Guide for

Comfort on Yachts

March 2019

GUIDE FOR

COMFORT ON YACHTS
MARCH 2019

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Foreword *(1 March 2019)*

This ABS *Guide for Comfort on Yachts* presents guidance for measuring the comfort of Owners and their guests while occupying cabins, dining spaces, lounges, cocktail bars and other interior or exterior Owner and guest spaces onboard.

The assessment criteria and measurement methodology outlined in this Guide can lead to obtaining an ABS Comfort notation for yachts. The criteria allow a measure of the comfort of a yacht related to the ambient environmental aspects of whole-body vibration and noise onboard. The Owner/guest comfort criteria are applicable to new and existing yachts for which an optional Comfort – Yacht (**COMF(Y)**) or a Comfort Plus – Yacht (**COMF+(Y)**) notation has been requested. Comfort criteria for whole-body vibration and noise are divided into two categories: yachts less than or equal to 50 meters (164 feet) in length and yachts greater than 50 meters (164 feet) in length.

This Guide has been revised due to several factors, including:

1) Input from industry (i.e., Owners, designers, and construction yards)

2) Revisions to standards referenced in this Guide

3) Changes in current design practices and principles

This Guide becomes effective on the first day of the month of publication.

Users are advised to check periodically on the ABS website www.eagle.org to verify that this version of this Guide is the most current.

We welcome your feedback. Comments or suggestions can be sent electronically by email to rsd@eagle.org.

GUIDE FOR

COMFORT ON YACHTS

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SECTION 1
General

1 Introduction

ABS recognizes the positive impact that appropriate comfort requirements and design practices can have on the Owner and their guests' comfort, safety, and overall well-being. The Owner/guest comfort criteria contained in this Guide have been developed to provide a means to measure and assess the level of comfort of Owners and their guests on yachts.

3 Application *(1 March 2019)*

The Owner/guest comfort criteria are applicable to new and existing yachts for which an optional Comfort – Yacht (**COMF(Y)**) or a Comfort Plus – Yacht (**COMF+(Y)**) notation has been requested. The Owner/guest comfort criteria are a measure of the acceptability of a yacht related to the ambient environmental aspects of whole-body vibration and noise. Comfort criteria for whole-body vibration and noise are divided into two categories: yachts less than or equal to 50 meters (164 feet) in length and yachts greater than 50 meters (164 feet) in length.

A separate document, the ABS *Guide for Passenger Comfort on Ships*, can be referenced for criteria on two (2) additional ambient environmental aspects of comfort; indoor climate and lighting. Compliance with those criteria for indoor climate and lighting are not a requirement for the Comfort – Yacht (**COMF(Y)**) or the Comfort Plus – Yacht (**COMF+(Y)**) notation.

5 Scope *(1 March 2019)*

The optional Comfort notations focus on two (2) Owner/guest comfort related aspects of yacht design, whole-body vibration and noise. The comfort criteria are based on currently available human performance-related research data and standards. The test conditions, measurement locations, test methods and instrumentation requirements were selected to provide a pragmatic methodology that can be applied internationally with reliability and suitable validity.

7 Terminology *(1 March 2019)*

Accommodation Areas: Yacht areas where the primary purpose is to rest and recreate. Owner/guest accommodations spaces include cabins, staterooms, dining areas, entertainment areas (interior or exterior spaces), recreation rooms, and other spaces designated for Owner/guest use. For the purposes of this Guide, accommodation areas are primarily restricted to the spaces Owners and their guests would normally use on board yachts.

Ambient Environment: Ambient environment refers to the environmental conditions that Owners and their guests are exposed to during periods of transit, leisure, or rest. Specifically, this Guide provides criteria and limits for whole-body vibration and noise.

Comfort: The acceptability of the conditions of a yacht as determined by its vibration and noise qualities according to prevailing research and standards for human comfort.

Testing Specialists: Specialized test personnel who must meet the requirements of Appendix A2, "Procedural Requirements for ABS Recognized Ambient Environmental Testing Specialists" of the ABS *Guide for Passenger Comfort on Ships*.

Occupied Owner/Guest Spaces: For the purposes of this Guide, any space used for rest, entertainment, and dining where the Owner or their guests may be present for twenty (20) minutes or longer at one time.

Owner/Guest: Every person on board other than the Master and the members of the crew or other persons employed or engaged in any capacity on board a yacht for the business of that yacht.

Test Plan: Document containing the requisite information regarding yacht design and layout, test personnel, test conditions, measurement locations, data acquisition, instruments, data analysis and test schedule necessary for verifying the measurements for the ambient environmental aspects of comfort.

Test Report: Document containing the actual testing result from the Ambient Environmental tests including details of the testing conditions, measurement locations, measurement equipment, and the results of the data collected and analyzed.

9 Notation *(1 March 2019)*

At the yacht Owner or shipyard's request, a yacht complying with the minimum criteria for Owner/guest comfort may be assigned a notation of **COMF(Y)**. A yacht complying with the motion sickness criteria with respect to whole-body vibration, may be assigned the notation **COMF+(Y)**. A summary of the differences between these notations is given below.

Notation	*Whole-body Vibration*	*Noise*
COMF(Y)	Must meet **comfort-based** vibration level criteria	Must meet **comfort-based** noise level criteria
COMF+(Y)	Must meet **comfort-based** vibration level criteria as well as motion sickness criteria	Must meet **comfort-based** noise level criteria

11 Process for Obtaining a Notation

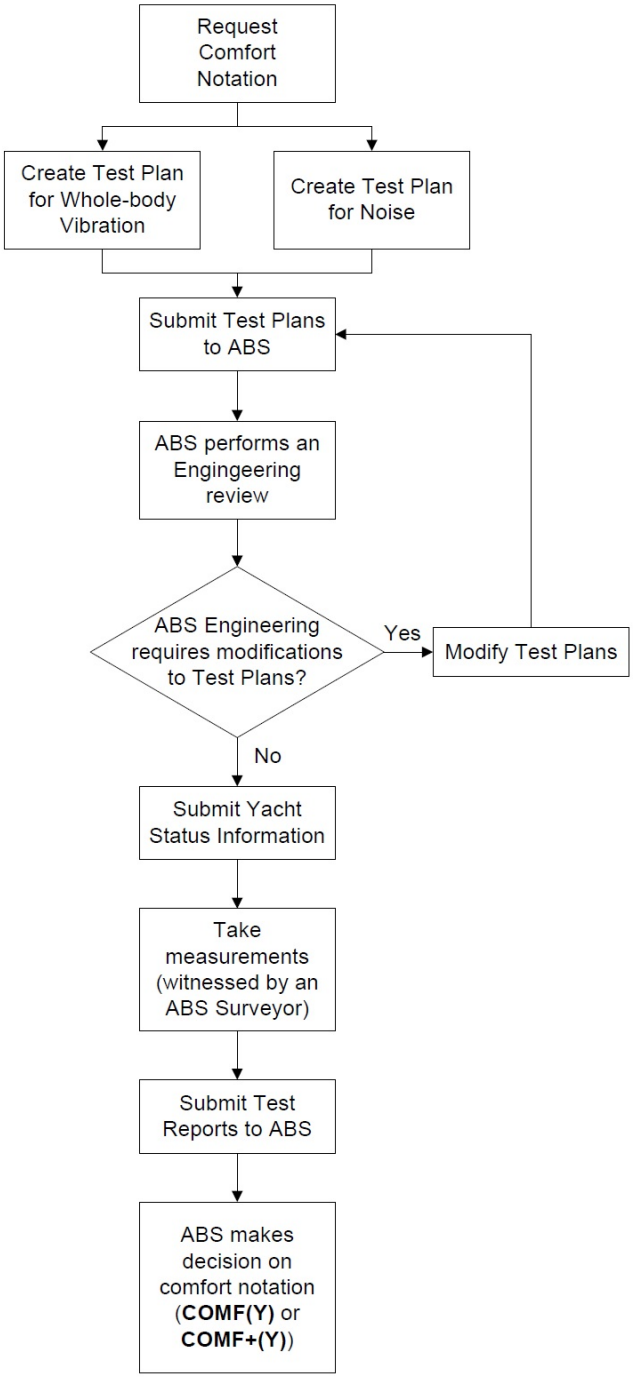
Prior to scheduling ambient environmental testing activities, the yacht Owner or shipyard is to certify the operational status of the yacht as being fully operational and/or inclusive of all equipment and furnishings. If the yacht is not fully operational, then a complete listing of deficient areas, components, equipment, etc., is to be submitted to ABS for review. ABS is to then make a determination and notify the yacht Owner or shipyard as to whether ambient environmental testing can commence. The intent is to align sea trial activities with the ambient environmental testing so that all testing is completed during this time.

