

Guide for

Crew Habitability on Workboats



February 2016



GUIDE FOR

CREW HABITABILITY ON WORKBOATS
FEBRUARY 2016

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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*.

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

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.

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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CREW HABITABILITY ON WORKBOATS

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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 corridors, 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 A2, "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:

- i) 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
- ii) 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:

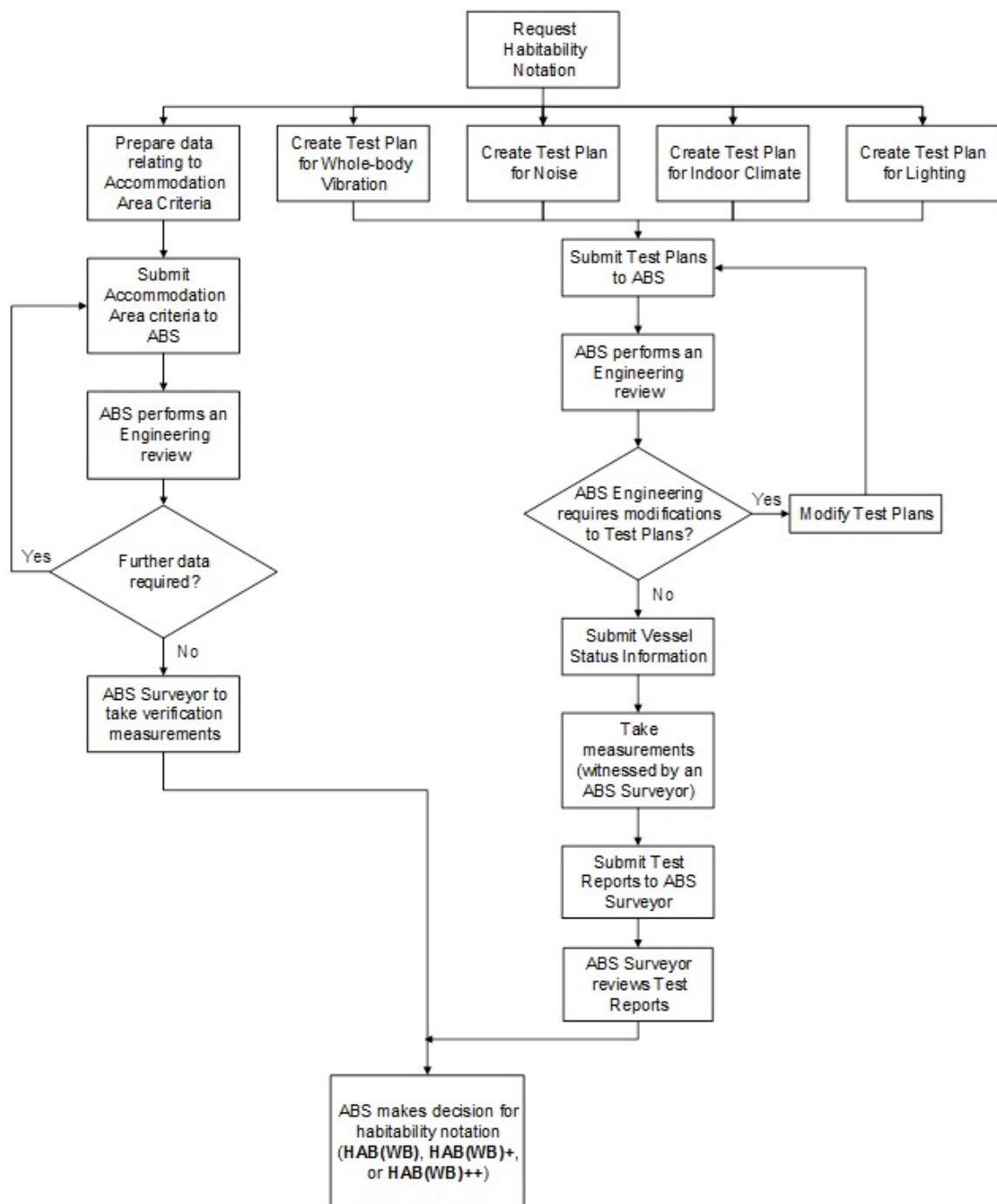
<i>Environmental Aspect</i>	<i>Test Plan Details</i>
Whole-body Vibration	Subsection 3/8
Noise	Subsection 4/8
Indoor Climate	Subsection 5/8
Lighting	Subsection 6/8

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.

1/8 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 1/8.2 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

<i>Ambient Environment Aspect</i>	<i>Testing Threshold</i>
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 Marine Vessels*
- *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways.*
- *ABS Rules for Materials and Welding (Part 2)*

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 A3, "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 A3 "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 (1 February 2016)

- 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 A3, “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 A3.

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.

<i>Requirement</i> # = Related ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+ (WB) <i>Requirements</i>	<i>Meets</i> HAB++ (WB) <i>Requirements</i>
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 A3, “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, Alphanumerical 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 3/5 TABLE 1, “Maximum Weighted Root-Mean-Square Acceleration Level (Workboats Less than or Equal to 60 Meters in Length)” and 3/5 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 3/5 TABLE 1, “Maximum Weighted Root-Mean-Square Acceleration Level (Workboats Less than or Equal to 60 Meters in Length)” and 3/5 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 3/5 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

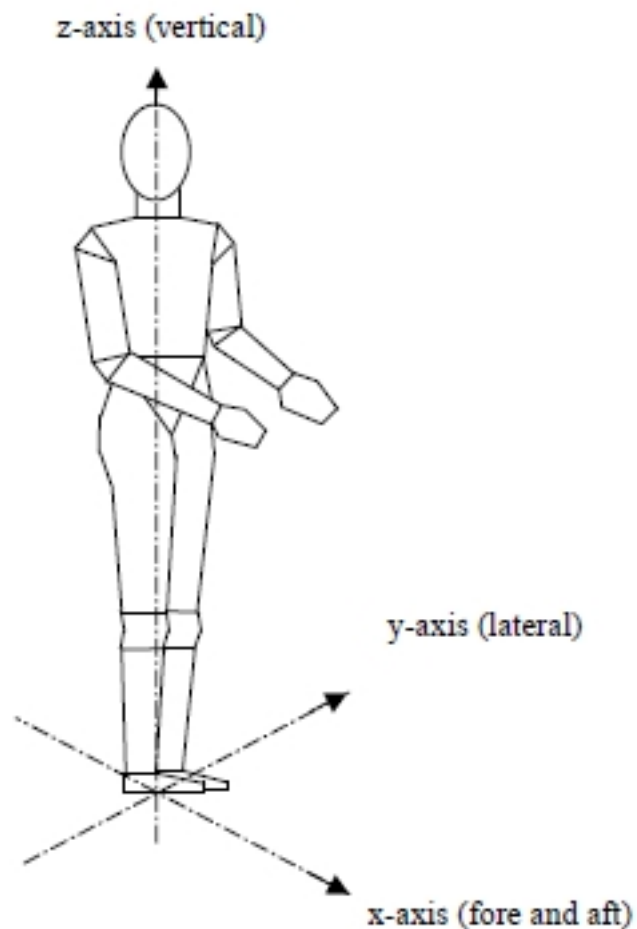


TABLE 1
Maximum Weighted Root-Mean-Square Acceleration Level
(Workboats Less than or Equal to 60 Meters in Length)

<i>Notation</i>	<i>Frequency Range</i>	<i>Acceleration Measurement</i>	<i>Maximum RMS Level</i>			
			<i>Transit Conditions</i>		<i>Dynamic Positioning Conditions</i>	
			<i>Accommodation Areas</i>	<i>Work spaces</i>	<i>Accommodation Areas</i>	<i>Work spaces</i>
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	Workspaces	Accommodation Areas	Workspaces
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 A2, “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 3/7.4.3 TABLE 3, "Distribution of Transducer Positions Within Spaces".

