2020

Guidance for Noise and Vibration

GC-21-E

KR

APPLICATION OF "GUIDANCE FOR NOISE AND VIBRATION "

1. Unless expressly specified otherwise, the requirements in the Guidance apply to Cargo ships for which the application for classification Survey is submitted to the Society on or after 1 July 2020.
2. The amendments to the Guidance for 2019 edition and their effective date are as follows;

Effective date : 1 July 2020

CHAPTER 1 GENERAL

Section 1 General

- 102. 12 has been newly added.

CHAPTER 4 VIBRATION

Section 1 General

- 101. 2 has been newly added.

Section 3 Measurement Locations

- 302. has been newly added.

Section 5 Criteria

- 502. has been newly added.

CONTENTS

CHAPTER 1 GENERAL

Section 1 General

101. Application

This Guidance is to apply to new and existing ships excluding passenger ships upon request of additional special feature notations "NVH(Noise, Vibration and Habitability)".

102. Definition

1. **Work spaces** are those spaces used as machinery spaces and machinery control rooms as well as workshops other than those forming part of machinery spaces.
   (1) Machinery spaces are machinery spaces of category A and other spaces containing propelling machinery, boilers, oil fuel units, steam and internal-combustion engines, generators and major electrical machinery, thrusters, steering gear, pumps, oil filling stations, refrigerating, stabilizing, ventilation and air-conditioning machinery and similar spaces and the trunks to such spaces.
2. **Control stations** are those spaces used as the cargo control room, ballast control room, fire control rooms, etc., where the operation status of equipment can be monitored and controlled other than machinery control room. However, the control station forming a part of work spaces is regarded as work spaces.
3. **Navigation spaces** are those spaces used as navigating bridges, chartrooms, bridge wings which are look-out posts, radio rooms and radar rooms.
4. **Accommodation spaces** are those spaces used as cabins, public spaces, hospitals, offices, mess rooms, recreation rooms, open deck recreation areas and similar spaces to be used by seafarers.
   (1) Offices are those spaces deck offices, ship's office and meeting room for carrying out ship's business affairs.
   (2) Recreation rooms are those spaces used as lounges, smoke rooms, cinemas, gymnasiums, libraries and hobbies and games rooms.
   (3) Open deck recreation areas are open deck spaces and enclosed promenades outside superstructures and deckhouses other than lifeboat and liferaft embarkation and lowing stations.
5. **Service spaces** are those spaces used as galleys, serveries, pantries containing cooking appliances, lockers, mail and specie rooms and store-rooms, etc .
6. **Manned spaces** are every space where a crew may be present for 20 minutes or longer at any one time during normal(on a voyage), routine daily activities. This includes work spaces, control stations, navigation spaces, accommodation spaces and service spaces.
7. **A-weighted noise level** is the quantity measured by a sound level meter in which the frequency response is weighted according to the A-weighting curve, obtained by using the frequency weighting A(dB(A)).
8. **A-weighted equivalent continuous noise level**(L_{Aeq}) is the A-weighted sound pressure level of a continuous steady sound that, within a measurement time interval, T, has the same mean square sound pressure as a sound under consideration which varies with time. It is expressed in decibels A(dB(A)). (Refer to Resolution MSC.337(91))
9. **Root mean square(r.m.s) value** is the square root value of time-average of the squared instantaneous values during a cycle.
10. **Frequency weighted** is the quantity measured by a vibration level meter in which the frequency response is weighted according to the frequency-weighting curve. *(2018)*
    (1) In human response to vibration, various frequency weighting have been defined in order to reflect known or hypothesized relationships between vibration frequency and human response.
    (2) The frequency weighting used to evaluate vibration in this Guidance is for 3 directions(x, y, and z), in accordance with ISO 2631-2. *(2018)*

11. **Measuring experts** are the persons who are conducting measurements of noise and/or vibration and meet one of the following.
    (1) measuring personnel certified by this Society
    (2) measuring personnel certified by testing institutions which support a quality management system according to ISO 17020/25
    (3) measuring personnel certified by Administration
12. **Local structural vibration** means vibration deflection shapes which are limited to one structural part of the ship. Local structural parts of a ship include parts of the superstructure, mast, tank bulkheads, web frame, stiffener, and plate. *(2020)*

103. Class Notations

Upon application of shipowner, ships satisfying the requirement in accommodation spaces, etc. according to the Guideline may be given a notation NVH. This notation is divided into "NVH-N1", "NVH-N2" and "NVH-N3" with regard to noise criteria in **Table 3.2** as well as "NVH-V1", "NVH-V2" and "NVH-V3" with regard to vibration criteria in **Table 4.2**.