The process for obtaining a **COMF(Y)** or **COMF+(Y)** notation is presented in 1/11 FIGURE 1. The following paragraph briefly describes the notation process.

Ambient Environmental Test Plans for whole-body vibration and noise are to be prepared and submitted to ABS for review and approval. Information submitted to ABS is to serve as a primary vehicle for verifying the measurement locations and measurement process, as well as specifying the Testing Specialist who will perform the ambient environmental testing. Testing, inspections and data collection is to be performed by the Testing Specialist and witnessed by ABS. Test Reports for ambient environmental testing are to be prepared by the Testing Specialist and submitted to the ABS Surveyor for review for determination of notation confirmation. Specific Test Plan and Test Reporting details for whole-body vibration and noise are outlined in the following locations:

Environmental Aspect	*Test Plan Details*	*Test Report Details*
Whole-body Vibration	2/11	2/15
Noise	3/11	3/15

FIGURE 1
Comfort Notation Process for Initial Requirements



13 Surveys after Construction *(1 March 2019)*

It is intended that all surveys after construction are to be aligned with Classification Surveys. Harmonization of surveys is to be carried out at the first available opportunity. See Section 7-9-17 of the ABS *Rules for Survey After Construction (Part 7)* for the survey requirements.

The following survey requirements specific to the **COMF(Y)** and **COMF+(Y)** notations supplement the requirements of Section 7-9-17 of the ABS *Rules for Survey After Construction (Part 7).*

13.1 Survey Requirements *(1 March 2019)*

Special Periodical Surveys 1 and 3 are to be completed similar to the Annual Surveys referenced in 7-9-17/1 of the ABS *Rules for Survey After Construction (Part 7)*. Any ambient environmental testing will be at the discretion of the ABS Surveyor.

The Special Periodical Surveys 2 and 4 and subsequent Special Periodical Surveys are to comprise ABS Surveyor verifications and ambient environmental testing. The Survey will cover both comfort aspects.

The following is to be submitted to ABS three (3) months prior to carrying out the ambient environmental testing:

i) Fire, repair, or damage reports since previous Annual Survey

ii) A list of all structural or mechanical modifications to the vessel since previous Annual Survey

iii) Drawings/arrangements of passenger spaces affected by alterations

iv) Copy of approved Initial Ambient Environmental Test Plans and Test Reports

v) Ambient Environmental Test Plans and Test Reports resulting from Annual Surveys, if applicable

vi) Previous Special Periodical Survey Ambient Environmental Test Plans and Reports, if applicable

vii) Proposed Special Periodical Survey Ambient Environmental Test Plans for the current survey

The Special Periodical Survey data submittal serves three purposes. The first is to perform an ABS review of passenger spaces against any alterations to the vessel since the Initial Survey, with measurements verified by an ABS Surveyor. The second purpose is to provide a history of ambient environmental testing, as well as the Special Periodical Survey ambient environmental Test Plans for review and approval. The third is to allow scheduling of measurement verifications and ambient environmental testing.

A Special Periodical Survey Test Plan for both ambient environmental aspect of comfort are to be submitted in accordance with the criteria stated below. The approved Initial Test Plans should be used as a basis for creating the Special Periodical Survey Test Plans.

13.3 Requirements for Vessel Alterations

No alterations which affect or may affect the yacht comfort notation awarded are to be made to the vessel unless plans of the proposed alterations are submitted to and approved by ABS before the work of alteration is commenced. If ABS determines that the alteration will affect the yacht Comfort notation, the altered vessel may be subject to the review, verification, and ambient environmental testing requirements of this Guide.

15 Alternatives

ABS will consider alternative arrangements, criteria and procedures, which can be shown to meet the criteria directly cited or referred to in this Guide. The demonstration of an alternative's acceptability can be made through either the presentation of satisfactory service experience or systematic analysis based on valid engineering principles.

15.1 Departures from Criteria *(1 March 2019)*

The criteria contained in this Guide are envisioned to apply to yachts within the scope of the following:

- ABS *Rules for Building and Classing Marine Vessels*
- ABS *Rules for Materials and Welding (Part 2)*
- ABS *Guide for Building and Classing Yachts*

It is recognized that unusual or unforeseen conditions may lead to a case where one or more of the parameters of interest in granting a notation may temporarily fall outside the range of acceptability.

When a departure from criteria is identified, during either the notation's initial issuance or reconfirmation process, it is to be reviewed by ABS in consultation with the Owner. When the departures from the stated criteria are found, these departures will be subject to special consideration upon the receipt of details about the departure. Depending on the degree and consequences of the departure, the shipyard or Owner may be required to provide an assessment and remediation plan to obtain or maintain the notation. Failure to complete the agreed remediation by the due date will lead to withdrawal of the notation.

SECTION 2

Whole-body Vibration

1 Background *(1 March 2019)*

Traveling in yachts may impose a series of generally low-frequency mechanical vibrations as well as single-impulse accelerations on the human body.

Low-frequency vibrations can also be imposed by yacht motions which are produced by the various sea states in conjunction with yacht speed. These motions can result in motion sickness, body instability, fatigue, discomfort and increased health risk aggravated by shock loads induced by vessel slamming. Vessel slamming/accelerations are dependent upon factors such as yacht size, speed, hull design, and wave conditions.

Higher-frequency vibration influencing comfort is often associated with rotating machinery. The imposition of higher frequency vibrations (about 1 to 80 Hz) induces corresponding motions and forces within the human body, possibly creating discomfort and degraded levels of comfort and health.

3 Scope

This Section provides criteria and methods for assessing whole-body vibration relating to Owner/guest comfort onboard yachts. The criteria were selected to limit potential vibration related interference with Owner/guest activities and to improve comfort.

Consideration of the vibration loads imposed on the body is restricted to motions transmitted from surrounding structures to the entire human body through the feet of a standing person in the frequency range 1 to 80 Hertz (Hz). Motions transmitted to the body of a seated or recumbent person have been omitted from this Guide. Due to the provision of resilient or non-rigid surfaces on seats and beds, these surfaces will generally attenuate the transfer of vibration to levels that are lower than those experienced when standing. The motions transmitted through the feet are expected to be the highest vibration levels to which Owners and their guests will be exposed.

Whole-body vibration limits defined in this Section are based on currently available standards. Compliance with this Section is a prerequisite for the Comfort – Yacht (**COMF(Y)**) or Comfort Plus – Yacht (**COMF+(Y)**) notation confirmation.