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

<i>Space Size</i>	<i>Minimum Number of Measurement Positions in Room</i>
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, Alphanumerical 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.

TABLE 1
Noise Criteria for Workboats (GT < 10,000) (1 February 2016)

<i>Space^(1,2)</i>	<i>Maximum Acceptable Noise L_{Aeq} Level dB(A)</i>					
	<i>Transit Condition</i>			<i>Dynamic Positioning Conditions</i>		
	HAB (WB)	HAB+ (WB)	HAB++ (WB)	HAB (WB)	HAB+ (WB)	HAB++ (WB)
Crew Accommodation Spaces and Open Deck Recreation Areas						
Cabins	60	55	50	60	55	55
Sanitary Spaces (if separate from the cabin)	65	60	55	65	65	60
Dining (Mess) Spaces	65	60	55	65	60	60
Indoor Recreation Spaces	65	60	55	65	60	60
Gymnasiums	65	60	60	65	60	60
Medical and First Aid Center	60	55	55	60	60	60
Open Deck Recreation Areas	75	70	70	75	75	70
Navigation and Control Spaces						
Wheelhouse, Pilothouse, Bridge	65	60	55	65	60	60
Radio Room	60	55	55	60	55	55
Offices	65	60	60	65	60	55
Cargo Control Rooms ⁽³⁾	65	60	60	65	60	60
Machinery Control Rooms	75	70	70	75	70	65
Service Spaces						
Food Preparation (e.g., Galley, Scullery)	75	70	65	75	70	70
Pantries	75	70	70	75	70	70
Storerooms	75	70	70	75	70	70
Laundry Areas	75	70	70	75	70	70
Operating and Maintenance Spaces						
Machinery Spaces	110	110	110	110	110	110

<i>Space</i> ^(1,2)	<i>Maximum Acceptable Noise L_{Aeq} Level dB(A)</i>					
	<i>Transit Condition</i>			<i>Dynamic Positioning Conditions</i>		
	HAB (WB)	HAB+ (WB)	HAB++ (WB)	HAB (WB)	HAB+ (WB)	HAB++ (WB)
Workshops (other than those forming part of machinery spaces)	85	80	80	85	85	80
Non-specified work spaces ⁽⁴⁾ (other work spaces)	85	80	80	85	85	80

Notes:

- 1 In any manned space with noise levels above 85 dB(A), hearing protection should be worn in accordance with appropriate IMO regulations.
- 2 Unless this space is normally manned, no confirmatory measurements for the workboat Habitability notations are required.
- 3 (1 February 2016) If located within machinery spaces, it is to comply with the machinery control room's criteria.
- 4 (1 February 2016) Examples of non-specified work spaces are open deck workspaces that are not machinery spaces, and open deck workspaces where communication is relevant.

TABLE 2
Noise Criteria for Workboats (GT ≥ 10,000) (1 February 2016)

<i>Space</i> ^(1,2)	<i>Maximum Acceptable Noise L_{Aeq} Level dB(A)</i>					
	<i>Transit Conditions</i>			<i>Dynamic Positioning Conditions</i>		
	HAB (WB)	HAB+ (WB)	HAB++ (WB)	HAB (WB)	HAB+ (WB)	HAB++ (WB)
Crew Accommodation Spaces and Open Deck Recreation Areas						
Cabins	55	55	50	55	55	50
Sanitary Spaces (if separate from the cabin)	65	60	55	65	65	60
Dining (Mess) Spaces	60	55	50	60	55	55
Indoor Recreation Spaces	60	55	50	60	55	55
Gymnasiums	60	55	55	60	55	55
Medical and First Aid Center	55	55	50	55	55	55
Open Deck Recreation Areas	75	70	70	75	75	70
Navigation and Control Spaces						
Wheelhouse, Pilothouse, Bridge	65	60	55	65	60	60
Radio Room	60	55	55	60	55	55
Offices	60	55	55	60	55	50
Cargo Control Rooms ⁽³⁾	65	60	60	65	60	60
Machinery Control Rooms	75	70	70	75	70	65
Service Spaces						

<i>Space ^(1,2)</i>	<i>Maximum Acceptable Noise L_{Aeq} Level dB(A)</i>					
	<i>Transit Conditions</i>			<i>Dynamic Positioning Conditions</i>		
	HAB (WB)	HAB+ (WB)	HAB++ (WB)	HAB (WB)	HAB+ (WB)	HAB++ (WB)
Food Preparation (e.g., Galley, Scullery)	75	70	65	75	70	70
Pantries	75	70	70	75	70	70
Storerooms	75	70	70	75	70	70
Laundry Areas	75	70	70	75	70	70
Operating and Maintenance Spaces						
Machinery Spaces	110	110	110	110	110	110
Workshops (other than those forming part of machinery spaces)	85	80	80	85	85	80
Non-specified work spaces ⁽⁴⁾ (other work spaces)	85	80	80	85	85	80

Notes:

- 1 In any manned space with noise levels above 85 dB(A), hearing protection should be worn in accordance with appropriate IMO regulations.
- 2 Unless this space is normally manned, no confirmatory measurements for the workboat Habitability notations are required
- 3 If located within machinery spaces, it is to comply with the machinery control room's criteria.
- 4 Examples of non-specified work spaces are open deck workspaces that are not machinery spaces, and open deck workspaces where communication is relevant.

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 demonstrate or confirm compliance with noise criteria. The Test Plan shall include the following:

6.1 Documentation (1 February 2016)

The Test Plan shall include appropriate design information including noise specifications for the vessel. It shall also include layout drawings indicating the locations of all noise sources and noise generating equipment. The information shall be of such detail to enable an ABS Engineer to verify compliance with the criteria set in this Guide.

The Test Plan shall also include the acoustic insulation plan and relevant supporting documentation for review and approval. With the Test Plan, the acoustic insulation test results (see 4/5.2, "Acoustic Insulation") shall be submitted for review.

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

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 A2, "Procedural Requirements for ABS Recognized Ambient Environmental Testing Specialists".

6.3 Test Conditions

Measurements are to be taken under conditions of Sea State 3 or less, as defined by the World Meteorological Organization (WMO) (1995) *Sea State Code*.

6.4 Measurement Locations

The Test Plan shall document, in detail, on appropriate drawings, all spaces or areas where measurements will be taken for both transit and dynamic positioning operations. In addition, measurement positions shall be indicated on the drawings. Details on selecting measurement locations are provided in 4/7.4, "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, and sensitivity. More details on data acquisition and instruments are provided in 4/7.2, "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)

In general, the noise measurements shall be carried out in accordance with the requirements of IMO Resolution MSC.337(91) *Code on Noise Levels On-board Ships*. However, where the IMO requirements differ from those in this Guide, this Guide shall take precedence.

