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Ships and marine technology — Noise measurement method for HVAC system in accommodation spaces

First edition

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Contents

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 8, *Ship design*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Heating, ventilation and air conditioning (HVAC) is one of the most serious noise sources, especially for ~~the~~ ship accommodation spaces that are far from the machinery spaces~~, which~~. This noise source affects the habitability comfort ~~to the~~of crews and passengers on a ship. Although ~~there exist~~ some standards exist for measuring noise on board vessels, for example~~,~~ ISO 2923, no special attention has been paid to measure noise arising from the HVAC. ~~And other~~Other standards~~,~~ such as ISO 3740 are more accurate for quantifying measurement of a noise source~~, it needs~~. However, the methods specified in other standards require more measurement instruments ~~and consumes~~, are more time-consuming than the method presented ~~here,~~in this document and are difficult to ~~be used~~use in the noise measurement of HVAC system onboard ships, which has ~~so~~ many ~~of~~ outlets distributed in hundreds of cabins.

This document specifies a method of noise measurement of HVAC ~~system~~systems in ship accommodation spaces by placing three microphones around the vent outlets to reduce airflow interference and space inhomogeneity, and by correcting the noise result by measuring the reverberation time of the cabin. The noise measurement method for the HVAC system is a compromise, which is more precise~~,~~, but less laborious, compared to the previous methods.

The measurement should be performed for ship accommodation spaces, where noise exceeds the required limits according to ~~the~~ existing regulations~~, and the~~. The measurement and analysis results could be used ~~for detection of~~ to detect the causes ~~arising~~of the higher noise level of the HVAC system~~, furthermore taking the~~, further enabling objective measures to be taken to mitigate ~~it~~these causes.

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Ships and marine technology — Noise measurement method for HVAC system in accommodation spaces

1 Scope

~~The~~This document provides the instrumentation requirements and measurement procedures for measuring noise from HVAC ~~system~~systems in ship accommodation spaces.

Accommodation spaces are defined according to ISO 2923, ~~which~~and include cabins, offices (for carrying out ship's business), hospitals, messrooms and recreation rooms.

~~Noise~~Measurement of noise levels ~~measurement of~~ in HVAC ~~system~~systems in ship accommodation is performed in the third octave band over the frequency range from 63 Hz to 8 kHz, taking into account the correction of cabin reverberation.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 266, *Acoustics — Preferred frequencies*

ISO 3382-2, *Acoustics — Measurement of room acoustic parameters — Part 2: Reverberation time in ordinary rooms*

IEC 60942, *Electroacoustics — Sound calibrators*

IEC 61260-1, *Electroacoustics — Octave-band and fractional-octave-band filters — Part 1: Specifications*

IEC 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
nose cone
microphone shield designed to substitute the normal protection grid of the microphone and used in high-velocity air flows with low turbulence and little swirl having a streamlined shape with the least possible resistance to airflow and a fine wire mesh around its periphery allowing sound pressure transmission to the microphone diaphragm, whilst a truncated cone behind the mesh reduces the air volume in the form of the diaphragm

Note 1 to entry: See Figure 1.

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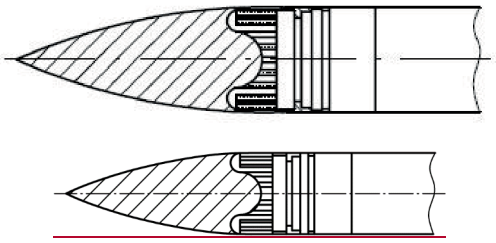

Figure 1 — Schematic diagram of a nose cone

3.2
windshield

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device designed for the insertion of the microphone and preamplifier, taking the form of a ball of open-pored foam with a cylindrical hole of appropriate diameter and not to affect the directivity of the microphone

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Note 1 to entry: A minimum size of the wind shield is suggested to diameter of 60 mm.

Note 2 to entry: See Figure 2.

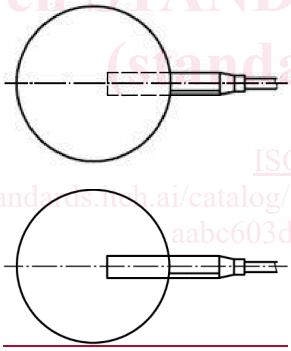

Figure 2 — Schematic diagram of a windshield

3.3
pink noise

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random noise signal with a spectral density that decreases by 3 dB per octave, giving constant energy per octave

3.4
white noise

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random noise signal having equal intensity at different frequencies, giving it a constant power spectral density

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4 Instrumentation

4.1 Microphone with sound level meter or other microphone amplifier

A microphone combined with a sound level meter or other microphone amplifier shall be used, as required by ~~IEC61672~~IEC 61672-1 for a Class 1 sound level meter~~ shall be used~~.

4.2 Microphone cable

The microphone cable shall meet the requirement that the sensitivity does not vary with temperature in the main range during the test. Disturbance of the cable, whether due to the traverse of the microphone or airflow across the cable, should not produce noise that interferes with the measurement.

4.3 Frequency ~~analyzer~~analyser

The frequency ~~analyzer~~analyser shall use a one-third-octave-band filter set as required by ~~IEC61260~~IEC 61260-1. The filter band centre frequencies shall ~~refer to ISO266~~be in accordance with ISO 266.

4.4 Nose cone and windshield

The use of a nose cone or windshield is desirable to offset the effect of air flow. The influence of nose cone and windshield on the measurement of noise levels shall not be greater than 0,5 dB (A). The combination of the nose cone and windshield with the microphone should be omni-directional.

4.5 Sound level recorder or other data sampling devices

Sound level recorders or other data sampling devices shall comply with the requirements of ~~IEC61672~~IEC 61672-1 for Class 1 instruments.

4.6 Calibration of instruments

The instruments shall be calibrated before and after each test by applying a Class 1 acoustic calibrator to the microphone in accordance with ~~IEC60942~~IEC 60942. The calibrator shall be calibrated within the interval specified by manufacturer.

5 General requirements

Noise level measurement should be carried out after the completion of the ship construction with all mechanical equipment switched off, unless necessary for running the HVAC system. If possible, the shore power in wharf condition or battery system should be used to avoid the influence of other mechanical equipment, such as diesel generator sets.

The HVAC system shall be in normal operation, its power shall meet the design conditions, and each exhaust outlet shall be adjusted ~~according to~~in accordance with the designed flowrate.

Doors and windows should be closed tightly.

Noise generated by external sound sources, such as crew or ~~passengers~~passenger activities, recreation, construction and maintenance work, should not affect the noise value at the measurement site. If necessary, the measured values can be corrected according to the steady-state background noise.

When measuring the noise level, there should be no person except the measurement operator in the measuring accommodation spaces.

The noise level measurement should be carried out using an integral measurement method, and a stable reading ~~of~~lasting at least 30 s shall be obtained to represent the average value of the changes due to changes in the sound field.

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6 Measurement procedure

6.1 Outlet noise measurement

Firstly, check and record the operating status of the measured HVAC system, especially if the individual exhaust outlets have been adjusted according to the designated flow rate. The data of flow rates should be recorded in the measurement report.

In order to reduce the turbulence effect of air flow from the outlets and to lower the measurement error, three microphones with windshields are placed on the tripods and located in one plane at an equal angle interval of β. The distance between each microphone and the edge of the measured exhaust outlet is 1 m. Position angle of the microphone, α, should be between 30° and 45° with inclination to the plane of the ceiling, as shown in Figure 3. For the case of outlets near the corners of the cabin, there is not enough space to place three microphones~~,~~; one or two microphones of those ~~would~~should be adopted.