5 Terminology *(1 March 2019)*

Acceleration: The rate of change of velocity over time (i.e., meters-per-second squared, m/s^2).

Calibration Checks: Field calibration of a measuring instrument conducted before and after a field test, using a reference calibrated signal. Field calibrators (portable calibrators) are to comply with an international or national standard.

Exposure Action Value: The value of vibration/repetitive shock above which controlling the whole-body vibration exposure to humans is recommended.

Exposure Limit Value: A value of vibration/repetitive shock above which humans should not be exposed.

Frequency: The number of complete cycles of a periodic process occurring per unit time. Frequency is expressed in Hertz (Hz) which corresponds to the number of cycles observed-per-second.

Frequency Weighting: A transfer function used to modify a signal according to a required dependence on vibration frequency.

- In human response to vibration, various frequency weightings have been defined in order to reflect known or hypothesized relationships between vibration frequency and the various human responses.
- The frequency weighting used to evaluate whole-body vibration in this Guide is W_m (whole-body) for all three axes (x, y, and z), in accordance with ISO 20283-5.

Motion Sickness: Various undesirable effects including sweating, nausea and vomiting caused by low-frequency (normally less than 0.5 Hz) oscillation in the vertical z-axis of the human body, primarily in the standing and sitting postures.

Motion Sickness Dose Value ($MSDV_Z$): A cumulative measure of exposure to low-frequency oscillation that may be used to provide an indication of the probable incidence of motion sickness. The vertical Motion Sickness Dose Value $MSDV_Z$, in m/s$^{1.5}$, is defined by the following expression:

$$MSDV_Z = \sqrt{\int_0^T a_{zw}^2(t)dt}$$

where $a_{zw}(t)$ is the z-axis acceleration as a function of time in meters-per-second squared (m/s^2), weighted by the W_f frequency weighting as defined in ISO 8041, and T is the duration of the motion in seconds.

In the case of shorter exposure periods with continuous motion of approximately constant magnitude, the Motion Sickness Dose Value may be estimated from the frequency-weighted RMS value determined over a short period. The Motion Sickness Dose Value (m/s$^{1.5}$) for the exposure period T_0 (s) is defined by the following expression:

$$MSDV_Z = a_w {T_0}^{1/2}$$

Multi-Axis Acceleration Value: The Multi-Axis Acceleration Value is calculated from the root-sums-of-squares of the weighted RMS acceleration values in each axis (a_{xw}, a_{yw} and a_{zw}) at the measurement point using the following expression:

$$a_w = \sqrt{a_{xw}^2 + a_{yw}^2 + a_{zw}^2}$$

where a_{xw}, a_{yw} and a_{zw} are the weighted RMS acceleration values measured in the x-, y-, and z-axes, respectively.

Multi-Axis Vibration: Mechanical vibration or shock acting in more than one (1) direction simultaneously.

Reference Calibration: Calibration of a measuring instrument and of a portable calibrator conducted at least every two (2) years (or more frequently if specified by the manufacturer) by a Testing and Calibration Laboratory accredited according to ISO 17025, with traceability to a national or international standard.

Transit Conditions: Those conditions where the vessel is transitioning (moving) from one location to another by its own means of propulsion.

Velocity: The rate of change of distance over time (i.e., millimeters per second, mm/s).

Vibration: The variation with time of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value.

Weighted Root-Mean-Square Acceleration Value (a_w): The weighted root-mean-square (RMS) acceleration a_w, in meters-per-second, is defined by the expression:

$$a_w = \sqrt{\frac{1}{T}\int_0^T a_w^2(t)dt}$$

where $a_w(t)$ is the weighted acceleration as a function of time in meters-per-second squared (m/s^2) and T is the duration of the measurement in seconds.

Whole-body Vibration: Mechanical vibration (or shock) transmitted to the human body as a whole. Whole-body vibration is often due to the vibration of a surface supporting the body.

7 Associated Documentation *(1 March 2019)*

The following documents provide details about Test Plan preparation, test measurement procedures and/or Test Reporting:

- ISO 20283-5, Mechanical Vibration – Measurement of Vibration on Ships – Part 5: Guidelines for Measurement, Evaluation and Reporting of Vibration with Regard to Habitability on Passenger and Merchant Ships.
- ISO 2631-2, Mechanical Vibration and Shock – Evaluation of Human Exposure to Whole Body Vibration – Part 2, Vibration in Buildings.
- ISO 8041, Human response to vibration – Measuring instrumentation.
- ISO 5348 Mechanical vibration and shock – Mechanical mounting of accelerometers.
- World Mateorological Organization (WMO) Manual on Codes, No. 306, Part A, Alphanumerical Codes.

9 Criteria *(1 March 2019)*

The whole-body vibration criteria for the Comfort – Yacht (**COMF(Y)**) and Comfort-Plus – Yacht (**COMF +(Y)**) notations are provided in 2/9 TABLE 1, "Yachts ≤ 50 m (164 ft) in Length - Maximum Root-Mean Square Levels" and in 2/9 TABLE 2, "Yachts > 50 m in Length - Maximum Root-Mean Square Levels".

The severity of the vibration is to be indicated by the weighted root-mean-square acceleration value (a_w) as defined in ISO 8041. Different maximum RMS levels are provided for yachts ≤ 50 m (164 ft) and > 50 m (164 ft).

Whole-body vibration measurements are to be taken only in Owner/guest accommodation areas, recreation spaces/areas, and open deck areas occupied by Owners and their guests for twenty (20) minutes or longer at a time. Specific locations are referred to in 2/13.7, "Measurement Locations".

The maximum vibration levels for Owner/guest spaces are not to be exceeded under normal conditions for the **COMF(Y)** and **COMF+(Y)** notations. For the **COMF+(Y)** notation, in addition to the Maximum Root-Mean-Square Acceleration Level (a_w), the Motion Sickness Dose Value Level ($MSDV_Z$) provided in 2/9 TABLE 1 and in 2/9 TABLE 2 are not to be exceeded. The more stringent maximum levels for the **COMF +(Y)** notation are aimed at facilitating optimal Owner/guest comfort and to restrict the incidence of motion sickness to ten (10) percent or less among Owners and their guests.

TABLE 1
Yachts ≤ 50 m (164 ft) in Length - Maximum Root-Mean Square Levels
(1 March 2019)

Notation	*Location*	*Maximum RMS Level , mm/s (mm/s^2)*	
		In-Harbour	*Transit Conditions*
COMF(Y)	Owner / Passenger Cabins	1.5 (53.6)	2.25 (80.4)
	Interior Accommodation / Recreation Areas	1.75 (62.5)	2.5 (89.5)
	Exterior Recreation Areas	2.0 (71.5)	2.75 (98.3)
COMF+(Y)	Motion Sickness Dose Value ($MSDV_Z$)	Not Applicable	30 $m/s^{1.5}$
	Owner / Passenger Cabins	1.25 (44.7)	2.0 (71.5)
	Interior Accommodation / Recreation Areas	1.50 (53.6)	2.25 (80.4)
	Exterior Recreation Areas	1.75 (62.5)	2.5 (89.5)

TABLE 2
Yachts > 50 m (164 ft) in Length - Maximum Root-Mean Square Levels
(1 March 2019)