7.2 Data Acquisition and Instruments

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

For each location sampled, a measurement shall be taken for transit and dynamic positioning operations in accordance with the requirements in 4/7.3, "Test Conditions". It is recommended that dynamic positioning measurements be noted as to whether positioning was maintained dynamically or manually.

7.3 Test Conditions

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

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 (1 February 2016)

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 noise measurements.

For the galley/scullery, all equipment that runs for twenty (20) minutes or more (e.g., ventilation hoods) should be running during the noise measurements. Equipment that is used only intermittently (e.g., blender/mixer/meat cutter) does not need to be running during the noise measurements. Note any equipment that is running in the Noise Test Report.

7.3.3 Course and Water Depth (1 February 2016)

For transit mode of operations, noise 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.

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 Noise Test Report.

7.3.7 Test Interference

During the noise measurements, noise 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.

Doors and windows shall be closed, except where they are normally left open (such as the door on the lee side of the navigation bridge, which may normally be open). Any open doors or windows shall be noted in the Noise Test Report. Spaces shall be furnished with all usual equipment and furnishings normally found in the space. Equipment shall be configured to operate in its normal operating mode.

7.4 Measurement Locations

7.4.1 Selection of Spaces where Measurements are to be Conducted

The aim when selecting noise 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 sample 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 noise emitting sources such as propulsion or other rotating machinery or where noise 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)* *(1 February 2016)* 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 as 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 noise qualities. At the discretion of the ABS Surveyor, additional measurements may be required.

7.4.3 Measurement Positions *(1 February 2016)*

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

Measure at positions where persons will be seated or standing. The microphone shall 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 crew accommodation spaces, measure in the middle of the space.

For all measurements, the microphone shall not be closer than 500 mm (20 in.) from the boundary surface (e.g., bulkhead) of a space. The measurement time shall be at least fifteen (15) seconds and shall 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.

If practicable, do not measure closer than 1000 mm (39.5 in.) from operating machinery, air inlets, or from decks, bulkheads or other large surfaces. Where this is not possible, measure midway between the machinery and an adjacent reflecting surface.

7.5 Measurement Procedures and Recorded Results

7.5.1 Persons Present During Measurements (1 February 2016)

When Testing Specialist personnel are conducting noise level measurements in any space, only crew members necessary for the operation of equipment or machinery in that space should be present.

7.5.2 Sampling Duration

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

7.5.3 Cyclic Noise

If the noise within a space is cyclic, the L_{Aeq} sampling duration shall be sufficient to capture an integer number of complete cycles. If a long-duration sample is judged impractical, an L_{Aeq} value shall be determined and reported for the high-noise portion of the cycle.

7.5.4 Intermittent Noise

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

7.5.5 HVAC Related Noise

If HVAC system-related noise is a large contributor to the noise level in the space, a noise measurement shall 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.

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 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 shall be provided in the Noise Test Report.

8.1 Test Details (1 February 2016)

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

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

8.2 Measurement Positions

For transit and dynamic positioning measurements, actual measurement location positions 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, sampling frequency and resolution) shall be provided.

Copies shall 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.

8.4 Results (1 February 2016)

The following results, per measurement location, shall be provided in table format (for transit and dynamic positioning measurements):

- i) Measurement position
- ii) Number of people present in the space at time of measurement
- iii) Measurement period if different from requirement
- iv) Equivalent continuous A-weighted sound pressure level (L_{Aeq})
- v) Note any open doors and windows
- vi) Note equipment operating in proximity to the measurement position
- vii) Note observed direct sources of noise (such as ventilation devices) and any additional measurement data collected
- viii) 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 space
- 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 the noise level tests 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 noise level testing were completed to their satisfaction. A copy of the witnessing document shall be given to the person conducting the testing, for insertion into the final Noise Test Report. The original shall be retained for ABS' files.

9 Results

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

SECTION 5 Indoor Climate

1 Background

Thermal comfort is defined in ISO 7730 as "...that condition of mind which expresses satisfaction with the thermal environment". The sensation of thermal comfort is therefore largely subjective and will vary from person to person. Due to differences in metabolism and expectations, there are distinct individual differences among people's perception of comfort as a function of temperature, humidity, and other atmospheric characteristics. Acclimatization, habits, and expectations influence perceived comfort. These individual differences make it difficult to specify a single thermal environment that will be satisfactory to everyone. A thermal environment is therefore typically defined to be acceptable to at least eighty (80) percent of the occupants of an interior space.

Individually, the perception of thermal comfort is largely determined by the interaction of thermal environmental factors such as air temperature, air velocity, relative humidity, and factors related to activity and clothing.

The thermal control or Heating, Ventilation, and Air Conditioning (HVAC) systems on a vessel should be designed to effectively control the indoor thermal environmental parameters to within acceptable limits to facilitate the thermal comfort of the occupants.

2 Scope (1 February 2016)

This Section provides the assessment criteria, verification, and measurement methodology for indoor climate relating to habitability on workboats. The criteria are based on currently available standards and were selected to provide an index of crew thermal comfort.

The thermal environmental variables covered by this Guide include the ambient qualities of air temperature, air velocity, and relative humidity. Vertical thermal gradient is used to indicate uncomfortable temperature differentials between a person's head and feet. The crew cabin area horizontal gradient temperature differential between the temperature of inside bulkhead surfaces adjacent to crew cabins and the average air temperature within the space serves as an indication of potential thermal comfort or discomfort.

The thermal environmental criteria provided in this Guide are for persons wearing typical indoor clothing occupied with light, primarily sedentary activity and resulting in a thermal environment acceptable to at least eighty (80) percent of the occupants.

This Section applies to enclosed manned spaces as defined in Section 1. Examples of such spaces include crew accommodation areas, bridge, engine control room, and indoor work spaces.

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)

Air Supply Quantity: The total amount of air supplied to a specific space consisting of a percentage of recirculated air and a percentage of fresh air supply quantity, measured in liters per second (l/s).

Air Temperature: The temperature of the air surrounding a person, measured with a standard thermometer.

Air Velocity or Movement: The rate of displacement of ambient air in a specific direction in meters-per-second (m/s) or feet-per-second (ft/s).

Comfort Zone: That range of environmental conditions in which at least eighty (80) percent of crew members experience thermal comfort.

Fresh Air Supply Quantity: The amount of fresh/outdoor air supplied to a specific space, expressed in liters per second (l/s).

Horizontal Gradient: The difference between the inside surface temperatures of the bulkheads bounding the berth and the average air temperature within the cabin. This is used as an indication of potential thermal discomfort due to radiant thermal sources.

HVAC Zone: A space or group of spaces that is (are) independently controlled for temperature, humidity, and air distribution. A zone usually comprises common duct work fed from an air handler.

Reference Calibration: Calibration of a measuring instrument, 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.

Relative Humidity (RH): The ratio of the amount of vapor contained in the air (absolute humidity) to the maximum amount of vapor the air can hold at a given temperature before precipitation (condensation) occurs.

