

Transport
Canada

TP 3685E

Coast Guard

**Standards Respecting Noise
Control and Hearing Protection
in Canadian Towboats
Over 15 Tons, Gross Tonnage**

Ship Safety 1982

FOREWARD

High noise levels on board ships can affect seafarers' health and impair the safety of the ship. For this reason, seafaring nations have been considering the matter of noise levels on board ships for some time and a consequence of this concern was the adoption on November 19, 1981 of IMCO Resolution A.468(XII) "CODE ON NOISE LEVELS ON BOARD SHIPS".

The Ship Safety Branch of the Canadian Coast Guard, being aware of the importance of noise levels on board ships, commissioned Messrs. Jackson, Talbot and Associates in August 1972 to prepare a study to ascertain feasible noise levels attainable in the accommodation spaces of both existing and new towboats. The study was published in 1974 under the title "Feasible Noise Levels in Accommodation of Vessels Engaged in Towing".

Based on this study and recommendations in use in other countries, particularly in the United Kingdom, the Ship Safety Branch in November 1979 presented to the Industry for comments, as an initial proposal, recommended Standards respecting noise control and hearing protection in Canadian ships.

As a result of this presentation, the West Coast towboat industry made representations to the Director of the Ship Safety Branch for a separate Code for the towboats. The Branch recognized the special problems inherent in towboats owing to their high power to length ratio and set up a small working group, composed of labour, Towboat Owners from the West Coast and Government representatives, to discuss standards respecting noise control and hearing protection in Canadian towboats over 15 tons, gross tonnage.

These Standards are the result of the work of the members of this group, whom I wish to thank, especially those from Labour and Industry, for their continuous efforts and cooperation. I wish also to thank Dr. Patrick Gannon and Dr. E.A.G. Shaw for their continuous and valuable technical help in the formulation of the Standards.

J. Hornsby,
Director,
Ship Safety.

EXPLANATORY NOTE ON SOUND MEASURING INSTRUMENTS

During the past decade, experience in Canada and elsewhere has shown that accurate measurements of sound level are needed if industrial noise control programmes are to be fully effective. To meet such needs, many new and improved instruments have been developed in recent years, some of which are already in general use. Unfortunately, the national and international standards that define instrument performance have not kept pace with advances in technology and design.

In an effort to address this situation, the Standards refer to a new international standard (IEC 651 published in 1979) and two other standards, which are in preparation and approaching finality.

In IEC Publication 651, the time weighting characteristics are designated S, F and I ("slow", "fast" and "impulse"). Instruments that incorporate I time weighting (e.g. Type 11 and Type 21 Sound Level Meters) have the wide dynamic range and high crest factor capability needed for the accurate measurement of short-duration sounds. These features are also desirable when measuring some of the highly complex steady-state sounds that industrial machinery produces. Moreover, the detector performance of instruments that do not include I time weighting is more closely defined in IEC 651 than in earlier standards such as CSA Z107.1-1973 and ANSI S1.4-1971. The ANSI Standard now in preparation (the revision of ANSI S1.4-1971) conforms as closely as possible to IEC Publication 651 (with respect to time-weighting, for example) but deviates from 651 in the requirement for diffuse field calibration rather than the free field method. It is understood that the Canadian Standards Association has IEC Publication 651 under consideration for endorsement or adoption and that a similar treatment of the revised ANSI Standard can be anticipated in a year or two.

The standard for Integrating Sound Level Meters now in preparation in WG11 of IEC TC29/SC29C is consistent with the relevant parts of IEC Publication 651 but specifies additional characteristics necessary to measure the equivalent sound pressure level L_{Aeq} of steady, intermittent, fluctuating and impulsive sounds. It recognizes two degrees of pulse-handling capability designated N and P. Category N instruments are not capable of measuring impulsive sounds.

The Standards allow a wide latitude in the choice of measuring instruments while requiring that the instruments comply with the precise standards of performance defined in the new documents. In particular, the use of Type 2 instruments is accepted in keeping with current industrial practice. At the same time, it is recognized that all measurements are subject to error and that measurement differences may occasionally require resolution. (It is, for example, conceivable that sound level measurements made with two properly calibrated Type 2 instruments might differ by two decibels or more). In such cases, section 5.7 of the Standards requires that reference measurements be made with a precision instrument capable of handling complex or impulsive sounds (i.e., a Type 1I SLM or Type 1(P) Integrating-Averaging SLM).

STANDARDS RESPECTING NOISE CONTROL AND HEARING PROTECTION

IN CANADIAN TOWBOATS OVER 15 TONS, GROSS TONNAGE

1. AIM OF THE STANDARDS

1.1 The aim of these Standards is to limit maximum sound levels and to reduce exposure to noise in order to:

- (a) protect the crew from the risk of noise-induced hearing loss;
- (b) provide the crew with acceptable conditions for recuperation from the effects of exposure to high sound levels; and
- (c) provide for safe working conditions by giving consideration to the need for speech communication.

1.2 Where it is reasonable and practicable to do so, it is recommended that the sound levels be reduced to values lower than those specified in these Standards to further reduce the risk referred to in 1.1(a).