Section 2 Approval of Plans and Documents

201. Plans and Documents

For ship requiring for surveys, the noise and/or vibration measurement plan specified in **202. 1.** is to be submitted to the Society for approval. After the noise and/or vibration measurements have been conducted in the presence of the Surveyor, the measurement result reports, containing the items specified in **202. 2.** are to be submitted to the Society for approval. The Society, where considered necessary, may require further plans and documents.

202. Plans and Documents for approval

1. Noise and/or Vibration Measurement Plan

(1) Measurement spaces and locations
(2) Measuring procedure
(3) Details of measuring equipment (including calibration records)
(4) Operating condition of main engine and auxiliary machinery
(5) Loading condition

2. Measurement result report

(1) General
  (a) Type of ship, gross tonnage and dimensions
  (b) Operating condition of main engine, shaft speed(rpm) and setting of controllable pitch propeller
  (c) Operating condition of auxiliary engine and auxiliary machinery
  (d) Loading condition(mean draft and trim)
  (e) Test site, draft, depth of water, meteorological conditions, and sea state
  (f) Measuring equipment(Type and manufacturer, etc.)
  (g) Names and affiliation of those carrying out the measurement
  (h) Measurement spaces and locations
  (i) Measurement result
(2) Noise
  (a) Presence of tonal sound and impulse noise(For reference)
  (b) Indications concerning any probable noise sources
  (c) Indications of any windows and doors which are open
(3) Vibration
  (a) Measuring direction at each measuring location(x, y, z direction) ⚓

CHAPTER 2 CLASSIFICATION SURVEYS

Section 1 General

101. General

The requirements not specified in this Chapter are to comply with those specified in **Pt 1** of **Rules for the Classification of Steel Ships**

Section 2 Classification survey

201. General

1. In cases where a ship is to be surveyed in accordance with the Guidance, it is the responsibility of the Owner to notify Surveyors of the locations where they wish to undergo the relevant survey.
2. Applicants for surveys are to arrange supervisors who are well conversant with all of the survey items required for the preparation of such surveys and who are able to provide all assistance necessary per Surveyor request during such surveys.
3. Surveys may be suspended in cases where necessary preparations have not been made, no appropriate supervisor is present, or the Surveyor considers that the safety needed for the execution of the survey is not ensured.
4. In cases where repairs are considered to be necessary as a result of surveys, Surveyors are to notify survey applicants of their findings. Applicants, upon receiving such notification, are to obtain Surveyor verification after carrying out any such repairs.

Section 3 Periodical Surveys

301. General

1. Periodical Surveys are to be carried out at the Annual Survey, Intermediate Survey and Special Survey.
2. During Periodical Surveys, the non-existence of any alternations which may affect the noise and vibration level is to be confirmed. Additional noise and/or vibration measurements may be required in cases where deemed necessary by the Society in order to ascertain whether the relevant requirements given in the Guideline are satisfied.

Section 4 Occasional Surveys

401. General

1. Occasional Surveys are to be carried out on the following occasions at times other than Initial Surveys or Periodical Surveys:
   (1) In cases where any conversion affecting the noise or vibration of a ship are carried out.
   (2) In cases where any applications for surveys are submitted by owners.
   (3) Other occasions when Occasional Surveys are considered to be necessary
2. Occasional Surveys are to be carried out and noise and vibration levels are to be confirmed as complying with those specified in the Guideline. ⚓

CHAPTER 3 NOISE

Section 1 General

101. General

1. Measurements are to be carried out in accordance with the following **Sec 2** to **Sec 4**, and the measurement results are to comply with the criteria specified in **Sec 5**.
2. The requirements not specified in this Guidance are to be in accordance with the **IMO Resolution MSC.337(91)** and **MSC.1/Circ.1509**.