Thermal Comfort: Subjective index of “that condition of mind which expresses satisfaction with the thermal environment”.

Ventilation: Ventilation is the process of supplying air to, and removing air from, any space by natural or mechanical means. From the standpoint of comfort and health, ventilation issues involve both quantity and quality.

Vertical Gradient: The vertical air temperature difference within an enclosed space. The vertical gradient is used as an indication of potential local discomfort at the head and feet.

4 Associated Documentation (1 February 2016)

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

- ANSI/ASHRAE 55-2013, Thermal Environmental Conditions for Human Occupancy
- ISO 7726:1998, Ergonomics of the Thermal Environment – Instruments for Measuring Physical Quantities
- ISO 7547:2002, Ships and Marine Technology – Air-Conditioning and Ventilation of Accommodation Spaces – Design Conditions and Basis of Calculations
- NEBB:2005, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

5 Criteria (1 September 2013)

(1 February 2016) The indoor climate criteria for the workboat Habitability notations (**HAB(WB)**, **HAB+(WB)**, and **HAB++(WB)**) are provided in 5/5.7 TABLE 1, “Summary of Indoor Climate Requirements”.

Indoor climate measurements shall be taken only in indoor manned spaces. Specific measurement locations are discussed in 5/7.4, “Measurement Locations”.

The thermal environmental comfort ranges and conditions shall be achievable, under the test conditions specified in 5/7.3, “Test Conditions”, for normal operating conditions, in all indoor manned spaces.

The **HAB(WB)** and **HAB+(WB)** notations criteria provide for a range of air temperatures maintained by a temperature controller for each zone and are primarily aimed at HVAC systems that do not make provision for individual adjustment to suit personal preferences and activities within a specific space. The **HAB++(WB)** notation is aimed at enhancing crew comfort by making provisions for the crew to adjust indoor climate conditions, with regard to air temperature to suit personal needs within a particular space.

5.1 Air Temperature (1 February 2016)

5.1.1 For a HAB(WB) Notation

The HVAC system shall be capable of providing an air temperature within the range of 20 to 25°C (68 to 77°F) during winter months and 23 to 28°C (73.5 to 82.5°F) during summer months to an HVAC zone. This temperature shall be maintained by a temperature controller. Each zone shall have a thermostat for reheat and dehumidification purposes.

5.1.2 For a HAB+(WB) or a HAB++(WB) Notation

The HVAC system shall be capable of sustaining an adjustable range of air temperatures between 20 to 25°C (68 to 77°F) during winter months and 23 to 28°C (73.5 to 82.5°F) during summer months in indoor manned crew accommodation spaces. This temperature shall be maintained by a temperature controller. Each indoor manned crew accommodation space shall have its own individual controller for temperature regulation.

5.2 Relative Humidity

The HVAC system shall be capable of providing and maintaining a relative humidity within a range from thirty (30) percent minimum to seventy (70) percent maximum.

5.3 Enclosed Space Vertical Gradient

The difference in temperature at 100 mm (4 in.) above the deck and 1700 mm (67 in.) above the deck shall be maintained within 3°C (6°F).

5.4 Air Velocity

Air velocities shall not exceed 30 meters-per-minute or 100 feet-per-minute (0.5 m/s or 1.7 ft/s) at the measurement position in the space.

5.5 Crew Cabin Area Horizontal Gradient

In crew cabin areas, the difference between the inside bulkhead surface temperature adjacent to crew cabins and the average air temperature within the space shall be less than 10°C (18°F).

5.6 Air Supply Quantity (1 February 2016)

The minimum quantity of fresh/outdoor air supply shall be not less than 40% of the total air supplied to a specific space. The fresh/outdoor air supply quantity shall not be less than 8 l/s per the number of person(s) for which the specific space is designed for (e.g., for cabins is the number of beds, for mess rooms is the number of seats, for workspaces is the number of workstations, etc.).

5.7 Summary

A summary of the indoor climate requirements is presented in 5/5.7 TABLE 1, “Summary of Indoor Climate Requirements”.

TABLE 1
Summary of Indoor Climate Requirements (1 February 2016)

<i>Item</i>	<i>Requirement or Criterion</i>	
	HAB(WB) & HAB+(WB)	HAB++(WB)
Adjustability	Non-adjustable air temperature	Adjustable range of air temperatures
Air Temperature	Winter: 20 to 25°C (68 to 77°F) Summer: 23 to 28°C (73.5 to 82.5°F)	
Relative Humidity	A range from 30% minimum to 70% maximum	
Vertical Gradient	The acceptable range is 0 – 3°C (0 – 6°F)	
Air Velocity	Not exceed 30 meters-per-minute or 100 feet-per-minute (0.5 m/s or 1.7 ft/s)	
Horizontal Gradient (Crew Cabin Areas)	The horizontal temperature gradient in crew cabin areas shall be <10°C (18°F)	
Air Supply Quantity	The minimum quantity of fresh/outdoor air supply shall be not less than 8 l/s per person and in addition will need to be at least 40% of the total air supplied to a specific space	

6 Test Plan

(1 February 2016) 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 indoor climate criteria. The Test Plan shall include the following:

6.1 Documentation (1 February 2016)

The Test Plan shall include the following documentation and data to enable ABS Engineering to verify compliance to the indoor climate criteria set in this Guide:

- i) The HVAC system design specifications
- ii) Schematics/layout drawings of the HVAC system

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 A2, “Procedural Requirements for ABS Recognized Ambient Environmental Testing Specialists”.

6.3 Test Conditions

The Test Plan shall detail the conditions under which the tests will be performed. Details about test conditions are given in 5/7.3, “Test Conditions”.

6.4 Measurement Locations (1 February 2016)

The Test Plan shall document, in detail, on appropriate drawings, all spaces or areas where measurements will be taken. Details on selecting measurement locations and determining transducer placement positions are provided in 5/7.4, “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, response time, calibration and sensitivity. More details on data acquisition and instruments are provided in 5/7.2, “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)

Indoor climate measurements shall be in accordance with the requirements of ANSI/ASHRAE 55-2013. When the requirements or procedures described in this Guide deviate from those in ANSI/ASHRAE 55-2013, this Guide shall take precedence.

7.2 Data Acquisition and Instruments (1 February 2016)

The thermal measurement instrumentation shall meet or exceed the minimum characteristics of instruments for measuring physical quantities characterizing an environment specified in ISO 7726.

The following quantities shall be measured in each of the spaces or zones identified in the Test Plan and the results noted in the Indoor Climate Test Report:

- i) Air temperature
- ii) Relative humidity
- iii) Air velocity
- iv) Vertical gradient
- v) Horizontal gradient (in crew cabin spaces only)

The air temperature and humidity measurements shall be made at least every five (5) minutes for a minimum period of one (1) hour. The minimum, maximum, and average values for the 1-hour period shall be reported for each space measured. For the **HAB++(WB)** notation, the air temperature measurements shall be made at least every five (5) minutes for a minimum period of one (1) hour if the system has the capacity to reach within that hour the **HAB++(WB)** requirements for lower and upper temperatures. If not,

the air temperature measurements shall be made at least every ten (10) minutes for a minimum period of two (2) hours.

Note:

Data loggers are a type of device that can be left unattended to capture data. These type devices have been proven effective in gathering temperature and humidity values.