1.3 The limits set out in these Standards should be regarded as maximum acceptable levels. As more scientific information becomes available, consideration should be given to amending these Standards accordingly.

2. DEFINITIONS

2.1 In these Standards the following definitions shall apply:

"crew" includes the master, officers, seamen and apprentices of a ship;

"existing ship" means any ship that is not a new ship;

"new ship" means a ship whose construction was started on or after January 1, 1982, or which was registered in Canada on or after that date;

"ship" means every towboat over 15 tons, gross tonnage, not engaged in the salvage of logs;

"sleeping cabins" means the sleeping rooms required by the "Towboat Crew Accommodation Regulations";

"noise" means unwanted sound;

"noise-induced hearing loss" means a permanent hearing loss attributable to the effects of noise;

"sound level" means the A-weighted sound pressure level, as determined with a sound level meter or other suitable instrument;

"sound pressure level" in decibels (dB) is defined as 20 times the logarithm to the base ten of the ratio of a sound pressure to the reference pressure. For the purposes of these Standards, the reference pressure is 20 micropascals (or 2×10^{-5} N/m²) and does not depend on frequency or time weighting;

"A-weighted sound pressure level" in decibels (dB or dB(A)) is 20 times the logarithm to the base ten of the ratio of sound pressure, weighted in accordance with the frequency weighting A, to the reference pressure;

"equivalent continuous sound levels in decibels" is defined as follows:

$$L_{Aeq} = 10 \log_{10} \left\{ \frac{1}{T_m} \int_0^{T_m} \left[\frac{P_A^2(t)}{P_o^2} \right] dt \right\} dB$$

where

$P_{A(t)}$ is the instantaneous A-weighted sound pressure in pascals (note that P_A is a function of time t, measured in seconds);

P_o is the reference sound pressure of 20 micropascals (or 2×10^{-5} N/m²); and

T_m is the integration time interval in seconds.

(Note - The equivalent continuous sound level (L_{Aeq}) can be regarded as the steady A-weighted sound pressure level which, over the integration period T_m , would cause the same A-weighted sound energy to be received as that caused by the actual (fluctuating) A-weighted sound pressure $P_{A(t)}$ existing during the integration period. Typical intergration periods are 1 minute, 10 minutes, 1 hour, 4 hours, 8 hours and 24 hours.)

3. APPLICATION

3.1 Subject to the provisions of 3.2, these Standards shall apply to new and existing ships over 15 tons, gross tonnage.

3.2 The maximum sound level specified in 4.3 shall apply to new ships only.

3.3 These Standards apply to ships in service, i.e., in port or at sea with crew on board.

4. ACCEPTABLE MAXIMUM SOUND LEVELS

4.1 Any crew member entering any space of the ship where the sound level is 85 dB(A) or more shall use a hearing protector of appropriate quality (Class A, B or C as defined in CSA Standard Z94.2-1979), as follows:

- (a) in spaces where the level is not in excess of 95 dB(A), the protector shall be of Class A, B or C;
- (b) in spaces where the level exceeds 95 dB(A) but is not in excess of 100 dB(A), the protector shall be of Class A or B;
- (c) in spaces where the level exceeds 100 dB(A), the protector shall be of Class A.

4.2 For existing ships the equivalent continuous sound level in sleeping cabins shall not exceed 75 dB(A).

4.3 For new ships the equivalent continuous sound level in sleeping cabins shall not exceed 70 dB(A).

5. MEASUREMENT OF SOUND LEVEL

5.1 When a new ship is completed, or as soon as possible thereafter, measurements of sound level shall be taken under the operating conditions specified in 5.4 and be suitably recorded.

5.2 In existing ships, sufficient measurements of sound level shall be taken as soon as possible under the operating conditions specified in 5.4 and shall be suitably recorded.

5.3 In the case of new and existing ships, measurements of sound level shall be taken and recorded

- (a) whenever a major refit or conversion is undertaken, and
 - (b) at each quadrennial or quinquennial inspection, as applicable to the ship,
- following the initial measurements.

5.4 The condition of the ship during the measurement of sound level shall be as follows:

- (a) ship in full working condition with engine controls set at full ahead;
- (b) all continuously operating auxiliary machinery functioning normally;
- (c) ventilation and air conditioning systems operating normally;
- (d) at least 75% oil fuel and water on board; and

(e) all cabin doors, windows and sidelights closed during measurements in cabins.

5.5 During the measurement of sound level, as required in 5.4, the sea state, wind, rain, depth of water and other environmental conditions that may influence sound level readings shall be recorded.

5.6 Measurements of sound level in accordance with 5.4 and 5.5 shall be entered on a form, as shown in Appendix A of these Standards, which shall be retained on board the ship.