Section 2 Measurement Procedure

201. General

1. Measurements are to be carried out by qualified noise measuring experts.
2. It is not acceptable for anyone except the persons necessary for operation and the persons taking the measurements to stay in the concerned space while measurements are being conducted.
3. L_{Aeq}s are to be reported for each measurement location. The measurement duration is to be sufficient to achieve a stable reading. Duration is to be 15 seconds or longer.
4. Microphones are to be directed at the noise source.(In cases where the measuring location is close to the noise source.)
5. Microphone wind screens are to be used in cases where the effect of the wind cannot be avoided.
6. If the noise within a space is cyclic, the L_{Aeq} sampling duration shall be sufficient to capture an integer number of complete cycles. If a long-duration sample is judged impractical, an L_{Aeq} value is to be determined and reported for the high-noise portion of the cycle.
7. Measurement equipment are to comply with the requirements related to IEC 61672-1.

Section 3 Measurement Locations

301. General

1. All normally manned spaces are to be subject to noise measurement locations.
2. The noise measurements are to be taken in the center of the space.
3. For a specific room size, the minimum number of measurement locations is indicated in **Table 3.1**.

Table 3.1 Distribution of Measurement Positions Within Spaces

Space Size	Minimum Number of Measurement Positions
up to 20 m^2	1
20-40 m^2	2
40-80 m^2	3
80-120 m^2	4
120-200 m^2	5
Greater than 200 m^2	6

4. Measurements are to be carried out with the microphone at a height between 1.2 m and 1.6 m from the deck.
5. On machinery spaces, measurements are to be taken at a distance of 1 m and at intervals not greater than 3 m around from the machinery. No microphone location is to be closer than 0.5 m from the boundary surface of the space.
6. On open deck, measurements are to be taken in any areas provided for the purpose of recreation and at 1 m at least from the existing noise sources such as inlet and outlet of ventilation.
7. In order to restrict the number of measurements and recordings, noise levels need not be measured for normally unoccupied spaces, holds, deck areas, spaces used for anchoring and mooring and other spaces which are remote from sources of noise

Section 4 Measurement Conditions

401. General

1. Sea trials are to be carried out with the ship in loaded or ballast condition. The actual condition during the measurements is to be recorded on the result report.
2. Measurements are to be taken with the vessel in a depth of water not less than 5 times the draft of the vessel.
3. Measurements are to be taken under conditions of Sea State 3 or less, as defined by Sea State Code of the World Meteorological Organization(WMO) and of Beaufort wind force scale 4 or less. If this cannot be achieved, the actual conditions are to be recorded on the result report.
4. Ship course has to be kept constant, with rudder angle less than 2 degrees portside or starboard, for the duration of the measurement. If ship maneuvering is need, measurements must be stopped until recovery of heading.
5. During the measurement, propeller output is to correspond to the operating conditions specification of the ship and not less than 80% of the maximum continuous rating(MCR).
6. Controllable pitch and Voith-Schneider propellers, if any, are to be in the normal seagoing position. For ships with special propulsion and power configurations, such as diesel-electric systems, the actual ship's design or operating parameters as defined in the ship's specifications will be used and are to be recorded on the result report.
7. For ships which are frequently operated by means of a Dynamic Positioning(DP) system, measurement are to be performed in DP mode. A simulation of the operation of the DP thruster system is to be performed under conditions which would approximate station keeping at or above 40% of maximum thruster power for design environmental conditions that the ship operates in.
8. All machinery essential for vessel operation is to operate under normal conditions throughout the measurement period. The list of machine and equipment to be run during the measures is to include(if present) the following.
   (1) generating sets
   (2) air conditioning and machinery ventilation
   (3) evaporators
   (4) anti rolling devices
   (5) compressors and chillers
   (6) refrigerating chamber
   (7) waste treatment units
   (8) bow thrusters
   (9) cargo pumps
   (10) laundry with the entire equipment running
9. For the galley/pantries, all equipment that runs for 20 minutes or more(e.g., ventilation hoods) are to be running during the noise measurements. Any equipment that is running is to be reported.
10. In radio rooms, measurements are to be carried out with radio equipment operating but not producing audio signals.

11. Doors and windows are to be closed, except where they are normally left open. Any open doors or windows are to be reported.

12. Spaces are to be furnished with all usual equipment and furnishings normally found in the space. Equipment is to be configured to operate in its normal operating mode.