The measuring period for determining the average air velocity at any location shall be three (3) minutes.

Surface temperatures for all wall surfaces that are adjacent to the head of the bed in crew cabins shall be measured for determining the horizontal gradient in crew cabin spaces. The horizontal gradient is to be calculated and recorded as the difference between the wall temperature and the average air temperature at 1100 mm (43 in.) above the deck crew cabin areas.

The Test Plan shall include supporting documentation and calculations relating to the air supply for each of the spaces or zones identified in the Test Plan.

7.3 Test Conditions

In order to determine the effectiveness of the HVAC system at providing the environmental conditions specified in this Guide, measurements shall be made under the following conditions:

7.3.1 Testing (1 February 2016)

Testing of identified spaces can be performed in port and at sea, provided the required test conditions stated here are in compliance at the time the measurements are made and recorded. In the case where some testing is performed in port, confirmatory testing shall be performed at sea with all normally functioning equipment in its operational mode. This confirmatory testing will consist of a sample of the manned spaces selected as follows:

- Spaces that were identified as “worst case” locations.
- Spaces which were out of compliance or close to non-compliance (See 1/8.2 TABLE 1).
- Spaces that required some type of mitigation.
- Additional testing may be required at the ABS Surveyor’s discretion.

7.3.2 Equipment Operation (1 February 2016)

The HVAC system shall be operating in the normal operation or mode. A written confirmation issued by the builder confirming that the HVAC system has been tested, adjusted and balanced shall be provided to the ABS Surveyor before any measurement commences. The total system Testing, Adjusting, and Balancing (TAB) shall be conducted in accordance with the National Environmental Balancing Bureau (NEBB) standard “*NEBB Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems*” or other similar certification standard.

7.3.3 Doors and Windows (1 February 2016)

The space doors (including louvers) and windows shall be closed during the evaluation period, except for routine entry and exit. Any open doors or windows should be noted in the Indoor Climate Test Report.

7.3.4 Equipment and Furnishings

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

7.3.5 Weather and Climatic Conditions

When thermal conditions in the manned space have a high sensitivity to time of day and weather conditions (e.g., spaces adjacent to exterior bulkheads), the measurement should be made such that the high and low extremes of the thermal parameters are determined (e.g., measurements could therefore be taken during the day and night in the same space). If possible, measurements should be taken with little or no cloud cover.

7.3.6 Test Interference

During the indoor climate measurements, any activity that might affect the indoor climatic variables in the space 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.

Doors and windows shall be closed, except where they are normally left open (such as the door on the lee side of the navigation bridge, which may normally be open). Any open doors or windows shall be noted in the Indoor Climate Test Report.

7.4 Measurement Locations

7.4.1 Selection of Spaces where Measurements are to be Conducted (1 February 2016)

The aim when selecting indoor climate 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 sample data can be collected during the testing phase. The measurement locations shall be selected in accordance with the following criteria:

- i)* Select potential problem areas where the influence of internal conditions or factors may adversely impact the quality of the indoor climate in enclosed manned spaces. Internal conditions include space proximity to equipment that radiates or absorbs heat (e.g., engine exhaust trunks, freezer spaces, galley, scullery, etc.) and surfaces with thermal differentials in excess of 10°C (18°F) from the ambient temperature in the space. Living and working areas at the ends of HVAC ductwork or piping runs (for heating or cooling) shall be selected as potential problem locations. Measurements shall be taken in all identified potential problem areas.
- ii)* Select potential problem areas where the influence of external ambient environmental conditions (e.g., sun, wind, precipitation, etc.) may adversely impact the quality of the indoor climate. These areas include manned spaces, accommodation areas and recreation areas which may be outboard or adjacent to the vessel's hull. Measurements shall be taken in all identified problem areas.
- iii)* Where a single instance of one (1) type of space exists within the vessel (e.g., bridge, mess room, gymnasium, library, etc.), the location shall be selected for measurement.
- iv)* Where multiple instances of one (1) type of space exist (e.g., cabins or recreation areas), a representative sample of at least twenty-five (25) percent of each type (e.g., one-man room, two-man room, etc.) shall be selected for measurement. The worst case locations are to be considered part of the representative sample, if applicable.

All of 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.

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 indoor climate qualities. At the discretion of the ABS Surveyor, additional measurements may be required.

7.4.3 Transducer Placement Positions (1 February 2016)

For each space identified in the Test Plan, the transducer locations shall be standardized as follows:

- i)* Air temperature and relative humidity measuring instrumentation shall be set up approximately in the middle of the space to measure general space temperature and humidity levels. Air temperature shall be measured at approximately 100 mm (4 in.), 1100 mm (43 in.) and 1700 mm (67 in.) above the deck. Relative humidity shall be measured at a height of approximately 1700 mm (67 in.) above the deck.
- ii)* Air velocity shall be measured at approximately 100 mm (4 in.), 1100 mm (43 in.) and 1700 mm (67 in.) above the deck in manned spaces, as applicable (to assure air velocity is not excessive). This measurement should be taken in the center of the space. Air velocity only needs to be measured once per testing location.
- iii)* For crew cabin spaces, inside wall surface temperatures for determining the horizontal gradient shall be captured at approximately 300 mm (12 in.) above the mattress.

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 indoor climate levels meet the criteria and whether this part of the notation requirement has been met. The details listed in the following Paragraphs shall be provided in the Indoor Climate Test Report.

8.1 Test Details (1 February 2016)

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

- i)* Vessel’s geographical location
- ii)* Weather conditions and meteorological data (i.e., wind speed and direction, ambient outdoor air temperature, outdoor humidity, barometric pressure) at the onset of every data collection period and at intervals of every four (4) hours during any data collection period. Weather conditions shall also be reported at the end of each data collection period.
- iii)* Any indications of abnormal activities or conditions during the test that might skew results

8.2 Transducer Placement Positions (1 February 2016)

Actual measurement locations and transducer placement positions shall be indicated on appropriate drawings.

8.3 Measurement Equipment Details

Details of measuring and analysis equipment (e.g., manufacturer, type and serial number, accuracy, sampling frequency and resolution) 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 measurement location and sample period as appropriate for notation, shall be provided in table format:

- i)* Measurement position

- ii)* Number of people present in the space at time of measurement
- iii)* Measurement period if different from requirement
- iv)* Air temperature (minimum, maximum, and average) at 100 mm (4 in.) above deck
- v)* Air temperature (minimum, maximum, and average) at 1100 mm (43 in.) above deck
- vi)* Air temperature (minimum, maximum, and average) at 1700 mm (67 in.) above deck
- vii)* Relative humidity (minimum, maximum, and average) at 1700 mm (67 in.) above deck
- viii)* Air velocity at 100, 1100, and 1700 mm (4, 43, and 67 in.) above deck at measurement positions
- ix)* Vertical gradient (Average air temperature at 1700 mm (67 in.) minus average air temperature at 100 mm (4 in.) above deck)
- x)* Horizontal gradient (Side wall surface temperature in crew cabin spaces minus average air temperature at 1100 mm (43 in.) above deck crew cabin areas)
- xi)* 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 space
- 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 the indoor climate tests 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 indoor climate testing were completed to their satisfaction. A copy of the witnessing document shall be given to the person conducting the testing for insertion into the final Indoor Climate Test Report. The original shall be retained for ABS' files.