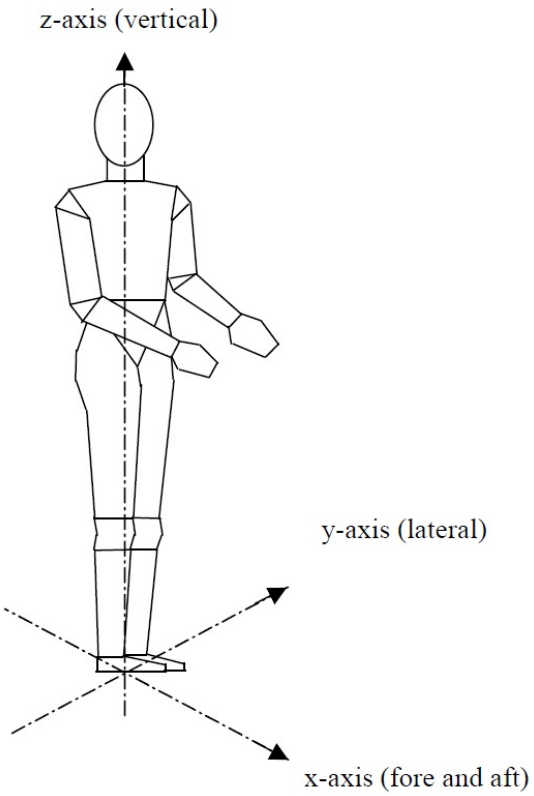
Notation	*Location*	*Maximum RMS Level , mm/s (mm/s^2)*	
		In-Harbour	*Transit Conditions*
COMF(Y)	Owner / Passenger Cabins	1.25 (44.7)	2.0 (71.5)
	Interior Accommodation / Recreation Areas	1.50 (53.6)	2.25 (80.4)
	Exterior Recreation Areas	1.75 (62.5)	2.5 (89.5)
COMF+(Y)	Motion Sickness Dose Value ($MSDV_Z$)	Not Applicable	30 $m/s^{1.5}$
	Owner / Passenger Cabins	1.0 (35.7)	1.5 (62.5)
	Interior Accommodation / Recreation Areas	1.25 (44.7)	2.0 (71.5)
	Exterior Recreation Areas	1.50 (53.6)	2.25 (80.4)

For the purpose of this Section, the notation applies to the whole-body vibration levels occurring on the deck supporting the human in the three (3) translational (x-, y- and z-) axes as shown in 2/9 FIGURE 1, "Measurement Axes".

The vibration levels are computed for each axis individually, as well as combined as a multi-axis acceleration value. Each is expressed as a frequency weighted root mean square (a_w) value. To meet the vibration criteria, the single-axis and multi-axis a_w levels must be less than or equal to the maximum level expressed in 2/9 TABLE 1 or 2/9 TABLE 2.

The Motion Sickness Dose Value Level ($MSDV_Z$) is computed in the z-axis only and adjusted to the duration of a typical voyage. If the duration of a typical voyage exceeds six (6) hours, the $MSDV_Z$ is to be computed for a duration of six (6) hours. To meet the Motion Sickness Dose Value Level, the computed $MSDV_Z$ value must be equal to or lower than the $MSDV_Z$ value expressed in 2/9 TABLE 1 or 2/9 TABLE 2.

FIGURE 1
Measurement Axes



11 Test Plan

As stated in 1/11, "Process for Obtaining a Notation", a Test Plan is to be developed to serve as the principal means for verifying the measurements to be performed to verify compliance with whole-body vibration criteria. The Test Plan is to include the following:

11.1 Documentation *(1 March 2019)*

The Test Plan is to include appropriate drawings indicating the location of all vibration sources, sample data sheets (in table format), and the identification of any potential conflicts of interest with the testing specialists, designers, and/or construction yard.

11.3 Test Personnel

The Test Plan shall provide information about the Testing Specialist who will be conducting the test and their approval and certification in accordance with Appendix A2, "Procedural Requirements for ABS Recognized Ambient Environmental Testing Specialists" of the ABS *Guide for Passenger Comfort on Ships*.

11.5 Test Conditions

The Test Plan is to detail the conditions under which the tests will be performed. Further details on test conditions are provided in 2/13.5, “Test Conditions”.

11.7 Measurement Locations

The Test Plan is tol document in detail, on appropriate drawings, all spaces where measurements will be taken. In addition, transducer measurement positions are to be indicated. Details on selecting measurement locations and determining transducer measurement positions are provided in 2/13.7, “Measurement Locations”.

11.9 Data Acquisition and Instruments

The Test Plan is to provide information regarding the methods and instrumentation to be used for measurement and data collection. Instrumentation specification details are to include type of instruments to be used, accuracy, calibration, sensitivity, conformance with ISO 8041 and frequency range. More details on data acquisition and instruments are provided in 2/13.3, “Data Acquisition and Instruments”.

11.11 Data Analysis

The Test Plan is to provide information regarding the methods, software and instrumentation to be used for data analysis.

11.13 Test Schedule *(1 March 2019)*

The Test Plan is to provide information regarding the proposed test schedule. The test schedule is to include information on the approximate date and duration of testing.

13 Test Requirements

13.1 General *(1 March 2019)*

Whole-body vibration measurements are to be in accordance with the procedures described in ISO 20283-5. When the procedures described in this Guide deviate from any requirements or procedures mentioned in ISO 20283-5, the more stringent requirement are to take precedence.

The relationship between the various factors to be considered when taking whole-body vibration measurements and computing results is illustrated in 2/13.3 FIGURE 2, “Process for the Measurement and Analysis of Whole-body Vibration”.

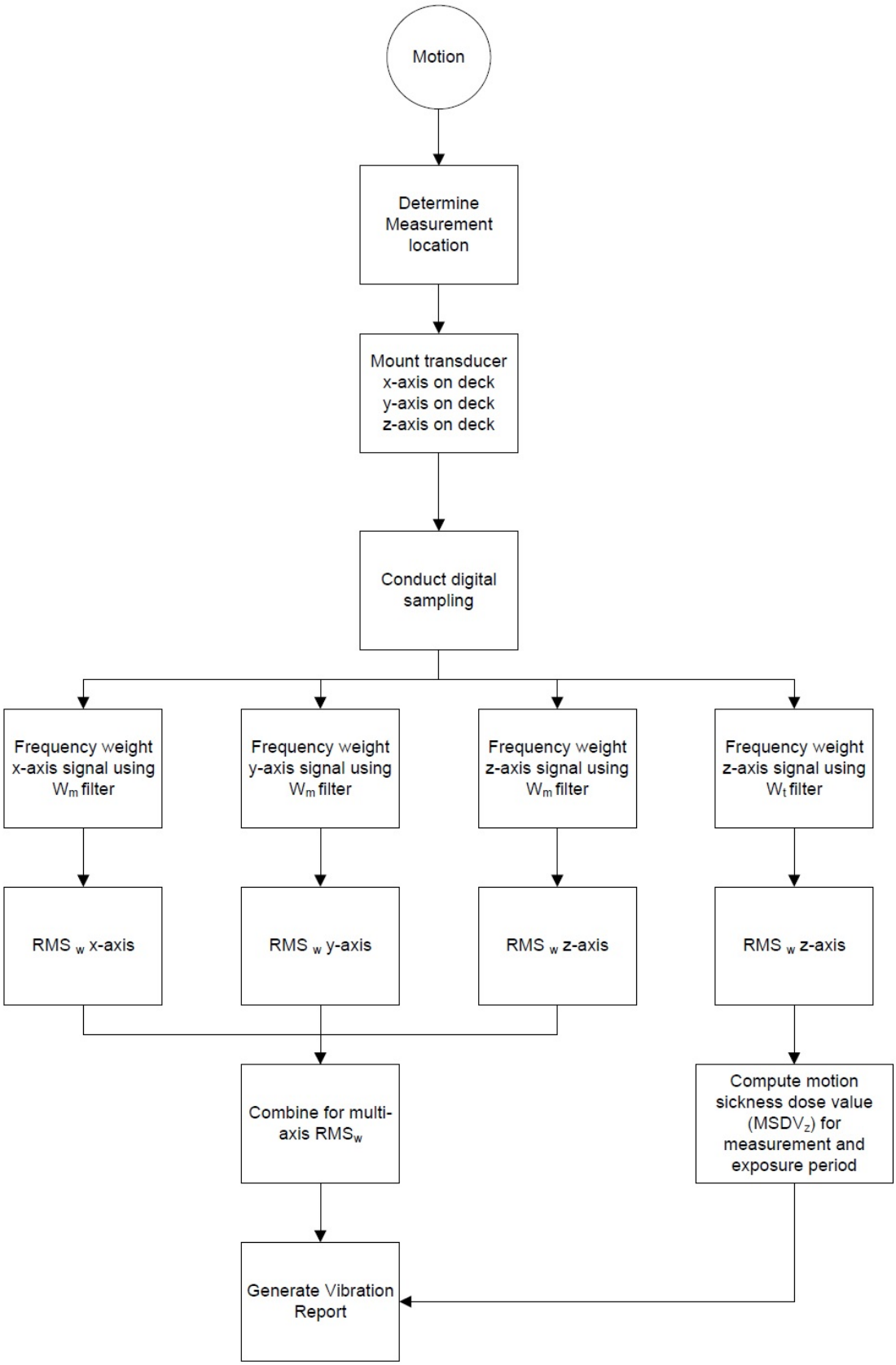
13.3 Data Acquisition and Instruments *(1 March 2019)*