Section 5 Criteria

501. General

1. Noise level is to be evaluated as an A-weighted equivalent continuous noise level, and is to be in accordance with **Table 3.2**.

2. Noise level is classified into categories as "N1", "N2" and "N3" from lowest to highest.

3. In cases where measurements are carried out at multiple locations in the same space, the maximum measurement data is to be used. ⚓

Table 3.2 Noise level limits(dB(A))

Location	Up to 10,000 GT			≥10,000 GT		
	N1	N2	N3	N1	N2	N3
Navigation spaces and control stations						
Radio rooms[1)]	60	58	55	60	58	55
Navigating bridges, chartroom, radar rooms	65	63	60	65	63	60
Look-out post, incl. navigating bridge wings and windows	70	70	70	70	70	70
Control stations	65	63	60	65	63	60
Accommodations Spaces						
Cabin	60	55	50	55	53	50
hospitals	60	58	55	55	53	50
Messroom	65	60	55	60	58	55
Offices, recreation rooms, public rooms	65	63	60	60	58	55
Open deck recreation area	75	73	70	75	73	70
Staircase and passages in accommodation	75	73	70	75	73	70
Service spaces						
Galley	75	73	70	75	73	70
Other services	75	73	70	75	73	70
Work spaces						
Machinery spaces	110	110	110	110	110	110
Machinery control rooms	75	73	70	75	73	70
Other work spaces	85	83	80	85	83	80
Normally unoccupied spaces						
Spaces referred in **301. 7**	90	90	90	90	90	90

Remark [1)] A navigating bridge provide with radio equipment should be regard as a navigating bridge. Radio room means separate rooms dedicated for sending/receiving radio messages.

CHAPTER 4 VIBRATION

Section 1 General

101. General

1. Measurements are to be carried out in accordance with the following **Sec 2** to **Sec 4**, and the measurement results are to comply with the criteria specified in **Sec 5**.
2. The guidances for local structural vibration to assess the risk of structural damage are recommendations and unless otherwise specified apply to the general requirements of the following sections. *(2020)*

Section 2 Measurement Procedure

201. General

1. Measurements are to be carried out by qualified vibration measuring experts.
2. In general, it is not acceptable for anyone except the persons necessary for operation and the persons taking the measurements to stay in the concerned space while measurements are being conducted.
3. The measurement duration is to be at least 1 minute. If significant frequency components exist in the range below 2 Hz, the measurement duration is to be at least 2 minutes.
4. Measurements are required in all 3 directions (x, y, z directions) at a minimum of two locations, and only in the vertical direction (z direction) at all other locations on each deck.
5. The direction is to correspond to the 3 translational axes of the ship: longitudinal, transversal and vertical.
6. Measurement equipment and calibration are to comply with the requirements related to ISO 8041.

Section 3 Measurement Locations

301. General

1. The aim when selecting vibration measurement locations shall be to obtain a representative sample of data that reflects the actual conditions in manned spaces. The measurement locations shall be selected in accordance with the following.
   (1) Select potential worst case locations based on their proximity to vibration emitting sources such as propulsion or other rotating machinery or where vibration is likely to be transmitted to manned spaces via the vessel's structure.(e.g., cabin adjacent to a machinery space)
   (2) Where a single instance of one type of manned space exists within the vessel (e.g., bridge, mess room, gymnasium, library, etc.), that location is to be selected for measurement.
   (3) For vessels with less than 20 cabins 50 % of cabins on each deck shall be selected. For vessels with greater than 20 cabins, 30 % of cabins on each deck shall be selected. These measurement locations must be selected at locations portside, starboard, fore, amidships and aft. Locations according to (1) are to be considered part of the representative sample for crew cabins, if applicable.
   (4) Where multiple instances of the same type accommodation space exist that are not crew cabins, a representative sample of at least 50 % of each type shall be selected for measurement. Locations according to (1) are to be considered part of the representative sample, if applicable.
2. All normally manned spaces are to be subject to a walkthrough inspection by the Surveyor. The number and locations of the walkthrough inspections will be determined by the Surveyor. At the discretion of the Surveyor, additional measurements may be required.