9 Results

The Indoor Climate Test Report and test results shall be reviewed by the ABS Surveyor against the appropriate **HAB(WB)**, **HAB+(WB)**, and **HAB++(WB)** criteria for notation confirmation.

SECTION 6 Lighting

1 Background (1 February 2016)

The lighting of seafarer spaces should facilitate visual task performance and facilitate movement in the space and aid in the creation of an appropriate visual environment. Lighting design involves integrating these aspects to provide adequate illumination for the safety and well-being of the crew as well as for the various tasks performed onboard vessels.

The selection of appropriate illuminance levels for specific tasks and seafarer spaces is an important consideration in the design of lighting systems. There is a difference of opinion as to what levels of light may be considered best for visual tasks. Since illuminance recommendations are generally consensus values, for any task, a range of illuminances may apply.

Since visual tasks performed within habitable spaces onboard a vessel are generally similar to tasks encountered ashore, requirements for illuminance on vessels generally correspond to those tasks performed in living, working, and recreation areas on shore.

2 Scope

This Section provides criteria for assessing the illuminance levels of general lighting and task lighting on vessels. The main objective of the assessment is to determine whether the various lighting systems comply with minimum standards to accommodate crew visual task performance and facilitate crew movements and well-being and safety onboard vessels.

Lighting criteria are defined based on currently available objective standards and research data. Compliance with this Section is a pre-requisite 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)

Disability Glare: Glare which reduces the ability to perform a visual task.

Discomfort Glare: Glare which produces viewer discomfort, but which does not significantly interfere with visual task performance or visibility.

General Lighting: Lighting designed to provide a substantially uniform level of illuminance throughout an area, exclusive of any provision for special, localized tasks. Such lighting should be provided by fixed luminaires.

Glare: The discomfort or impairment of vision experienced when parts of the visual field are excessively bright in relation to the general surroundings.

Illuminance: The luminous flux density at a surface (or the amount of light falling on an object or surface), i.e., the luminous flux incident-per-unit area. Illuminance is measured in units of Lux (lm/m^2) or foot-candles (fc; lm/ft^2). One foot-candle equals 10.76 Lux.

Lumen: The International System of Units (SI) of luminous flux, used in describing a quantity of light emitted by a source or received by a surface.

Luminaire: A complete lighting unit consisting of a lamp(s) together with the parts designed to distribute the light, to position and protect the lamp, and to connect the lamp to the power supply.

Luminance: The photometric brightness of an illuminated surface (or the amount of light emitted or reflected from the surface). The SI unit of luminance is candela-per-square meter (cd/m^2).

Luminous Flux: The light emitted by a source, or received by a surface and indicates the intensity of a source. Flux is expressed in lumens.

Lux: a unit of illumination, equivalent to 0.0929 foot-candle and equal to the illumination produced by luminous flux of one lumen falling perpendicularly on a surface one meter square. Also called *meter-candle*

Red or Low-level White Illuminance: Lighting provided to accommodate efficient dark adaptation in areas where seeing tasks are performed during nighttime operations and in areas where people need to move from a lit interior into a dark environment and maintain good vision.

Reference Calibration: Calibration of a measuring instrument, 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.

Task Lighting: Lighting provided to meet the illuminance requirements of a specific task. Task lighting refers to the total illuminance requirement that may be obtained by supplementary lighting provided in addition to the general illuminance. Such lighting may be provided by fixed luminaires, or via floor lamps or table lamps.

Task Plane: The horizontal, vertical, or inclined plane in which the visual task lies. If no information is available, the task plane may be considered to be the horizontal and at 750 mm (29.5 in.) above the deck for seated tasks and 1000 mm (39.5 in.) for standing tasks.

Veiling Reflection (or Reflected Glare): A reflection of incident light that partially or totally obscures the details to be seen on a surface by reducing the contrast.

4 Associated Documentation (1 February 2016)

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

- ISO 8995-1:2002, Lighting of Work Places – Part 1: Indoor
- DIN EN 12464-1:2011, Light and Lighting – Lighting of Work Places – Part 1: Indoor Work Places
- DIN 5032-7:1985, Photometry; Classification of Illuminance Meters and Luminance Meters
- CIE S 023/E:2013 (ISO/CIE 19476:2014), Characterization of the Performance of Illuminance Meters and Luminance Meters
- BS 667:2005, Illuminance meters. Requirements and test methods

5 Criteria (1 September 2013)

(1 February 2016) The lighting criteria for the ship Habitability notation are provided in:

- 6/5.2 TABLE 1, “Lighting Criteria for Crew Accommodation Spaces”
- 6/5.2 TABLE 2, “Lighting Criteria for Entrances and Passageways”
- 6/5.2 TABLE 3, “Lighting Criteria for Navigation and Control Spaces”
- 6/5.2 TABLE 4, “Lighting Criteria for Service Spaces”
- 6/5.2 TABLE 5, “Lighting Criteria for Operating and Maintenance Spaces/Areas”
- 6/5.2 TABLE 6, “Lighting Criteria for Red or Low-level White Illuminance”

For lighting, the criteria for **HAB(WB)**, **HAB+(WB)**, and **HAB++(WB)** are the same. In this Section, general lighting and task lighting requirements are provided for crew tasks and spaces normally encountered on vessels. The lighting levels provided in the tables are for new lamps. Emergency lighting is covered in SOLAS and IMO Resolutions and was not considered in the selection of the lighting levels provided in this Guide.

The criteria in this Section are applicable to the entire vessel, not just manned spaces.

5.1 General and Task Lighting (1 February 2016)

The minimum maintained illuminance levels in Lighting Criteria Tables 1 through 5 of this Section shall be achieved under the test conditions specified in 6/7.3, “Test Conditions”, measured with task lighting turned on where provided but with external light sources (e.g., daylight, moonlight, shore light, etc.) excluded. These levels were selected from a variety of sources that are listed in Appendix 1, “References”.

5.2 Red or Low-level White Illuminance

In work spaces where red or low-level white illuminance is provided to facilitate dark adaptation, the maintained illuminance levels in 6/5.2 TABLE 6, “Lighting Criteria for Red or Low-level White Illuminance”, are provided for guidance only and are not required for a **HAB(WB)**, **HAB+(WB)**, or **HAB++(WB)** notation.

TABLE 1
Lighting Criteria for Crew Accommodation Spaces (1 February 2016)

<i>Space</i>	<i>Illuminance Level in Lux</i>	<i>Space</i>	<i>Illuminance Level in Lux</i>		
Cabins and Sanitary Spaces					
General Lighting	150	Sanitary Spaces ● Lavatory/Toilet ● Bath/Shower Area	200 150		
Reading and Writing ● Desk [#] ● Bunk Light [#] ([#] compliance with one or the other)	500 200				
Changing Room	200			Light During Sleep Periods*	<30
Dining Spaces					
Mess Room and Cafeteria	300	Snack or Coffee Area	150		
Recreation Spaces					
Recreation Room/Lounges	200	Gymnasiums	300		

<i>Space</i>	<i>Illuminance Level in Lux</i>	<i>Space</i>	<i>Illuminance Level in Lux</i>
Library • General Lighting • Reading Area	150 500	Bulletin Boards/Display Areas	150
Multimedia Resource Center (e.g., computer room)	300	All other Recreation Spaces (e.g., Game Rooms)	200
TV Room/Movie Theater	150	Reception Areas	300
Medical, Dental and First Aid Center			
General Lighting/Medical Waiting Areas	150	Dispensary • General Lighting • On dispensary table	150 500
Medical and Dental Treatment/ Examination Room	500	Laboratories	500
Reading and Writing (Desk)	500	Other Medical Spaces	300

Note: * If there is any opportunity for light to enter cabins at the times of day or night when people sleep (e.g., portlights, transoms, etc.), the maximum lighting level shall be 30 Lux.

