

10.2 Where structure-borne sound from auxiliary machinery, compressors, hydraulic units, generating sets, vents, exhaust pipes and silencers produces unacceptable noise levels in accommodation spaces or on the navigating bridge, resilient mountings should be fitted.

10.3 When sound insulating enclosures are fitted it is desirable that the machine should be resiliently mounted and that all pipe, trunk and cable connexions to it be flexible.