For the **COMF(Y)** notation, a single sample of data is to be recorded for each whole-body vibration measurement position. Each whole-body vibration measurement sampleis to be at least sixty (60) seconds in duration.

For the **COMF+(Y)** notation, motion sickness measurements are to be taken in addition to the whole-body vibration measurements. Motion sickness measurement locations are to be made in the most aft-and-port, aft-and-starboard, forward-and-port and forward-and-starboard Owner/guest spaces, irrespective of deck level.

The above measurement samples are to be taken using the appropriate Type 1 instrumentation (ISO 8041), then frequency weighted and analyzed in accordance with ISO 20283-5. It is desirable to employ equipment that records and stores acceleration time histories.

FIGURE 2
Process for the Measurement and Analysis of Whole-body Vibration



13.5 Test Conditions

The test conditions required for the whole-body vibration measurements are to be in accordance with the following Subparagraphs.

13.5.1 Power Output

The propulsion machinery Is to run at contractual service conditions or with at least 40% power on the thrusters.

13.5.2 Equipment Operation

All machinery essential for yacht operation is to operate under normal conditions throughout the measurement period. Heating, Ventilation, and Air Conditioning (HVAC) systems are to be running as for normal seagoing conditions during the whole-body vibration measurements.

13.5.3 Course and Water Depth

Whole-body vibration measurements are to be taken with the yacht in a depth of water not less than five (5) times the draft of the yacht. For yachts that do not operate in water depths of five (5) times draft, measurements are to be taken under normal operating and transit conditions. The yacht is to maintain a single heading and a constant speed during the test, as far as practicable.

13.5.4 Rudder Conditions

The rudder action is to be minimized.

13.5.5 Sea Conditions *(1 March 2019)*

Measurements are to be taken under conditions of a Sea State 3 or less, as defined by the World Meteorological Organization (WMO) Manual on Codes, No. 306, Part A, Alphanumerical Codes.

13.5.6 Loading Conditions

The loading condition of the yacht is to be as close as possible to normal operating conditions. If this is not practicable, the loading condition is to be recorded in the Whole-body Vibration Test Report.

13.5.7 Test Interference

During the whole-body vibration measurements, noise and vibration arising from every kind of unnecessary human activity are to be avoided. For this reason, only the personnel needed for the normal operation of equipment in the space and those carrying out the measurements are to be present in the space being tested.

13.7 Measurement Locations

13.7.1 Selection of Spaces where Measurements are to be Conducted

Whole-body vibration measurements are to be taken in all Owner/guest spaces. The number of measurements within a space is to be selected according to 2/13.7.3 TABLE 3, “Distribution of Transducer Positions within Spaces”.

13.7.2 Walkthrough Verification Inspection Locations

All Owner/Guest spaces are to be subject to a walkthrough inspection by the ABS Surveyor. The number and locations of the walkthrough inspections will be determined by the ABS Surveyor. The purpose of the walkthrough verification is to subjectively assess the vibration qualities. At the discretion of the ABS Surveyor, additional measurements may be required.

13.7.3 Transducer Measurement Positions

Vibration transducers (accelerometers) are to be located and attached properly to the deck surface to measure the vibration at the interface between the standing Owner/guest and the source of vibration. The mounting of accelerometers shall comply with ISO 5348. When the vibration enters

the human body from a non-rigid or resilient material (e.g., deck covering), secure the transducers with a suitably formed mount that does not alter the pressure distribution on the surface of the deck covering.

In cabins or staterooms, the vibration transducers are to be placed on the deck in the center of the space.

Note: This location may not provide the maximum vibration levels for this particular space. The objective is to minimize the number of measurements yet still obtain a fair and representative sample of the exposure conditions for the person occupying the cabin or stateroom.

For larger spaces (entertainment areas, dining rooms, meeting rooms, etc.) it will be necessary to place transducers at a number of locations in order to obtain a representative sample of the whole-body vibration levels for that space. Transducer locations are to be evenly distributed throughout the space. For a specific room size, the minimum number of measurement locations are to be as indicated in 2/13.7.3 TABLE 3, "Distribution of Transducer Positions within Spaces".

TABLE 3
Distribution of Transducer Positions within Spaces

Space Size	*Minimum Number of Measurement Positions in Room*
Less than or equal to 40 m^2 (431 ft^2)	1
Greater 40 m^2 (431 ft^2)	2

Transducers located at one (1) measurement position are to be orthogonally positioned (positioned at a 90 degree angle) to measure whole-body vibrations in the vertical, longitudinal, and transverse axes. Translational accelerometers oriented in different axes at a single measurement position are to be as close together as possible.

For the **COMF+(Y)** notation, at least three (3) sets of data are to be collected, each consisting of four (4) motion sickness measurements made at locations specified in 2/13.7.1, "Selection of Spaces Where Measurements are to be Conducted". For exposure periods greater than or equal to three (3) hours there is to be at least thirty (30) minutes elapsed between the final motion sickness measurement in a set and the first motion sickness measurement in the following set. For exposure periods shorter than three (3) hours, motion sickness measurements may be made in succession. Each motion sickness measurement sample is to be at least six hundred (600) seconds in duration.

15 Test Report

As stated in 1/11, "Process for Obtaining a Notation" a Test Report is to be submitted to the ABS Surveyor to determine whether the vibration levels meet the whole-body vibration criteria and whether this part of the notation requirement has been met. The details listed in the following paragraphs are to be provided in the Whole-body Vibration Test Report.

15.1 Test Details *(1 March 2019)*

The following details are to be recorded for each period of testing:

i) Loading (mean draft and trim)

ii) Number of persons present during testing

iii) Bridge confirmation that operating conditions complied with contractual service conditions

iv) Yacht course and speed, as well as latitude and longitude coordinates of tests

v) Average water depth under keel

vi) Weather conditions and meteorological data at the onset of every data collection period and at intervals of every four (4) hours (if needed) during any data collection period. Weather conditions shall also be reported at the end of each data collection period.

vii) Power output

viii) Sea state

ix) Yacht equipment operated during the test

x) Any indications of abnormal activity during the test that might skew results

15.3 Transducer Measurement Positions

Actual transducer positions within the measured spaces are to be indicated on appropriate drawings.