TABLE 2
Lighting Criteria for Entrances and Passageways (1 February 2016)

<i>Space</i>	<i>Illuminance Level in Lux</i>	<i>Space</i>	<i>Illuminance Level in Lux</i>
Interior Walkways, Passageways, Corridors, Stairways and Access Ways	100	Exterior Walkways, Passageways, and Access Ways (night)	50
Elevators	100	Exterior Stairways	100

TABLE 3
Lighting Criteria for Navigation and Control Spaces (1 February 2016)

<i>Space</i>	<i>Illuminance Level in Lux</i>	<i>Space</i>	<i>Illuminance Level in Lux</i>
Wheelhouse, Pilothouse, Bridge • Day • Night when Underway ⁽¹⁾	300 <30	Offices • General Lighting • Reading and Writing (Desk) • Meeting, Training Rooms	300 500 500
Chart Room • General Lighting ⁽²⁾ • On Chart Table	150 500		
Radar/Gyro Room ⁽²⁾	200		
Radio Room ⁽²⁾	300	Control Rooms & Control Stations ⁽³⁾ • General Lighting • Control Consoles and Boards, Panels, Instruments, etc. • Reading and Writing (Desk)	300 300 500

Notes:

- 1 (1 February 2016) At night, the wheelhouse must be kept as dark as possible to permit visibility of objects on the water, hazards to navigation, and navigational lights.
- 2 (1 February 2016) When the space is separate from the wheelhouse.
- 3 (1 February 2016) Includes control rooms and stations such as Engine Control Room, Cargo Control Room, Ballast Control Room, Fire Control Room, etc.

TABLE 4
Lighting Criteria for Service Spaces (1 February 2016)

<i>Space</i>	<i>Illuminance Level in Lux</i>	<i>Space</i>	<i>Illuminance Level in Lux</i>
Food Preparation		Laundries	300
• Galley	500	Chemical Storage (e.g., paint store, etc.)	300
• Pantry	300		
• Butcher Shop	500	Storerooms	
• Thaw Room	300	• Large Parts	200
• Working Surfaces, Food Preparation Counter and Range Tops	500	• Small Parts	300
• Scullery (Dishwashing)	300		
Food Serving Lines	300	Food Storage	
Package Handling/Cutting	300	• Non-refrigerated	200
		• Refrigerated	100
Mail Sorting	500		

TABLE 5
Lighting Criteria for Operating and Maintenance Spaces/Areas (1 February 2016)

<i>Space</i>	<i>Illuminance Level in Lux</i>	<i>Space</i>	<i>Illuminance Level in Lux</i>
Machinery Spaces (General)	200		
Engine Room (Main propulsion machinery)	300	Cargo Holds (Portable Lighting)	
Generator, Switchboard and Transformer Room	200	• General Lighting ⁽²⁾	30
Emergency Generator Room	200	• During Cargo Handling ⁽³⁾	200
		• Passageways and Trunks	80
Fan Room	200	Inspection and Repair Tasks	
HVAC Room	200	• Rough	300
		• Medium	500
Bilge/Void Spaces (Portable Lighting)	75	• Fine	750
		• Extra Fine	1000

<i>Space</i>	<i>Illuminance Level in Lux</i>	<i>Space</i>	<i>Illuminance Level in Lux</i>
Pump Room, Fire Pump Room	200	Workshops ⁽⁴⁾	
Steering Gear Room	200	• General Lighting	300
Windlass Rooms	200	• On work bench top/machine	500
Battery Room	200	Paint Shop	500
Boiler Rooms	100		
Muster/Embarkation Area	200	Shaft Alley	100
		Escape Trunks	50
Cargo Handling (Weather Decks) ⁽¹⁾	200	Crane Cabin	400
Lay Down Area ⁽¹⁾	200		
General Process and Utility Area ⁽¹⁾	200		
Loading Ramps/Bays ⁽¹⁾	200		
Cargo Storage and Maneuvering Areas ⁽¹⁾	200	Hand signaling areas between crane shack and workboat deck	300

Notes:

- (1 February 2016)* Covers all the activities related to the safe transferal, stowing, lashing and securing of the various cargoes to be transported on deck.
- (1 February 2016)* Refers to the general illumination of the cargo hold by a portable light which should be able to provide the required illuminance level on the inner bottom.
- (1 February 2016)* Refers to the illumination of the immediate points of activity (where the cargo handling activity takes place within the cargo hold) when this is applicable depending the ship type.
- (1 February 2016)* Refers to the illumination of mechanical workshop, welding workshop, instrument/electrical workshop, etc.

TABLE 6
Lighting Criteria for Red or Low-level White Illuminance*

<i>Area</i>	<i>Illuminance Level in Lux</i>
Where seeing is essential for charts and instruments	1 to 20
Interiors or Spaces	5 to 20
Bridge Areas (including chart tables, obstacles and adjacent corridors and spaces)	0 to 20 (Continuously Variable)
Stairways	5 to 20
Corridors	5 to 20
Repair work (with smaller to larger size detail)	5 to 55

Note: * Lighting criteria is provided for guidance only.

6 Test Plan

(1 February 2016) 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 lighting criteria. The Test Plan shall include the following:

6.1 Documentation (1 February 2016)

The Test Plan shall include appropriate design information and layout drawings showing the hull outline, bulkheads, access routes, location of luminaires, outlines of major furniture and equipment, and the space name and number. The drawings shall be to a scale and sized to permit the scaling of measurement points (required by 6/7.4, “Measurement Locations”) and lighting equipment and the recording of luminance and other relevant data.

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 A2, “Procedural Requirements for ABS Recognized Ambient Environmental Testing Specialists”.

6.3 Test Conditions

The Test Plan shall detail the conditions under which the tests will be performed. Details about test conditions are given in 6/7.3, “Test Conditions”.

6.4 Measurement Locations

The Test Plan shall document, in detail, on appropriate drawings, all spaces or areas where measurements will be taken. In addition, measurement positions within these areas shall be indicated. Details on selecting measurement locations are provided in 6/7.4, “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, and sensitivity. More details on data acquisition and instruments are provided in 6/7.2, “Data Acquisition and Instruments”.