3. Vibration transducers(e.g., accelerometers) are to be located and attached properly to the floor surface to measure the vibration at the interface between the standing crew member and the source of vibration. The mounting of accelerometers is to comply with ISO 5348.
4. In cabins, the vibration transducers are to be placed on the deck in the center of the space.
5. For larger spaces(public rooms, messes, recreation areas, etc.), it is necessary to place transducers at a number of locations in order to obtain a representative sample of the vibration levels for that space. For a specific room size, the minimum number of measurement locations is indicated in **Table 4.1**.

Table 4.1 Distribution of Transducer Positions Within Spaces

Space Size	Minimum Number of Measurement Positions
up to 20 m^2	1
20-40 m^2	2
40-80 m^2	3
80-120 m^2	4
120-200 m^2	5
Greater than 200 m^2	6

302. Local structural vibration *(2020)*

1. During the performance trial of ship, the vibration level of local structural parts in conspicuous areas should be checked visually by taking note of the noise and the overall vibration velocity values at the most representative spots for reference.
2. The measurement locations for local structural vibrations typically include superstructures, masts, tank bulkheads, web frames, stiffeners and parts of plates.

Section 4 Measurement Conditions

401. General

1. Sea trials are to be carried out with the ship in loaded or ballast condition. The actual condition during the measurements is to be recorded on the result report.
2. Measurements are to be taken with the vessel in a depth of water not less than 5 times the draft of the vessel.
3. Measurements are to be taken under conditions of Sea State 3 or less, as defined by Sea State Code of the World Meteorological Organization(WMO) and of Beaufort wind force scale 4 or less. If this cannot be achieved, the actual conditions are to be recorded on the result report.
4. Ship course has to be kept constant, with rudder angle less than 2 degrees portside or starboard, for the duration of the measurement. If ship maneuvering is need, measurements must be stopped until recovery of heading.
5. During the measurement, propeller output is to correspond to the operating conditions specification of the ship and not less than 80% of the maximum continuous rating(MCR).
6. Controllable pitch and Voith-Schneider propellers, if any, are to be in the normal seagoing position. For ships with special propulsion and power configurations, such as diesel-electric systems, the actual ship's design or operating parameters as defined in the ship's specifications will be used and are to be recorded on the result report.
7. For ships which are frequently operated by means of a Dynamic Positioning(DP) system, measurement are to be performed in DP mode. A simulation of the operation of the DP thruster system is to be performed under conditions which would approximate station keeping at or above 40% of

maximum thruster power for design environmental conditions that the ship operates in.

8. All machinery essential for vessel operation is to operate under normal conditions throughout the measurement period. The list of machine and equipment to be run during the measures is to include(if present) the following.
   (1) generating sets
   (2) air conditioning and machinery ventilation
   (3) evaporators
   (4) anti rolling devices
   (5) compressors and chillers
   (6) refrigerating chamber
   (7) waste treatment units
   (8) bow thrusters
   (9) cargo pumps
   (10) laundry with the entire equipment running

Section 5 Criteria

501. General

1. Vibration levels are to be in accordance with **Table 4.2**.
2. Vibration level is classified into categories such as "V1", "V2" and "V2" from lowest to highest.
3. The frequency range to be evaluated is 1 Hz to 80 Hz.
4. The result of each measurement is to be the overall frequency weighted r.m.s value for acceleration or velocity in accordance with ISO 2631-2. *(2018)*
5. The maximum value taken from the measurement data of 3 directions is to be used.

Table 4.2 Vibration level limits(velocity: mm/s, acceleration: mm/s2) ***(2018)***

Location	V1		V2		V3	
	velocity	accel-eration	velocity	accel-eration	velocity	accel-eration
Navigation spaces	6	214	5	179	4	143
Accommodation spaces	5	179	3.5	125	2.5	89.5
Offices	4.5	161	4.5	161	3.5	125
Open deck recreation areas	4.5	161	4.5	161	3.5	125
Work spaces	6	214	6	214	5	179
Engine control rooms	5	179	5	179	4	143

502. Local structural vibration *(2020)*

1. The frequency range to be evaluated is 5 Hz to 100Hz.
2. The recommended vibration level for the avoidance of structural fatigue damage should be less than single amplitude peak value of 30 mm/s in each of 3 directions (x, y, z directions) at individual frequencies. ⚓

GUIDANCE FOR NOISE AND VIBRATION

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