5.7 The measured sound levels shall be A-weighted sound pressure levels taken with:

(a) a Type (Category P), Type 1 (Category N), Type 2 (Category P) or Type 2 (Category N) instrument as specified in the standard for Integrating-Averaging Sound Level Meters now in preparation in Working Group 11, Technical Committee No. 29, Sub-Committee 29C of the International Electrotechnical Commission, or other equivalent standard; or

(b) a Type 1, Type 1 I, Type 2 or Type 2 I instrument as specified in International Electrotechnical Commission Publication 651; Sound Level Meters (First Edition, 1979), American National Standard: Specification for Sound Level Meters (Revision of ANSI S1.4-1971) now in preparation in ANSI Working Group S1-45 of the Acoustical Society of America, or other equivalent standard.

When the instrument is an integrating-averaging sound level meter the equivalent continuous sound level (L_{Aeq}) shall be measured with an integration time interval chosen to give a reading fully representative of the sound level in the space.

When the fluctuations in sound level are no greater than 6 dB, the sound level may be measured with a sound level meter with S time weighting (i.e., "slow" response). A measuring period of at least ten seconds shall be allowed for each reading, and an estimate of level made by averaging the excursions of the meter needle by eye. When the fluctuations in level are between 4 and 6 dB, the estimated average level shall be increased by 1 dB.

In the event of disagreement, reference measurements shall be made with a Type 1 (Category P) integrating-averaging sound level meter or a Type 1I sound level meter.

Notes: (i) Pending the publication of the IEC standard for integrating-averaging sound level meters referred to in 5.7(a), such instruments shall comply with the draft document dated July 1981.

(ii) Pending the publication of the revision of ANSI S1.4-1971 referred to in 5.7(b), the draft document ANSI S1.4-198X may be used.

5.8 In cabins and spaces of similar size, sound level measurements shall normally be taken in the centre of the room at normal ear height (1.2 to 1.5 m). The microphone shall be moved horizontally and/or vertically over a distance of approximately 1 metre (i.e., swung on 0.5 m radius) to provide spatial averaging during the measurement.

In larger spaces, where sound levels may vary considerably within the space, readings shall be taken at intervals not greater than 3 m throughout the space, including positions of maximum sound level.

5.9 Sound levels need not be recorded for normally unoccupied spaces and deck areas that are remote from sources of noise and where a rough check shows that the sound levels are well below 85 dB(A).

5.10 Unless specifically required, the measurements shall not normally be taken closer than 1 metre from decks, bulkheads or other major surfaces.

5.11 In machinery spaces, readings shall not normally be taken at distances less than 1 metre from operating machinery, decks, bulkheads or other major surfaces, inlets and exhausts. Where this is not possible, measurements shall be taken at a position mid-way between the machine and the adjacent reflecting surface. Measurements of noise from inlet and exhaust openings shall be taken at positions located 30° to the direction of flow to avoid influencing the readings by low frequency turbulence in the gas stream. Measurements shall be made at a height 1.2 to 1.5 m above the deck, platform or walkway as follows:

(a) in single screw engine rooms, one measurement forward and one measurement aft of the main engine; and

(b) in twin screw engine rooms, the measurement shall be taken at a position midway between the engines.

5.12 The batteries and calibration of the measuring instrument shall be checked immediately before and after each period of use. During measurements of sound level, only those persons necessary for the operation of the ship and those persons taking the measurements shall be present in the space concerned, which shall be furnished to the normal seagoing standard.

6. HEARING TESTING PROGRAM

6.1 Every crew member of a ship to which these Standards apply shall undergo an annual hearing test and the results shall be recorded. Testing programs, acceptable to the Director, Ship Safety Branch, shall be established. Such programs shall be under the supervision of a certified audiologist or a medical practitioner duly qualified in the hearing field, who shall also have the responsibility for interpreting the test results.

APPENDIX A

Ship Noise Survey Test Sheet

Name of Ship:

Official Number:

Port of Registry:

Owner:

Registered Length:

Gross Tonnage:

Engine Make and Rating:

Main Engine Revolutions at Time of Test:

Condition of Ship at Time of Test (Answer the following questions):

Were the engine controls set full ahead?

Fuel and water on board (at least 75% of total capacity)

Was all continuous operating auxiliary machinery functioning normally?

Were ventilation and air conditioning systems operating normally?

Were all doors, windows and sidelights of the space closed?

Depth of water under the ship at time of test:

Sea State:

Wind:

Rain:

Other environmental conditions that may influence readings:

SOUND LEVEL MEASUREMENTS

COMPARTMENT	SOUND LEVEL dB (A)	LOCATION	REMARKS
Wheelhouse			
Master's Cabin			
1st Mate's Cabin			
2nd Mate's Cabin			
Chief Engineer Cabin			
Deckhand's Cabin			
Deckhand's Cabin			
Cook's Cabin			
Mess Area			
Galley Area			
SINGLE SCREW ENGINE ROOM Forward of Main Engine Aft of Main Engine			
TWIN SCREW ENGINE ROOM Midway between engines			
Engine Room (Control Booth)			
Aft Deck (Working Area)			
Aft Deck Control			
Top Deck Control			

Make, type and serial number of sound level meter:

Duration of measurement (integration period):

Was the measuring instrument calibrated immediately before and after the recording of measurements?

Sound level measurements taken by:

Sound level measurements witnessed by:

Date of Test:

Additional Comments or Remarks: