



GUIDE FOR

CREW HABITABILITY ON WORKBOATS

FEBRUARY 2016

**American Bureau of Shipping
Incorporated by Act of Legislature of
the State of New York 1862**

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American Bureau of Shipping
ABS Plaza
16855 Northchase Drive
Houston, TX 77060 USA**

Foreword (1 February 2016)

This Guide, originally published in December 2008, has undergone significant revision. Key revision areas include changes to the Whole-body Vibration (WBV) and Noise measurement and evaluation methodology and criteria, changes to the ambient Lighting methodology and criteria, and changes to the Accommodation Area criteria. These revisions are 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. Revised statutory regulations
4. Changes in current vessel design practices and principles

ABS has produced this *Guide for Crew Habitability on Workboats* in order to provide a single source for habitability criteria suitable for workboats. This Guide may be applied to vessels falling under the categories of offshore support vessels, tug boats, tow boats, dredgers, research vessels, anchor handling vessels, or other vessels providing service to offshore oil and gas exploration and production. This Guide does not apply to vessels such as oil or chemical tankers, bulk or combination carriers, container carriers, multi-purpose cargo vessels, or mobile offshore drilling units (MODUs). These types of vessels are addressed in other ABS Habitability Guides*.

This Guide provides the assessment criteria and describes the measurement methodology for obtaining a workboat Habitability notation. It is intended for use by vessel Owners or companies requesting the optional notations of workboat Habitability (**HAB(WB)**), workboat Habitability Plus (**HAB+(WB)**), or workboat Habitability Plus Plus (**HAB++(WB)**). For the assessment of habitability in terms of whole-body vibration, criteria are provided for workboats less than or equal to 60 meters (200 feet) in length and for workboats greater than 60 meters (200 feet) in length.

For the **HAB(WB)** level, this Guide focuses on five (5) categories of habitability criteria that can affect task performance and can be controlled, measured, and assessed in crew work, rest, and recreation areas of workboats. These categories are: accommodation area design, whole-body vibration (separate criteria for accommodation areas and work spaces), noise, indoor climate, and lighting.

For the **HAB+(WB)** level, this Guide invokes more stringent accommodation area, whole-body vibration, and noise criteria aimed at increasing crew comfort and safety. For the **HAB++(WB)** level, there are more stringent accommodation area, whole-body vibration, noise, and indoor climate criteria.

To be awarded any of these notations, a vessel must meet the appropriate prescriptive criteria across the various habitability categories. In addition to the **HAB** notation assignment, at the Owner's request, ABS may review the accommodation area design for compliance with ILO MLC, 2006 Title 3 requirements, as related to the **MLC-ACCOM**, **MLC-ACCOM(SPS)** and **MLC-ACCOM(WB)** notations.

* Note: The other ABS Habitability Guides include: *ABS Guide for Crew Habitability on Ships*, *ABS Guide for Crew Habitability on Mobile Offshore Drilling Units*, and *ABS Guide for Crew Habitability on Offshore Installations*.

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.

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SECTION 1 General

1 Introduction

ABS recognizes the positive impact that suitable habitability criteria and design practices may have on the safety, productivity, morale, and overall well-being of seafarers. The *ABS Guide for Crew Habitability on Workboats* has been developed with the objective of improving the quality of crew member performance and comfort by improving working and living environments in terms of accommodation area design and ambient environmental qualities. These habitability criteria have been chosen to provide a means to help reduce crew fatigue, improve performance and safety, and to assist with crew recruiting and retention.

2 Application (1 February 2016)

This Guide is applicable to new and existing vessels for which an optional workboat Habitability (**HAB(WB)**), workboat Habitability Plus (**HAB+(WB)**), or workboat Habitability Plus Plus (**HAB++(WB)**) notation has been requested. The habitability criteria are a measure of the acceptability of crew accommodation areas and work spaces for living and working. In addition to the **HAB** notation assignment, at the Owner's request, ABS may review the accommodation area design for compliance with ILO MLC, 2006 Title 3 requirements, as related to the **MLC-ACCOM**, **MLC-ACCOM(SPS)** and **MLC-ACCOM(WB)** notations.

ABS has produced this *Guide for Crew Habitability on Workboats* in order to provide a single source for habitability criteria suitable for workboats. This Guide may be applied to vessels falling under the categories of offshore support vessels, tug boats, tow boats, dredgers, research vessels, anchor handling vessels, or other vessels providing service to offshore oil and gas exploration and production. This Guide does not apply to vessels such as oil or chemical tankers, bulk or combination carriers, container carriers, multi-purpose cargo vessels, or mobile offshore drilling units (MODUs). These types of vessels are covered and discussed in other ABS Habitability Guides.

3 Scope

This Guide focuses on five (5) habitability aspects of workboat design and layout that can be controlled, measured, and assessed. These five (5) aspects are broken into two (2) categories in this Guide, accommodation areas and the ambient environment.

Accommodation area criteria pertain to dimensional and outfitting aspects of spaces and open deck areas where crew members eat, sleep, recreate, and perform routine daily activities.

The ambient environmental aspects of habitability pertain to the environment that the crew is exposed to during periods of work, leisure, and rest. Specifically, this Guide provides criteria, limits, and measurement methodologies for the following:

- i) Whole-body Vibration (separate criteria for accommodation areas and work spaces)
- ii) Noise
- iii) Indoor Climate
- iv) Lighting

The criteria provided in this Guide are based on currently available research data and standards for the purpose of improving crew performance and providing a base level of habitability and elements of safety related to habitability.

While producing this Guide, ABS has taken a practical approach to measurements, test personnel (Testing Specialists), and test equipment.

4 Terminology (1 February 2016)

ABS Recognized Ambient Environmental Testing Specialists: Companies providing test or measurement services on behalf of the Owner of a vessel or shipyard for the purposes of meeting any of the ABS **workboat Habitability (HAB(WB), HAB+(WB), HAB++(WB))** notation requirements. Approval of the Testing Specialist for workboats may also allow for testing and measurement services for other ABS Habitability, Comfort, and MLC notations.

Accommodation Areas/Accommodation Block: Vessel areas where the primary purpose is to rest and recreate. Accommodation spaces include cabins, medical facilities (sick bays), offices, recreation rooms, and manned spaces within the accommodation block such as the bridge or control room. For the purposes of this Guide, accommodation areas also include service spaces such as mess rooms, laundry, and storerooms.

Ambient Environment: Ambient environment refers to the environmental conditions that the crew is exposed to during periods of work, leisure or rest. Specifically, this Guide provides criteria and limits for whole-body vibration, noise, indoor climate, and lighting.

Associated Documentation: Documents referenced in this Guide that are needed to provide measuring techniques and further guidance.

Crew Member: Any person onboard a vessel, including the Master, who is not a passenger. This term is used interchangeably throughout this document with “seafarer”.

Crew Spaces: All areas on a vessel intended for seafarers only, such as seafarer accommodation spaces and seafarer work spaces. This term is also used interchangeably throughout this document with “seafarer spaces”.

Dynamic Positioning: A system to automatically maintain a workboat’s position and heading by controlling propellers and/or thrusters. Dynamic positioning can maintain a position to a fixed point over the bottom, or in relation to a moving object (such as another vessel). It can also be used to position the vessel at a favorable angle towards wind, waves, and current.

Gross Tonnage: The gross tonnage calculated in accordance with the tonnage measurement regulations contained in Annex I to the International Convention on Tonnage Measurement of Ships, 1969, or any successor Convention.

Habitability: The acceptability of the conditions of a vessel in terms of whole-body vibration, noise, indoor climate, and lighting, as well as physical and spatial characteristics, according to prevailing research and standards for human efficiency and comfort.

Manned Space: For application of this Guide, a manned space is any space where a seafarer may be present for twenty (20) minutes or longer at any one time during normal, routine daily activities. Such spaces include working or living spaces. For machinery spaces, a manned space will be associated with the presence of a local work/control duty station manned for twenty (20) minutes or longer at one time during normal, routine daily activities. Normal inspection, walkthrough (patrolling) and maintenance tasks in machinery spaces are not considered tasks contributing towards a particular space being considered manned.

Passenger: A passenger is every person other than the Master and the members of the crew or other persons employed or engaged in any capacity onboard a vessel for the business of that vessel.

Recreation and Public Spaces: Those portions of the accommodation areas that are used for halls, dining rooms, lounges, and similar spaces.

Seafarer: Any person onboard a vessel, including the Master, who is not a passenger. This term is used interchangeably throughout this document with “crew member”.

Seafarer Spaces: All areas on a vessel intended for seafarers only, such as seafarer accommodation spaces and seafarer work spaces. This term is also used interchangeably throughout this document with “crew spaces”.

Shall: Expresses a provision that is mandatory.

Test Plan: Document containing the requisite information regarding vessel 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 habitability. This document is to be primarily prepared by the ABS Recognized Ambient Environment Testing Specialist with additional input provided by the designer/builder. Submission of the document for approval can be by either the Testing Specialist or the designer/builder.

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

Transit Conditions: Those conditions where the vessel is transitioning (moving) from one location to another.

Workboat: Vessels falling under the categories of offshore support vessels, tug boats, tow boats, dredgers, or research vessels and some special service vessels.

Work Spaces: Areas allocated for work. Categories of work spaces include, but are not limited to, navigation spaces, service spaces (e.g., galley), machinery spaces, and duty/control stations.

5 Associated Documentation

- Appendix 2, “Procedural Requirements for ABS Recognized Ambient Environmental Testing Specialists”

6 Notation

At the Owner’s or shipyard’s request, a vessel complying with the minimum criteria for accommodation areas and the ambient environment (i.e., whole-body vibration, noise, indoor climate, and lighting) provided in this Guide may be assigned a notation of **HAB(WB)**.

A vessel complying with the **HAB(WB)** criteria and the more stringent criteria with respect to accommodation, whole-body vibration, noise, and indoor climate may be distinguished in the *Record* by the notation **HAB+(WB)**. A vessel satisfying all the criteria in the Guide may be distinguished in the *Record* by the notation **HAB++(WB)**. A summary of the differences among each of these notations is presented below.

	HAB(WB)	HAB+(WB)	HAB++(WB)
Accommodation Areas	HAB (WB) Requirements for Accommodation Areas	HAB(WB) and HAB+(WB) Requirements for Accommodation Areas	HAB+(WB) and HAB++(WB) Requirements for Accommodation Areas
Whole-body Vibration	Level of vibration – reducing discomfort and promoting job performance	Lower level of vibration – promoting job performance and increased comfort	Lowest level of vibration – promoting job performance and increased comfort
Noise	IMO Code on Noise with modifications	HAB(WB) with additional requirements	HAB+(WB) with additional requirements
Indoor Climate	No provision for individual temperature adjustment		Aimed at enhancing crew comfort by making provisions for individual adjustments of indoor climate temperature
Lighting	No differences among the notations		

7 Data and Plans to be Submitted

7.1 General

The following General Arrangement-type drawings of the vessel shall be submitted:

- Inboard profile detailing the location of the main vertical zone boundaries, the location of the main watertight bulkheads, as well as the various deck levels
- Plan view of each deck annotating the various spaces on each deck

7.2 Accommodation Areas

At a minimum, scaled arrangement drawings of the various accommodation spaces (elevation and plan views) and the vessel’s accommodation area specifications shall be submitted to ABS Engineering. Details of the crew accommodation area data requirements are provided in Subsection 2/6, “Accommodation Area Documentation”.

7.3 Ambient Environment

(1 February 2016) The following items are to be submitted **individually** for each ambient environmental aspect.

7.3.1 Test Plans (1 February 2016)

Test Plans shall serve as the principal means for verifying the measurements for the ambient environmental aspects of habitability. Separate Test Plans are required for whole-body vibration, noise, indoor climate, and lighting. Specific Test Plan details for the various ambient environmental criteria are outlined in later sections of this Guide as follows:

<i>Environmental Aspect</i>	<i>Test Plan Details</i>
Whole-body Vibration	Subsection 3/6
Noise	Subsection 4/6
Indoor Climate	Subsection 5/6
Lighting	Subsection 6/6

The Test Plans require approval by ABS Engineering before any measurements are made. ABS Engineering shall notify the vessel Owner or shipyard whether the Test Plans have been approved or require alteration. An ABS approved copy of the Test Plan shall become part of the vessel's official documentation.

7.3.2 Test Reports

Upon completion of the ambient environmental testing, Test Reports shall be submitted to the ABS Surveyor. In addition, a copy of the Test Reports shall become part of the vessel's official documentation. These reports contain ambient environmental information such as test results, testing details, measurement equipment details, etc. The specific Report contents for the various ambient environmental criteria are outlined in later sections of this Guide as follows:

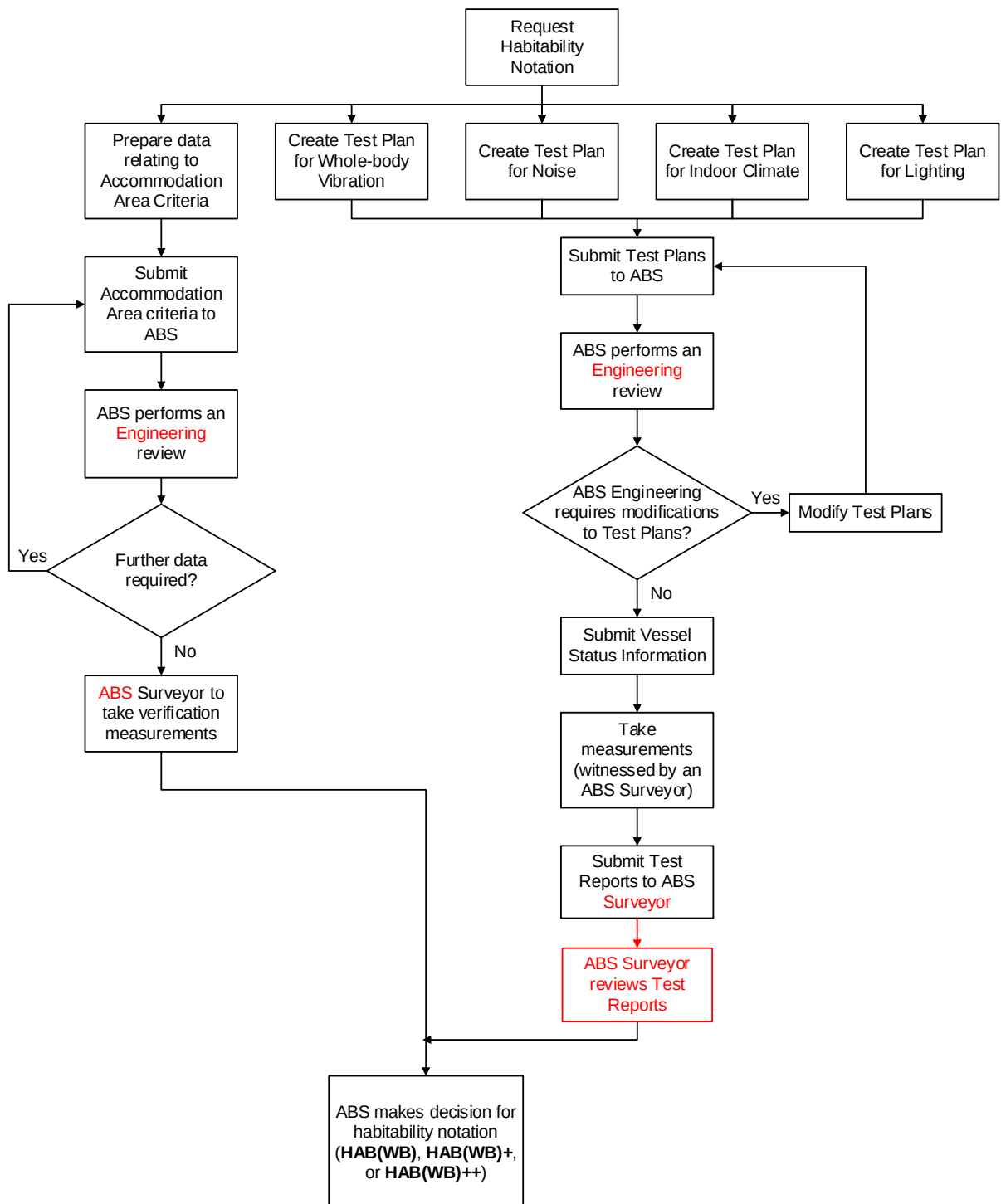
<i>Environmental Aspect</i>	<i>Test Plan Details</i>
Whole-body Vibration	Subsection 3/8
Noise	Subsection 4/8
Indoor Climate	Subsection 5/8
Lighting	Subsection 6/8

8 Process for Obtaining a Notation

(1 February 2016) Prior to scheduling accommodation area verification or ambient environmental testing activities, the vessel Owner or shipyard shall certify the operational status of the vessel as being fully operational and/or inclusive of all equipment and furnishings. If the vessel is not fully operational, a complete listing of deficiencies of areas, components, equipment, etc., shall be submitted to ABS for review. ABS shall then make a determination and notify the vessel Owner or shipyard as to whether accommodation area verification activities or ambient environmental testing can commence. The intent is to **conclude all** ambient environmental testing **by the end of the** sea trials.

Section 1, Figure 1, "Process for Obtaining a Habitability Notation", charts the process for obtaining a **HAB(WB)**, **HAB+(WB)**, or a **HAB++(WB)** notation. The following Paragraphs briefly describe the notation process.

FIGURE 1
Process for Obtaining a Habitability Notation (1 February 2016)



8.1 Accommodation Areas (1 February 2016)

Arrangement drawings, plans, and vessel design specifications for accommodation spaces shall be prepared and submitted to ABS Engineering for review. For new construction, the drawings shall be provided to ABS Engineering during the detailed design phase. For existing vessels, the arrangement drawings and plans, reflecting the current accommodation area configurations shall be provided to and approved by ABS Engineering, in advance of ABS Surveyor verifications.

Follow-up physical verification measurements of accommodation area criteria shall be performed by an ABS Surveyor. The ABS Surveyor shall select verification measurement sites. **The physical verification measurements of accommodation area criteria shall be performed for all vessels in a series of vessels.**

The results of the ABS Engineering review and actual ABS Surveyor verification shall be reviewed by the ABS Surveyor during the notation confirmation process.

8.2 Ambient Environment (1 February 2016)

Ambient environmental Test Plans for whole-body vibration, noise, indoor climate, and lighting shall be **individually** prepared and submitted to ABS Engineering. These Test Plans shall serve as a primary **means** 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 shall be performed by the Testing Specialist and witnessed by an ABS Surveyor. Test Reports for ambient environmental testing shall be prepared by the Testing Specialist and submitted to the ABS Surveyor for review.

For a vessel that is expected to operate in extreme environmental conditions (e.g., Polar regions, the Persian Gulf, etc.) that are significantly different from the conditions during sea trials, the designer/shipyard is required to submit information on the design/engineering analysis performed as part of the Test Plan submission verifying that the appropriate **HAB** criteria can be met in the actual area of operations. If there were instances during sea trials, where the criteria was either not met, or passed by a small margin, the ABS Surveyor in conjunction with the designer and Owner, may request additional confirmatory tests to be carried out in the actual area of operation.

Full ambient environmental testing as described in this Guide is required for the first vessel in a series of vessels. For the second and subsequent sister vessels (i.e., vessels being part of the same series of vessels that have identical structural, machinery, and outfitting designs), full scale testing for the ambient environmental aspects of the notation, is not required.

For the second or all subsequent sister vessels constructed in the same shipyard, the following is applicable for all aspects of ambient environmental testing (whole-body vibration, noise, indoor climate and lighting):

- Spaces that were identified as “worst case” locations in the test plans for the first vessel need to be tested.
- By review of the first vessel’s Test Reports (all ambient environment aspects), the ABS Surveyor shall identify the locations which were out of compliance or close to non-compliance (See Section 1, Table 1) that need to be tested.
- Spaces that required some type of mitigation for the first vessel need to be tested.
- All vessels are subject to ABS Surveyor walkthroughs. Additional testing may be required at the ABS Surveyor’s discretion.

TABLE 1
Threshold for Measurements to be Considered
Close to Non-Compliance (1 February 2016)

<i>Ambient Environment Aspect</i>	<i>Testing Threshold</i>
Whole Body Vibration	Within 10% of the criteria
Noise	Within 3 dB(A) of the criteria
Indoor Climate	Within 2°C (3.6°F) from the lower or upper air temperature range limits
Lighting	Within 10% of the criteria

For sister vessels constructed at a different shipyard the following is applicable:

- Full testing is required for the first vessel at each shipyard
- For the subsequent sister vessels, the procedure described previously for vessels built at the same shipyard is applicable.

8.3 Results

The ABS Engineering accommodation area assessment, ABS Surveyor verification measurements, and ambient environmental Test Reports shall be reviewed by the ABS Surveyor for determination of notation confirmation.

9 Initial Requirements

The initial process for obtaining any workboat Habitability notation shall comprise ABS Engineering reviews, ambient environmental testing, and ABS Surveyor verifications. Testing shall be in accordance with the submitted Test Plans reviewed and approved by ABS Engineering in advance of the testing. Testing shall be witnessed by an ABS Surveyor. If the criteria specified in this Guide have been **satisfied**, then the appropriate notation may be confirmed.

10 Surveys after Construction (1 February 2016)

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 also Section 7-9-16 of the ABS Rules for Survey After Construction (Part 7) for the survey requirements.**

11 Alternatives

11.1 General

ABS will consider alternative arrangements, criteria and procedures, which can be shown to **satisfy** 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.

11.2 National Regulations

ABS will consider for its acceptance alternative arrangements and details which can be shown to comply with standards recognized in the country (flag State) in which the vessel is registered or built, provided they are deemed not less effective.

11.3 Departures from Criteria (1 February 2016)

The criteria contained in this Guide are envisioned to apply to vessels that are engaged in the usual trades and services expected of such vessels, within the scope of the following:

- *ABS Rules for Building and Classing Steel Vessels*
- *ABS Rules for Building and Classing Steel Vessels Under 90 meters in Length (Part 5)*
- *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways.*
- *ABS Rules for Materials and Welding*
- *ABS Rules for Building and Classing Offshore Support Vessels*

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 shall be reviewed by ABS in consultation with the **shipyard or the** Owner. When the design of the accommodation areas or ambient environmental test results contain departures from the stated criteria, these 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 Accommodation Areas

1 Background (1 February 2016)

To promote maritime safety, efficiency, and habitability, it is important that seafarers maintain appropriate levels of mental and physical fitness while onboard vessels. To help accomplish this, seafarers should be provided with suitable accommodation areas. Appropriate accommodation area design helps promote reliable performance by reducing the potential for fatigue and human error. Appropriately designed and outfitted accommodation areas may also enhance crew morale, recruiting, retention, comfort, and overall quality of life at sea.

Conversely, inappropriate accommodation areas can adversely impact a seafarer's ability to reliably perform assigned duties, fully relax, sleep, and recover from mentally and physically demanding work activities. This in turn can impact their ability to carry out duties on succeeding watches with the required diligence, accuracy, and attention to safety procedures. Providing an onboard environment that increases seafarer alertness and well-being should be of concern to vessel Owners.

2 Scope

This Section and Appendix 3, "Accommodation Area Criteria", provide the measurement criteria for accommodation spaces. In particular, Appendix 3 encompasses criteria for access and egress, as well as crew cabins, sanitary spaces, offices, food services, recreation areas, laundry, and medical spaces. The criteria were selected to help increase crew member safety, productivity, quality of work, retention, and morale.

Note: The criteria for access/egress are applicable only to the crew accommodation block, and do not include crew member work spaces outside of the accommodation block.

Compliance with this Section and Appendix 3 "Accommodation Area Criteria" is a prerequisite for the workboat Habitability (**HAB(WB)**), workboat Habitability Plus (**HAB+(WB)**), or workboat Habitability Plus Plus (**HAB++(WB)**) notation confirmation.

3 Terminology (1 February 2016)

Accommodation Areas/Accommodation Block: Vessel areas where the primary purpose is to rest and recreate. Accommodation spaces include cabins, medical facilities (sick bays), offices, recreation rooms, and manned spaces within the accommodation block such as the bridge or control room. For the purposes of this Guide, accommodation areas also include service spaces such as mess rooms, laundry, and storerooms.

4 Associated Documentation

- Appendix 3, "Accommodation Area Criteria"
- International Labor Organization (ILO) Conventions 92 and 133 and the ILO MLC, Title 3, 2006
- *ABS Guide for Compliance with The ILO Maritime Convention, 2006 Title 3 Requirements*

5 Criteria (1 February 2016)

The accommodation area criteria are contained in Appendix 3, “Accommodation Area Criteria”. The ILO MLC, 2006 quantitative accommodation area requirements have been included in this Guide and are denoted by a “#” symbol in the tables of Appendix 3.

The **HAB+(WB)** and **HAB++(WB)** notations have more stringent criteria than the **HAB(WB)** notation with the objective of providing enhanced living and working conditions to improve seafarer safety and comfort. This includes enhanced criteria for work space design, crew cabins, and recreation/leisure areas.

The **HAB+(WB)** notation requires meeting the accommodation area criteria of **HAB(WB)** and **HAB+(WB)**. To achieve a **HAB++(WB)** notation requires meeting the criteria for both **HAB(WB)** and **HAB+(WB)**, as well as the **HAB++(WB)** requirements. For example, Criteria #14 below provides three degrees for angles of inclination for stairways, one for **HAB(WB)**, **HAB+(WB)**, and **HAB++(WB)**. If seeking a **HAB++(WB)** notation, the 40 degrees criteria would need to be fulfilled. By fulfilling the criteria for the **HAB++(WB)** requirements, the criteria for **HAB+(WB)** and **HAB(WB)** are met.

Requirement # = Related ILO MLC 2006, Title 3 Requirement			Meets HAB(WB) Requirements	Meets HAB+(WB) Requirements	Meets HAB++(WB) Requirements
	14	Accommodation area stairways have a maximum angle of inclination from the horizontal of:			
		• 50 degrees			
		• 45 degrees			
		• 40 degrees			

6 Accommodation Area Documentation

As stated in 1/7.2, “Accommodation Areas”, accommodation area documentation shall be prepared and submitted to ABS Engineering for review. Confirmatory verification measurements shall be performed by an ABS Surveyor. The following data shall be submitted to ABS Engineering:

6.1 Data Requirements

The submitted data shall serve as a means for verifying that the vessel meets the Accommodation Area criteria specified in Appendix 3, “Accommodation Area Criteria”.

6.1.1 New Construction

For new construction, scaled arrangement drawings of the accommodation spaces (elevation and plan views), details of the accommodation area outfitting and vessel’s design specification in relation to the accommodation spaces shall be submitted to ABS Engineering.

6.1.2 Existing Vessels

For existing vessels, appropriate arrangement drawings and plans reflecting the current accommodation area configurations shall be provided to ABS Engineering along with any current vessel accommodation area design specifications.

7 Submittal Review and Verification

Arrangement drawings, plans, and vessel specifications for the accommodation areas shall be prepared and submitted for review by ABS Engineering. For new construction, the drawings shall be provided to ABS Engineering during the detailed design phase. For existing vessels, the arrangement drawings and plans reflecting the current accommodation area configurations shall be provided to ABS Engineering in advance of onboard ABS Surveyor verifications.

ABS Engineering shall review the submitted accommodation area documentation. ABS Engineering shall report any deviation from criteria to the Owner/shipyard for resolution and shall also identify any criteria that the ABS Surveyors must field verify.

The ABS Surveyor shall verify that the submitted drawings match the constructed vessel. The ABS Surveyor shall also verify any criteria that are outstanding from the ABS Engineering review and document deviations from criteria.

8 Results

The results of the ABS Engineering review and the ABS Surveyor verification shall be reviewed by the ABS Surveyor against the appropriate **HAB(WB)**, **HAB+(WB)**, or **HAB++(WB)** criteria for notation confirmation.

SECTION 3 Whole-body Vibration

1 Background

Working and/or living onboard vessels imposes a series of generally low-frequency mechanical vibrations, as well as single-impulse shock loads, on the human body.

Low-frequency vibrations are also imposed by vessel motions, which are produced by the various sea states in conjunction with vessel speed. These motions can result in motion sickness, body instability, fatigue, and increased health risk aggravated by shock loads induced by vessel slamming. Vessel slamming may be caused by dynamic impact loads being exerted on the vessel's bottom or bow flare due to vessel size, speed, 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, creating discomfort and possibly resulting in degraded performance and health (Griffin, 1990).

2 Scope (1 February 2016)

This Section provides the criteria and methods for assessing whole-body vibration relating to habitability onboard vessels. The criteria were selected to limit potential vibration-related interference with work tasks and to improve crew 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 crew will be exposed.

This Section applies to manned spaces as defined in Section 1. Examples of such spaces include accommodation spaces (e.g., cabins, mess areas, recreation spaces, etc.) and work spaces (e.g., galley, control rooms, duty stations, etc.) both inside and, in other vessel locations, outside the accommodation block.

Whole-body vibration limits defined in this Section are based on currently available standards. Compliance with this Section is a prerequisite for the workboat Habitability (**HAB(WB)**), workboat Habitability Plus (**HAB+(WB)**), or workboat Habitability Plus Plus (**HAB++(WB)**) notation confirmation.

3 Terminology (1 February 2016)

Acceleration: The rate of change of velocity over time (i.e., meters-per-second squared, m/s²).

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

Dynamic Positioning: A system to automatically maintain a workboat's position and heading by controlling propellers and/or thrusters. Dynamic positioning can maintain a position to a fixed point over the bottom, or in relation to a moving object (such as another vessel). It can also be used to position the vessel at a favorable angle towards wind, waves, and current.

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 human response.
- 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 6954.

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 an accredited Testing and Calibration Laboratory accredited according to ISO 17025:2005, as amended, 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 squared, 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.

4 Associated Documentation (1 February 2016)

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

- ISO 6954:2000, Mechanical Vibration and Shock – Guidelines for the Measurement, Reporting and Evaluation of Vibration with Regard to Habitability on Passenger and Merchant Ships.
- ISO 2631-2:2003, Mechanical Vibration and Shock – Evaluation of Human Exposure to Whole Body Vibration – Part 2, Vibration in Buildings.
- ISO 8041:2005, Human Response to Vibration – Measuring Instrumentation.
- ISO 5348:1998, Mechanical Vibration and Shock – Mechanical Mounting of Accelerometers
- WMO: Manual on Codes, No. 306, Part A, Alphanumeric Codes (2011 Edition, Updated in 2014)

Further guidance can be found in:

- ISO 20283-2:2008, Mechanical Vibration – Measurement of Vibration on Ships – Part 2: Measurement of Structural Vibration.