15.5 Measurement Equipment Details

Details of measuring and analysis equipment (e.g., manufacturer, type and serial number, accuracy and resolution), including frequency analysis parameters (e.g., resolution, averaging time, filtering and window functions) shall be provided.

15.7 Results *(1 March 2019)*

The following results, per sample period and measurement axis, as appropriate for notation, are to be provided in table format:

i) Measurement position (i.e., space and location within space)

ii) Measurement period if different from requirements

iii) Sample number

iv) Weighted RMS-per-axis (a_w)

v) Multi-Axis weighted RMS values

vi) Motion Sickness Dose Value ($MSDV_Z$)

vii) Exposure period

viii) Equipment operating in proximity to the measurement position

ix) Indication of space pass/fail

For all the remaining spaces that were checked through walkthrough verification inspection and spot check measurements, the following information shall be provided:

i) Name and number of spaces

ii) Walkthrough inspection observations

iii) Measurement results, if necessary

15.9 Deviations

All deviations from the approved Test Plan are to be reported.

15.11 Surveyor Witnessing Documentation *(1 March 2019)*

The equipment field calibration and data collection process of vibration tests conducted at sea are to be witnessed by an ABS Surveyor. The ABS Surveyor is to sign or initial each page of the test data sheets included in the Test Report and is to prepare a witnessing document stating whether all steps of the vibration testing were completed to their satisfaction. A copy of the witnessing document is to be given to the person conducting the onboard testing for insertion into the final Whole-body Vibration Test Report. The original is to be retained for ABS' files.

17 Results

The Whole-body Vibration Test Report and test results are to be reviewed by the ABS Surveyor against the appropriate **COMF(Y)** and **COMF+(Y)** criteria for notation confirmation.

SECTION 3
Noise

1 Background *(1 March 2019)*

Noise is any unwanted sound which may result in annoyance, disturbance of sleep, or interfere with activities or speech. Compliance with the noise level criteria specified herein will contribute to the comfort and well-being of the yacht's Owner and guests when using these spaces for their intended purpose.

3 Scope

In this Section, noise criteria have been selected to improve the comfort of the Owner and their guests. In this instance, "comfort" means the ability of the Owner and their guests to use a space for its intended purpose, with minimal interference or annoyance from noise.

This Section applies to Owner/guest spaces occupied for twenty (20) minutes or longer at any one time (e.g., cabins, staterooms, dining and recreation spaces).

Compliance with this Section is a prerequisite for the Comfort-Yacht (**COMF(Y)**) or Comfort Plus-Yacht (**COMF+(Y)**) notation confirmation.

5 Terminology *(1 March 2019)*

A-weighted Sound Pressure Level: The magnitude of a sound, expressed in decibels (i.e., 20 micropascals); the various frequency components are adjusted according to the A-weighted values given in IEC 61672-1 in order to account for the frequency response characteristics of the human ear. The symbol is L_A; the unit is dB(A). The measurement L_{Aeq} is an equivalent continuous A-weighted sound pressure level, measured over a period of time.

Accommodation Areas: Yacht areas where the primary purpose is to rest or recreate. Owner/guest accommodation spaces include cabins, staterooms, dining areas, entertainment areas, recreation rooms, and other interior or exterior Owner/guest spaces. For the purposes of this Guide, accommodation areas are primarily restricted to the spaces Owners and their guests would normally use on board yachts.

Calibration Checks: Field calibration of a measuring instrument conducted before and after a field test using a reference calibrated signal or through zero calibration. Sound calibrators are to comply with the standard IEC 60942 type/class (1) standard and are to be approved by the manufacturer of the measuring instrument used.

Equivalent Continuous A-weighted Sound Pressure Level: The A-weighted sound pressure level of a notional steady sound over a certain time interval, which would have the same acoustic energy as the variable-loudness real sound under consideration, over the same time interval. The symbol is L_{Aeq}; the unit is dB(A).

Reference Calibration: Calibration of measuring instrument and sound calibrator, conducted at least every two (2) years (or more frequently if specified by the manufacturer) by a Testing and Calibration Laboratory accredited according to ISO 17025 with traceability to a national or international standard.

Weighted Sound Reduction Index R_w: A single number value expressed in decibels (dB) which describes the overall sound insulation performance (in laboratory) of walls, doors or floors provides.

7 Associated Documentation *(1 March 2019)*

The following documents provide details about Test Plan preparation, test measurement procedures and/or Test Reporting:

- ISO 60942. Electroacoustics – Sound Calibrators
- IEC 61672-1. Electroacoustics – Sound Level Meters – Part 1: Specifications
- IMO Resolution MSC.337(91), Code on Noise Levels Onboard Ships
- ISO 717-1, Acoustics – Rating of Sound Insulation in Buildings and of Building Elements – Part 1: Airborne Sound Insulation
- ISO 2923, Acoustics – Measurement of noise on board vessels
- ISO 10140-2, Acoustics – Laboratory Measurement of Sound Insulation of Building Elements – Part 2: Measurements of Airborne Sound Insulation
- ISO 16283-1, Acoustics – Field Measurement of Sound Insulation in Buildings and of Building Elements – Part 1: Airborne Sound Insulation
- ISO 17025, General requirements for the competence of testing and calibration laboratories
- World Meteorological Organization (WMO) Manual on Codes, No. 306, Part A, Alphanumerical Codes.

9 Criteria

9.1 Equivalent Continuous A-weighted Sound Pressure Level *(1 March 2019)*

The noise criteria for the Comfort-Yacht (**COMF(Y)** and Comfort-Plus Yacht **COMF+(Y)**) notations are provided in the tables below. 3/9.1 TABLE 1, displays the noise criteria for the **COMF(Y)** Notation. 3/9.1 TABLE 2, displays the noise criteria for the **COMFY+(Y)** Notation. Noise levels for comfort are to be determined for the test conditions specified in 3/13.5, "Test Conditions".

TABLE 1
Noise Criteria - COMF(Y) Notation *(1 March 2019)*

Spaces	*Maximum Acceptable Noise L_{Aeq} Level dB(A)*			
	Yachts ≤ 50 Meters		*Yachts > 50 Meters*	
	In-Harbor	*Transit Conditions*	*In-Harbor*	*Transit Conditions*
Owner's Cabin	52	55	50	53
Passageways serving Owner's Cabin	52	55	50	53
Guest Cabins	52	55	50	53
Passageways serving Guest Cabin	55	58	52	55
Dining Spaces	55	58	52	55

Spaces	*Maximum Acceptable Noise L_{Aeq} Level dB(A)*			
	Yachts ≤ 50 Meters		*Yachts > 50 Meters*	
	In-Harbor	*Transit Conditions*	*In-Harbor*	*Transit Conditions*
Indoor Guest Spaces (including Lounges, Cocktail Bars, etc.)	55	58	52	55
Entertainment Spaces (Cinema, Meeting rooms, etc.)	55	58	52	55
Passageways near Guest Spaces	60	63	57	60
Gymnasiums	65	65	65	65
Outdoor Spaces	70	73	67	70
Medical Facilities	55	55	55	55