5 Criteria (1 February 2016)

The whole-body vibration criteria for the workboat Habitability notations (**HAB(WB)**, **HAB+(WB)**, or **HAB++(WB)**) are provided in Section 3, Table 1, “Maximum Weighted Root-Mean-Square Acceleration Level (Workboats Less than or Equal to 60 Meters in Length)” and Section 3, Table 2, “Maximum Weighted Root-Mean-Square Acceleration Level (Workboats Greater Than 60 Meters in Length)”. Maximum whole-body vibration levels are provided for transit and dynamic positioning conditions. The severity of the vibration shall be indicated by the weighted root-mean-square acceleration value (a_w) as defined in ISO 8041.

Whole-body vibration measurements shall only be taken in manned spaces. Specific locations are referred to in 3/7.4, “Measurement Locations”.

The maximum vibration levels for accommodation areas and work spaces in Section 3, Table 1, “Maximum Weighted Root-Mean-Square Acceleration Level (Workboats Less than or Equal to 60 Meters in Length)” and Section 3, Table 2, “Maximum Weighted Root-Mean-Square Acceleration Level (Workboats Greater Than 60 Meters in Length)” shall not be exceeded under normal operating conditions, either in transit or dynamic positioning. The **HAB(WB)** notation’s maximum vibration level is primarily aimed at reducing discomfort and interference with task performance. The more stringent maximum level for the **HAB+(WB)** and **HAB++(WB)** notations are aimed at improving performance and comfort. In this instance, “comfort” means the ability of the crew to use a space for its intended purpose with minimal interference or annoyance from whole-body vibration.

For the purpose of this Section, the notation applies to the vibration levels occurring on the deck supporting the human body in the three (3) translational (x-, y- and z-) axes as shown in Section 3, 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 multi-axis a_w level must be less than or equal to the maximum level expressed in Section 3, Tables 1 and 2.

FIGURE 1
Measurement Axes

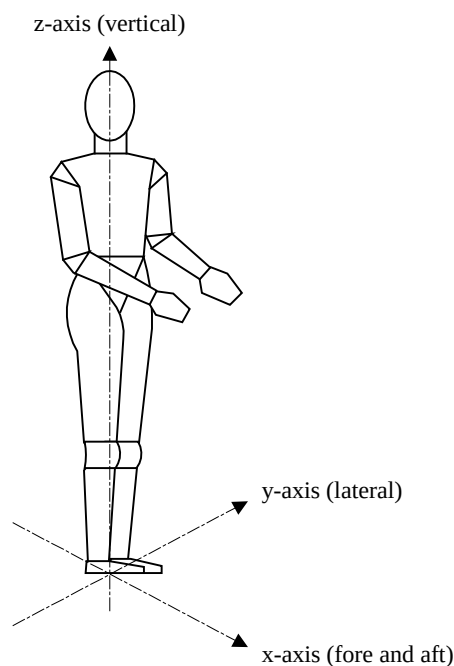


TABLE 1
Maximum Weighted Root-Mean-Square Acceleration Level
(Workboats Less than or Equal to 60 Meters in Length)

Notation	Frequency Range	Acceleration Measurement	Maximum RMS Level			
			Transit Conditions		Dynamic Positioning Conditions	
			Accommodation Areas	Work Spaces	Accommodation Areas	Work Spaces
HAB(WB)	1.0 – 80 Hz	a_w	178 mm/s ² (5.0 mm/s)	214 mm/s ² (6.0 mm/s)	178 mm/s ² (5.0 mm/s)	214 mm/s ² (6.0 mm/s)
HAB+(WB)	1.0 – 80 Hz	a_w	161 mm/s ² (4.5 mm/s)	196 mm/s ² (5.5 mm/s)	161 mm/s ² (4.5 mm/s)	196 mm/s ² (5.5 mm/s)
HAB++(WB)	1.0 – 80 Hz	a_w	143 mm/s ² (4.0 mm/s)	178 mm/s ² (5.0 mm/s)	143 mm/s ² (4.0 mm/s)	178 mm/s ² (5.0 mm/s)

TABLE 2
Maximum Weighted Root-Mean-Square Acceleration Level
(Workboats Greater than 60 Meters in Length)

Notation	Frequency Range	Acceleration Measurement	Maximum RMS Level			
			Transit Conditions		Dynamic Positioning Conditions	
			Accommodation Areas	Work Spaces	Accommodation Areas	Work Spaces
HAB(WB)	1.0 – 80 Hz	a_w	161 mm/s ² (4.5 mm/s)	178 mm/s ² (5.0 mm/s)	178 mm/s ² (5.0 mm/s)	196 mm/s ² (5.5 mm/s)
HAB+(WB)	1.0 – 80 Hz	a_w	143 mm/s ² (4.0 mm/s)	161 mm/s ² (4.5 mm/s)	161 mm/s ² (4.5 mm/s)	178 mm/s ² (5.0 mm/s)
HAB++(WB)	1.0 – 80 Hz	a_w	125 mm/s ² (3.5 mm/s)	143 mm/s ² (4.0 mm/s)	143 mm/s ² (4.0 mm/s)	161 mm/s ² (4.5 mm/s)

6 Test Plan

As stated in 1/7.3.1, “Test Plans”, a Test Plan shall 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 shall include the following:

6.1 Documentation

The Test Plan shall include appropriate drawings indicating the location of all vibration sources.

6.2 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 2, “Procedural Requirements for ABS Recognized Ambient Environmental Testing Specialists”.

6.3 Test Conditions

The Test Plan shall detail the conditions for both transit and dynamic positioning operations under which the tests will be performed.

6.4 Measurement Locations (1 February 2016)

The Test Plan shall document, in detail, on appropriate drawings, all spaces where measurements will be taken. In addition, transducer placement positions shall be indicated. Details on selecting measurement locations and determining transducer placement positions are provided in 3/7.4, “Measurement Locations”.

6.5 Data Acquisition and Instruments

The Test Plan shall provide information regarding the methods and instrumentation to be used for measurement and data collection. Instrumentation specification details shall 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 3/7.2, "Data Acquisition and Instruments".

6.6 Data Analysis

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

6.7 Test Schedule (1 February 2016)

The Test Plan shall provide information regarding the proposed test schedule. The Test schedule shall include information on the approximate date and duration of testing (including a summary of the scheduled measurements per day).

6.8 Data Collection Sheets (1 February 2016)

The Test Plan shall provide sample data sheets (in table format) that will be used for reporting the measurement data.

6.9 Conflict of Interest Declaration (1 February 2016)

In the case that the Testing Specialist has, in any capacity or to any extent, provided input into the design of the vessel, their participation shall be indicated in the Test Plan including details of the Testing Specialist's involvement. ABS will review any potential conflicts of interest and determine if any further action is necessary.

7 Test Requirements

7.1 General (1 February 2016)

Whole-body vibration measurements shall be in accordance with the procedures described in ISO 6954. When the requirements or procedures described in this Guide deviate from those mentioned in ISO 6954, this Guide shall take precedence.

7.2 Data Acquisition and Instruments

For the **HAB(WB)**, **HAB+(WB)**, or **HAB++(WB)** notation, a sample of data shall be recorded for each whole-body vibration measurement position. Each whole-body vibration measurement sample shall be at least sixty (60) seconds in duration. For each location measured, a data sample shall be taken during transit conditions and dynamic positioning conditions, in accordance with the requirements of 3/7.3, "Test Conditions".

The above measurement samples shall all be taken using the appropriate Type 1 instrumentation (ISO 8041), then frequency weighted and analyzed in accordance with ISO 6954. It is desirable to employ equipment that records and stores acceleration time histories.

7.3 Test Conditions

The test conditions required for the whole-body vibration measurements shall be in accordance with each of the following Subparagraphs.

7.3.1 Power Output (1 February 2016)

- i) *Transit:* The propulsion machinery shall run at 80% of the maximum continuous rating (MCR). Controllable pitch and Voith-Schneider propellers, if any, shall be in the normal seagoing position. For workboats with special propulsion and power configurations, such as diesel-electric systems, the actual workboat's design or operating parameters as defined in the workboat's specifications (i.e., contractual service conditions) will be used.
- ii) *Dynamic Positioning:* Devices such as azimuth or tunnel thrusters automatic or manual shall run at contractual service conditions or with at least 40% power on the thrusters.

7.3.2 Machinery and Equipment Operation

As appropriate for the mode of operation (transit or dynamic positioning), all machinery essential for vessel operation shall 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.

7.3.3 Course and Water Depth

Whole-body vibration measurements are to be taken with the vessel in a depth of water not less than five (5) times the draft of the vessel. For vessels that do not operate in water depths of five (5) times draft, measurements shall be taken under normal operating and transit conditions. The vessel shall maintain a single heading and a constant speed during the test. Measurements during dynamic positioning shall be taken while the vessel is maintaining a position relative to another vessel or fixed point (e.g., offshore installation).

7.3.4 Rudder Conditions

During transit measurements, rudder action shall be minimized. During dynamic positioning, measurements shall be taken while the vessel is maintaining a position relative to another vessel or fixed point (e.g., offshore installation).

7.3.5 Sea Conditions (1 February 2016)

Measurements are to be taken under conditions of Sea State 3 or less, as defined by the World Meteorological Organization (WMO) *Manual on Codes, No. 306, Part A, Alphanumeric Codes (2011 Edition, Updated in 2014)*.

7.3.6 Loading Conditions (1 February 2016)

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

7.3.7 Test Interference

During the whole-body vibration measurements, vibration arising from every kind of unnecessary human activity shall 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 shall be present in the space being tested.

7.4 Measurement Locations**7.4.1 Selection of Spaces where Measurements are to be Conducted (1 February 2016)**

The aim when selecting vibration measurement locations shall be to obtain a representative sample of data that reflects the actual conditions in manned spaces. For practical reasons, it is important to select the locations such that an appropriate amount of data can be collected during the testing phase. The measurement locations shall be selected in accordance with the following criteria:

- i) 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, accommodation areas and recreation areas via the vessel's structure. Measurements shall be taken in all identified worst case locations (e.g., cabin adjacent to a machinery space).
- ii) Where a single instance of one (1) type of manned space exists within the vessel (e.g., bridge, mess room, gymnasium, library, etc.), that location shall be selected for measurement.
- iii) Select a representative sample of crew cabins throughout the vessel. For vessels with less than 20 cabins, fifty (50) percent of cabins on each deck shall be selected. For vessels with greater than 20 cabins, thirty (30) percent of cabins on each deck shall be selected. These measurement locations must be selected at locations port, starboard, fore, amidships and aft. The worst case locations **are to** be considered part of the representative sample for crew cabins, if applicable.

- iv) Where multiple instances of the same type accommodation space exist that are not crew cabins, a representative sample of at least fifty (50) percent of each type shall be selected for measurement. The worst case locations are to be considered part of the representative sample, if applicable.

7.4.2 Walkthrough Verification Inspection Locations

All normally manned spaces shall 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.

7.4.3 Transducer Placement Positions (1 February 2016)

Vibration transducers (accelerometers) shall 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 shall comply with ISO 5348. When the vibration enters the human body from a non-rigid or resilient material (e.g., floor covering), secure the transducers with a suitably formed mount that does not alter the pressure distribution on the surface of the floor covering.

In cabins, the vibration transducers shall 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 of the person occupying the cabin).

For larger spaces (public rooms, messes, recreation areas, etc.) it shall 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 shall be evenly distributed throughout the space. For a specific room size, the minimum number of measurement locations shall be as indicated in Section 3, Table 3, "Distribution of Transducer Positions Within Spaces".

TABLE 3
Distribution of Transducer Positions Within Spaces (1 February 2016)

Space Size	Minimum Number of Measurement Positions in Room
Less than 20 m ² (215 ft ²)	1
> 20–40 m ² (215–431 ft ²)	2
> 40–80 m ² (431–861 ft ²)	3
> 80–120 m ² (861–1291 ft ²)	4
> 120–200 m ² (1291–2150 ft ²)	5
Greater than 200 m ² (2150 ft ²)	6

For vessels without crew cabins, transducers shall be located at standing positions normally occupied by crew near the port side, near the centerline and near the starboard side. Transducers shall be evenly distributed fore and aft.

Transducers located at one (1) measurement position shall 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 shall be as close together as possible.

8 Test Report

As stated in 1/7.3.2, “Test Reports”, a Test Report shall 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 shall be provided in the Whole-body Vibration Test Report.

8.1 Test Details (1 February 2016)

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

- i) Loading **conditions** (mean draft and trim)
- ii) Number of crew and other persons onboard during tests
- iii) **Power output**
- iv) **Class** of Dynamic Positioning (e.g., DP-0, DP-1, etc.)
- v) Vessel course and speed
- vi) Average water depth under keel
- vii) Sea state
- viii) Direction of swell relative to vessel heading
- ix) Any indications of abnormal activity during the test that might skew results
- x) **Machinery and** equipment operated during the test

8.2 Transducer **Placement Positions** (1 February 2016)

Actual transducer **placement** positions (for both transit and dynamically positioned operations) shall be indicated on appropriate drawings.

8.3 Measurement Equipment Details

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

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

8.4 Results (1 February 2016)

The following results **per measuring location**, shall be provided in table format (for both transit and dynamic positioning operations):

- i) Measurement position
- ii) Measurement period if different from requirements
- iii) Sample number
- iv) Multi-Axis weighted RMS values
- v) Equipment operating in proximity to the measurement position
- vi) **Indication of 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

8.5 Deviations

All deviations from the approved Test Plan shall be reported.

8.6 Surveyor Witnessing Documentation *(1 February 2016)*

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

9 Results

The Whole-body Vibration Test Report shall be reviewed by the ABS Surveyor against the appropriate **HAB(WB)**, **HAB+(WB)**, or **HAB++(WB)** criteria for notation confirmation.

SECTION 4 Noise

1 Background

A large amount of research has been performed on the effects of noise on humans. Established or commonly used criteria exist for the effects of noise on speech communication, hearing loss, sleep, concentration, and “annoyance”. These have provided a basis for the criteria in this Guide.

A detailed discussion of the effects of noise on human performance, health, and comfort is found in Kryter (1994) *The Handbook of Hearing and the Effects of Noise: Physiology, Psychology and Public Health*.

2 Scope (1 February 2016)

In this Section, noise criteria have been selected to improve crew performance and to facilitate communication and sleep in appropriate vessel spaces. An additional goal is to enhance crew safety and comfort. In this instance, “comfort” means the ability of the crew to use a space for its intended purpose with minimal interference or annoyance from noise.

The noise criteria presented in this Section are lower than the levels commonly associated with hearing loss. Further guidance with respect to hearing conservation is provided in the IMO Resolution **MSC.337(91): Code on Noise Levels On-board Ships** and should be followed for noise levels and exposure duration, particularly for areas with noise levels in excess of 85 dB(A).

This Section applies to manned spaces as defined in Section 1. Examples of such spaces include accommodation spaces (e.g., cabins, mess areas, recreation spaces, etc.) and work spaces (e.g., galley, control rooms, duty stations, etc.) both inside and, in other vessel locations, outside the accommodation block.

Compliance with this Section is a prerequisite for the workboat Habitability (**HAB(WB)**), workboat Habitability Plus (**HAB+(WB)**), or workboat Habitability Plus Plus (**HAB++(WB)**) notation confirmation.

3 Terminology (1 February 2016)

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 (2004) 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.

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 shall comply with the standard IEC 60942:2003, as amended, type/class (1) standard and shall be approved by the manufacturer of the measuring instrument used.**

Dynamic Positioning: A system to automatically maintain a workboat’s position and heading by controlling propellers and/or thrusters. Dynamic positioning can maintain a position to a fixed point over the bottom, or in relation to a moving object (such as another vessel). It can also be used to position the vessel at a favorable angle towards wind, waves, and current.

Equivalent Continuous A-weighted Sound Pressure Level: The A-weighted sound pressure level of a **noise fluctuating** over a **period of time T , expressed as the amount of average energy**. 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 an accredited Testing and Calibration Laboratory accredited according to ISO 17025:2005, as amended, 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.

4 Associated Documentation (1 February 2016)

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

- ISO 2923:1996, Acoustics – Measurement of Noise Onboard
- IEC 61672-1:2013, Electroacoustics – Sound Level Meters – Part 1: Specifications
- IEC 60942:2003, Electroacoustics – Sound Calibrators
- IMO Resolution MSC.337(91) (2012), Code on Noise Levels Onboard Ships
- ISO 10140-2:2010, Acoustics – Laboratory Measurement of Sound Insulation of Building Elements – Part 2: Measurements of Airborne Sound Insulation
- ISO 717-1:2013, Acoustics – Rating of Sound Insulation in Buildings and of Building Elements – Part 1: Airborne Sound Insulation
- WMO: Manual on Codes, No. 306, Part A, Alphanumeric Codes (2011 Edition, Updated in 2014)

5 Criteria (1 February 2016)

5.1 Equivalent Continuous A-weighted Sound Pressure Level

The noise criteria for the workboat Habitability notations (HAB(WB), HAB+(WB), and HAB++(WB)) are provided in Section 4, Tables 1 and 2.

Noise levels shall be determined for the test conditions specified in 4/7.3, “Test Conditions” and shall not exceed the maximum acceptable L_{Aeq} levels indicated in Section 4, Tables 1 and 2 (as applicable based on vessel size) for each type of space or area. The maximum acceptable noise levels given in Section 4, Tables 1 and 2 are L_{Aeq} values, determined as appropriate to the character of the noise (see 4/7.5, “Measurement Procedures and Recorded Results”). These limit values are for transit and dynamic positioning operations and do not include any in-port activities.

5.2 Acoustic Insulation

The airborne sound insulation properties for bulkheads and decks within the accommodation shall comply at least with the following weighted sound reduction index (R_w) according to ISO Standard 717-1:2013:

Cabin to cabin	$R_w = 35$
Mess rooms, recreation rooms, public spaces and entertainment areas to cabins and hospitals	$R_w = 45$
Corridor to cabin	$R_w = 30$
Cabin to cabin with communicating door	$R_w = 30$

The airborne sound insulation properties shall be determined by laboratory tests in accordance with ISO 10140-2:2010 as identified in IMO Code on Noise. The manufacturer of the acoustic insulation shall provide the weighted sound reduction index (R_w) value and evidence of the laboratory test.