TABLE 2
Noise Criteria - COMF+(Y) Notation *(1 March 2019)*

Spaces	*Maximum Acceptable Noise L_{Aeq} Level dB(A)*			
	Yachts ≤ 50 Meters		*Yachts > 50 Meters*	
	In-Harbor	*Transit Conditions*	*In-Harbor*	*Transit Conditions*
Owner's Cabin	50	53	48	51
Passageways serving Owner's Cabin	50	53	50	53
Guest Cabins	50	53	48	51
Passageways serving Guest Cabin	55	57	53	55
Dining Spaces	52	55	52	55
Indoor Guest Spaces (including Lounges, Cocktail Bars, etc.)	52	55	50	53
Entertainment Spaces (Cinema, Meeting rooms, etc.)	52	55	50	53
Passageways near Guest Spaces	57	60	57	60
Gymnasiums	65	65	65	65
Outdoor Spaces	70	73	67	70
Medical Facilities	55	55	55	55

9.3 Acoustic Insulation/Noise Attenuation *(1 March 2019)*

The airborne sound insulation properties for bulkheads and decks within the accommodation are to comply at least with the weighted sound reduction index (R_w) according to ISO 717-1 provided and 3/9.3 TABLE 3, "Airborne Sound Insulation Criteria". The airborne sound insulation properties are to be determined by laboratory tests in accordance with ISO 10140-2 as identified in IMO Code on Noise. The manufacturer of the acoustic insulation is to provide the weighted sound reduction index (R_w) value and evidence of the laboratory test.

Alternatively, in lieu of laboratory tests, the weighted apparent sound reduction index (R_w) for bulkheads and decks within the accommodation, based on field measurements according to ISO 16283-1 are to comply at least with the requirements provided in 3/9.3 TABLE 3, "Airborne Sound Insulation Criteria" with tolerance of up to 3 dB. The means by which the R_w values will be determined (i.e., laboratory test or field measurement) will be at the discretion of the owner in collaboration with the builder and clearly identified in the Noise Test Plan.

TABLE 3
Airborne Sound Insulation Criteria *(1 March 2019)*

Cabin to cabin	$R_w = 38$
Messrooms, recreation rooms, public spaces and entertainment areas to cabins and hospitals	$R_w = 48$
Corridor to cabin	$R_w = 33$
Cabin to cabin with communicating door	$R_w = 33$

11 Test Plan

As stated in 1/11, "Process for Obtaining a Notation", a Test Plan is to be developed to serve as the principal means for verifying the measurements to be performed to demonstrate or confirm compliance with noise criteria. The Test Plan is to include the following:

11.1 Documentation *(1 March 2019)*

The Test Plan is to include appropriate design information including noise specifications for the yacht. It is to also include layout drawings indicating the locations of all noise sources and noise generating equipment, sample data sheets (in table format), and the identification of any potential conflicts of interest with the testing specialists, designers, and/or construction yard.

The Test Plan shall be submitted to ABS Engineering for review and approval.

11.3 Test Personnel

The Test Plan is to provide information about the Testing Specialist who will be conducting the test and their approval and certification in accordance with Appendix A2, "Procedural Requirements for ABS Recognized Ambient Environmental Testing Specialists" of the ABS *Guide for Passenger Comfort on Ships*.

11.5 Test Conditions

The Test Plan is to detail the conditions under which the tests will be performed. Further details on test conditions are provided in 3/13.5, "Test Conditions".

11.7 Measurement Locations

The Test Plan is to document in detail on appropriate drawings all spaces where measurements will be taken. In addition, measurement positions is to be indicated. Details on selecting measurement locations and determining transducer positions are provided in 3/13.7, "Measurement Locations".

11.9 Data Acquisition and Instruments *(1 March 2019)*

The integrating-averaging sound level meter is to meet the requirements for a Type 1 instrument specified in IEC 61672-1. When used alone, or in conjunction with a sound level meter, as appropriate, an octave filter set is to conform to IEC 61260-1.

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

For each location measured, a data sample is to be taken for each applicable operational condition, in accordance with the requirements in 3/13.5, "Test Conditions". The Test Plan is to provide information regarding the methods and instrumentation to be used for measurement and data collection. Instrumentation specification details are to include type of instruments to be used, accuracy, calibration, and sensitivity.

11.11 Data Analysis

The Test Plan is to provide information regarding the methods, software and instrumentation to be used for data analysis.

11.13 Test Schedule

The Test Plan is to provide information regarding the proposed test schedule.

13 Test Requirements

13.1 General *(1 March 2019)*

In general, the noise measurements are to be carried out in accordance with IMO Resolution MSC.337(91) Code on Noise Levels On-board Ships and ISO 2923. However, where the IMO requirements differ from those in this Guide, the more stringent requirements are to take precedence. When applicable, sound insulation measurements are to be carried out in accordance with ISO 16283-1.

13.3 Data Acquisition and Instruments

The integrating-averaging sound level meter is to meet the requirements for a Type 1 instrument specified in IEC 61672-1.

For each location sampled, a measurement is to be taken in accordance with the requirements in 3/13.5, "Test Conditions".

13.5 Test Conditions

The test conditions required for the noise measurements are to be in accordance with the following Subparagraphs, based on ISO 2923.

13.5.1 Power Output

The propulsion machinery is to run at contractual service conditions or with at least 40% power on the thrusters.

13.5.2 Equipment Operation

All other rotating machinery essential for yacht operation is to operate under normal conditions throughout the measurement period. Heating, Ventilation and Air Conditioning (HVAC) system(s) are to be running as for normal seagoing conditions during the noise measurements.

13.5.3 Course and Water Depth

Noise measurements are to be taken with the yacht in a depth of water not less than five (5) times the draft of the yacht. For yachts that do not operate in water depths of five (5) times draft, measurements are to be taken under normal operating and transit conditions. The course of the yacht shall be as straight as possible and at a constant speed.

13.5.4 Rudder Conditions

The rudder action is to be minimized.

13.5.5 Sea Conditions *(1 March 2019)*

Measurements are to be taken under conditions of a Sea State 3 or less, as defined by the World Meteorological Organization (WMO) Manual on Codes, No. 306, Part A, Alphanumerical Codes.

13.5.6 Loading Conditions

The loading condition of the yacht is to be as close as possible to normal operating conditions. If this is not practicable, the loading condition is to be recorded in the Noise Test Report.

13.5.7 Test Interference

During the noise measurements, noise arising from every kind of unnecessary human activity is to be avoided. For this reason, only the personnel needed for the normal operation of the equipment in the space and those carrying out the measurements are to be present in the space being tested. Owners and their guests are not to be present during the noise measurements.

13.7 Measurement Locations

13.7.1 Selection of Spaces where Measurements are to be Conducted

Noise measurements are to be taken in all Owner/guest spaces.

13.7.2 Walkthrough Verification Inspection Locations *(1 March 2019)*

All Owner/guest spaces are to be subject to a walkthrough inspection by the ABS Surveyor. The number and locations of the walkthrough inspections will be determined by the ABS Surveyor. The purpose of the walkthrough verification is to subjectively assess the noise qualities. At the discretion of the ABS Surveyor, additional measurements may be required.

13.7.3 Measurement Positions *(1 March 2019)*

The measurement positions described below are taken or adapted from ISO 2923 and IMO Resolution MSC.337(91).

Measure at positions where Owners and their guests will be seated or standing. The microphone is to be at a height of approximately 1200 mm (47 in.) from the deck to represent seated persons and approximately 1600 mm (63 in.) from the deck to represent standing persons, as appropriate for the measurement position. In cabins, measure in the middle of the space.

For all measurements, the microphoneis not to be closer than 500 mm (20 in.) from the boundary surface (e.g., bulkhead) of a space. The measurement time is to be at least fifteen (15) seconds and is to be long enough to enable the measurement of the equivalent continuous A-weighted sound pressure level for any specified time interval within the stated limits of overall measurement uncertainty.

13.9 Measurement Procedures and Recorded Results

13.9.1 Persons Present During Measurements *(1 March 2019)*

When Testing Specialist personnel are conducting noise level measurements in any space, only seafarers necessary for the operation of that space are to be present. Owners and their guests are not to be present during the noise measurement.

13.9.2 Sampling Duration

Equivalent continuous A-weighted sound pressure levels (L_{Aeq}) are to be reported for each measurement location. The L_{Aeq} sampling duration is to be sufficient to achieve a stable reading. Sampling time is to be fifteen (15) seconds or longer.

13.9.3 Cyclic Noise

If the noise within a space is cyclic, the L_{Aeq} sampling duration is to 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.

13.9.4 Intermittent Noise

If the noise within a space is present intermittently, an L_{Aeq} value is to be determined and reported for a period of high-level noise.

13.9.5 HVAC Related Noise

If HVAC system-related noise is a large contributor to the noise level in the space, a noise measurement is to be made approximately 300 mm (12 in.) from the vent, measured in line with the direction of airflow, and recorded in the Noise Test Report.

15 Test Report

As stated in 1/11, "Process for Obtaining a Notation", a Test Report is to be submitted to the ABS Surveyor to determine whether the noise levels are at or below the limits and whether this part of the notation requirement has been met. The details listed in the following paragraphs are to be provided in the Noise Test Report.

15.1 Test Details *(1 March 2019)*

The following details shall be provided for each period of testing:

i) Loading (mean draft and trim)

ii) Number of persons present during testing

iii) Bridge confirmation that operating conditions complied with contractual service conditions

iv) Yacht course, speed, and latitude and longitude coordinates

v) Weather conditions and meteorological data at the onset of every data collection period and at intervals of every four (4) hours (if needed) during any data collection period. Weather conditions shall also be reported at the end of each data collection period.

vi) Average water depth under keel

vii) Sea state

viii) Power output

ix) Yacht equipment operated during the test

x) Any indications of abnormal activity during the test that might skew results.

15.3 Measurement Positions

Actual measurement location positions are to be indicated on appropriate drawings.

15.5 Measurement Equipment Details

Details of measuring and analysis equipment (e.g., manufacturer, type and serial number, accuracy, sampling frequency and resolution) are to be provided.

Copies are to be provided of the relevant instrumentation reference calibration certificates, together with the results of field setup and calibration checks before and after the field tests.

15.7 Results *(1 March 2019)*

The following results, per measurement location and sample period as appropriate for the notation, are to be provided in table format:

i) Measurement position (i.e., space and location within space)

ii) Number of persons present in space at time of measurement

iii) Measurement period

iv) Time at start and finish of measurement

v) Equivalent continuous A-weighted sound pressure level (L_{Aeq})

vi) Note any open doors and windows

vii) Note equipment operating in proximity to the measurement position

viii) Note observed direct sources of noise (such as ventilation devices) and any measurement data collected

ix) An indication of space pass/fail

For all the remaining spaces that were checked through walkthrough verification inspection and spot check measurements, the following information is to be provided:

i) Name and number of space

ii) Walkthrough inspection observations

iii) Measurement results, if necessary

15.9 Deviations

All deviations from the approved Test Plan are to be reported.

15.11 Surveyor Witnessing Documentation

The equipment calibration and data collection process of the noise level tests are to be witnessed by an ABS Surveyor. The ABS Surveyor is to provide documentation stating whether all steps of the noise level testing were completed to their satisfaction. A copy of the witnessing document is to be given to the person conducting the testing, for insertion into the final Noise Test Report. The original is to be retained for ABS's files.

17 Results

The Noise Test Report and test results are to be reviewed by the ABS Surveyor against the noise criteria for determination of the notation confirmation.

APPENDIX **1**

References *(1 March 2019)*

The submitted design is to be in accordance with the requirements of this Guide and the edition of the specified codes and standards, as referenced herein applicable at the date of contract (i.e., the rule application).

1 General References *(1 March 2019)*

1) American Bureau of Shipping. *Guide for Building and Classing Yachts*

2) American Bureau of Shipping. *Guide for Crew Habitability on Ships*

3) American Bureau of Shipping. *Rules for Building and Classing High-Speed Craft*

4) American Bureau of Shipping. *Rules for Building and Classing Marine Vessels*

2 Whole-body Vibration References *(1 March 2019)*

1) International Organization for Standardization. Mechanical Vibration and Shock – Evaluation of Human Exposure to Whole Body Vibration – Part 2, Vibration in Buildings. (ISO 2631-2).

2) International Organization for Standardization. Mechanical mounting of accelerometers for measuring mechanical vibration and shock (ISO 5348).

3) International Organization for Standardization. Human response to vibration – Measuring instrumentation (ISO 8041).

4) World Meteorological Organization (WMO). Manual on Codes, No. 306, Part A, Alphanumerical Codes.

3 Noise References *(1 March 2019)*

1) International Electrotechnical Commission. Electroacoustics – Sound Calibrators (International Standard IEC 60942).

2) International Electrotechnical Commission.. Electroacoustics – Sound Level Meters – Part 1: Specifications (International Standard IEC 61672-1).

3) International Maritime Organization. Code on noise levels on-board ships (IMO Resolution MSC.337(91).

4) International Organization for Standardization. Acoustics – Rating of sound insulation in buildings and of building elements – Part 1: Aiborne Sound Insulation (ISO 717-1).

5) International Organization for Standardization. Acoustics – Measurement of noise on-board vessels (ISO 2923).

6) International Organization for Standardization. Acoustics – Laboratory measurement of sound insulation of building elements – Part 2: Measurements of airborne sound insulation (ISO 10140-2).

7) International Organization for Standardization. Acoustics – Field Measurement of Sound Insulation in Buildings and of Building Elements – Part 1: Airborne Sound Insulation (ISO 16283-1).

8) International Organization for Standardization. Acoustics – General requirements for the competence of testing and calibration laboratories (ISO 17025: 2005). Geneva.

9) World Meteorological Organization (WMO). Manual on Codes, No. 306, Part A, Alphanumerical Codes.

APPENDIX **2**

Acronyms and Abbreviations

ABS: American Bureau of Shipping

a_w: Multi-axis acceleration value

a_{xw}: The weighted root mean square acceleration values measured along the x-axis

a_{yw}: The weighted root mean square acceleration values measured along the y-axis

a_{zw}: The weighted root mean square acceleration values measured along the z-axis

BS: British Standard

COMF(Y): Comfort notation for yachts

COMF+(Y): Comfort Plus notation for yachts

dB(A): Decibels measured using the A weighted scale

Hz: Hertz

IEC: International Electrotechnical Commission

ILO: International Labor Organization

IMO: International Maritime Organization

ISO: International Organization for Standardization

L_{Aeq}: Equivalent continuous A weighted sound pressure level

m^2: Square meter

m/s: Meters-per-second

m/s^2: Meters-per-second squared

Max: Maximum

MCR: Maximum Continuous Rating

Min: Minimum

$MSDV_Z$: Motion Sickness Dose Value

RMS: Root-mean square

rpm: Revolutions-per-minute

SOLAS: Safety Of Life At Sea

USA: United States of America

W_m: Frequency weighting used to evaluate x, y, and z-axis vibration with respect to comfort

WMO: World Meteorological Organization

APPENDIX **3**

Associated Documentation *(1 March 2019)*

Titles listed under the heading of "Associated Documentation" throughout this text can be obtained from the following sources:

IEC	www.iec.org
ILO	www.ilo.org
IMO	www.imo.org
ISO	www.iso.org