6.6 Data Analysis

The Test Plan shall provide information regarding the methods 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)

Visual tasks encountered on vessels vary and the lighting provided can influence the ability to see and perform those tasks. Some vision and lighting considerations include task duration, visual fatigue, task criticality, veiling reflections, shadows, and abilities of the observer. The presence of glare is a concern and is often difficult to identify, measure, and assess. Glare is often transient (based on factors such as the

direction of the sun to illuminated components or from the placement of lighting fixtures) and therefore difficult to anticipate. As part of lighting data collection, glare shall be subjectively evaluated jointly by the Testing Specialist and the ABS Surveyor witnessing the collection of lighting data. These assessments shall be made as a part of the activities discussed in 6/7.4.2, “Walkthrough Verification Inspection Locations”.

Illuminance measurements shall be carried out as described below.

Measurement of ambient lighting need only be performed once during sea trials or at pier side when all external light sources can be blocked out.

7.2 Data Acquisition and Instruments (1 February 2016)

The illuminance meter (light meter) shall conform to any of the International Standards specified below (or equivalent):

- DIN 5032-7:1985 (Class A)
- CIE S 023/E:2013 (ISO/CIE 19476:2014)
- BS 667:2005 (Type F)

Note:

The measurement of red and/or low level white illuminance is not required for workboat Habitability notation

7.3 Test Conditions

The test conditions required for Lighting measurements shall be in accordance with the following Subparagraphs:

7.3.1 Location (1 February 2016)

Lighting measurements may be taken in port, at sea, or both, since the measurements are not dependent on vessel operation. If testing is done in port, ship’s power and not shore power shall be used.

7.3.2 Spaces with Windows/Portlights (1 February 2016)

In spaces with windows or portlights where the minimum lighting level is intended to be provided by artificial light sources only, lighting measurements shall be taken after dark, or during the day provided all natural lighting is blocked out.

7.3.3 Spaces without Windows/Portlights

Interior spaces with no windows or portlights can be measured during daylight hours.

7.3.4 Stray Light

Stray light (e.g., deck lighting and moonlight) shall be capable of being masked out as far as practicable. Where it is not possible, measurements of stray light, at appropriate positions, with all lighting turned off, shall be obtained. These readings shall then be deducted from readings taken at the same positions, with the lighting turned on, to determine the illuminance from the lighting.

7.3.5 Light for Sleep (1 February 2016)

Lighting measurements shall be taken in cabins with all cabin lights turned off and curtains, shutters, etc., closed.

7.3.6 Test Interference (1 February 2016)

During the lighting measurements, shadows on the light meter caused by any kind of human activity shall be avoided. For this reason, only the personnel needed to operate any equipment during testing and those carrying out the measurements shall be present in the space.

Doors and windows shall be closed, except where they are normally left open (such as the door on the lee side of the navigation bridge, which may normally be open). Any open doors or windows shall be noted in the Lighting Test Report. Spaces shall be furnished with all usual equipment and furnishings normally found in the space.

7.3.7 External (Deck) Lighting (1 February 2016)

External areas (cargo handling, cargo lay down areas, and external operating consoles) shall be tested on dark evenings without contribution of light to the deck and cargo handling areas from shore lights. Light measurements taken for these locations shall result from lighting systems aboard (with the exception of star and moon light contributions).

7.4 Measurement Locations

7.4.1 Selection of Spaces where Measurements are to be Conducted (1 February 2016)

The aim when selecting lighting measurement locations shall be to obtain a representative sample of data that represents the actual conditions in the manned crew spaces listed in the Lighting Criteria Tables 1 to 5 of this Section. For practical reasons, it is important to select the locations such that an appropriate amount of sample data can be collected during the testing phase. The measurement locations shall be selected in accordance with the following criteria:

- i) Select problem areas based on the potential for excessive external illumination (daylight) into the space (e.g., bridge). Areas at the end of cable runs shall be selected as potential problem locations. Measurements shall be taken in all identified problem areas.
- ii) Select potential problem areas based on the positioning of luminaires in the space as indicated on the drawings (e.g., uneven spacing of luminaires resulting in non-uniform illuminance levels and dimly lit areas). Measurements shall be taken in all problem areas.
- iii) Where a single instance of one (1) type of space exists within the vessel (e.g., bridge, mess room, gymnasium, library, etc.), the location shall be selected for measurement.
- iv) Where multiple instances of one (1) type of space exist (e.g., recreation areas) with the exception of cabins, a representative sample of at least twenty-five (25) percent of each type shall be selected for measurement. The problem area locations are to be considered part of the representative sample, if applicable.
- v) Where a number of crew cabin spaces are identical in configuration in terms of lighting systems, surface treatments, geometry, furnishings and equipment layout, only two (2) of the spaces on each deck shall be selected to determine whether the lighting requirements are met. Where cabins are not identical in configuration in terms of lighting system, surface treatments, geometry, furnishing, and equipment at least twenty-five (25) percent shall be selected on each deck for measurement.
- vi) All of these measurement locations must be selected at locations port, starboard, fore, amidships and aft. The worst case locations are to be considered part as the representative sample for crew cabins, if applicable.
- vii) Where external nighttime measurements are taken, spaces shall be selected according to human presence in the space or task location, including: exterior passageways and access ways, operating consoles, hand signaling locations, anchor handling locations, mooring locations, crew embarkations and debarkation areas, and cargo handling locations – particularly with regard to attaching and detaching cargo from crane hooks.

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 lighting qualities.

The presence of discomfort or disability glare shall be specifically and subjectively assessed by the ABS Surveyor and the Testing Specialist, and a result of that assessment noted as “no glare present”, “some glare present”, “discomfort glare present”, or “disability glare present” shall be noted for each lighting test location. At the discretion of the ABS Surveyor, additional measurements or assessments may be required. The ABS Surveyor will determine if any follow-on activity is required for any noted discomfort or disability glare.

7.4.3 General Illuminance Measurement Positions

General lighting levels shall be measured with all lights turned on, except supplementary task lighting, such as desk lights and berth lights. Daylight shall be excluded during the measurements. Measurements shall be taken on a horizontal plane approximately 750 mm (29.5 in.) above the deck. For traffic areas, readings shall be taken on the deck.

For larger spaces (public rooms, messes, recreation areas, etc.), it shall be necessary to take measurements at a number of locations in order to obtain a representative sample of the illumination for that space. Measurement locations shall be evenly distributed throughout the space. For a specific room size, the minimum number of measurement locations shall be as indicated in 6/7.4.3 TABLE 7, “Distribution of Measurement Positions within Spaces”.

TABLE 7
Distribution of Measurement Positions within Spaces (1 February 2016)

<i>Space Size</i>	<i>Minimum Number of Measurement Positions in Room</i>
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

The arithmetic mean of the measurement shall be used for the measure of illuminance of the General area.

In the case of corridor lighting, measurements shall be taken approximately every 3000 mm (10 ft) of corridor length. The arithmetic mean shall not be used to determine compliance with corridor lighting requirements.

7.4.4 Task Lighting Measurement Positions (1 February 2016)

For task area lighting (such as consoles, control stations, workbenches, computer workstations, desktops and meeting tables, medical stations, galley areas, and maintenance workstations), a representative set of readings shall be taken over the task surface with the worker in the normal working position. Task lighting shall be measured with both general and supplementary task lighting turned on. Daylight shall be excluded during the measurements.

Measurements of task lighting shall be made on the surface or in the plane of the task (horizontal, vertical or at an angle). For small task surfaces, smaller than 0.5 m² (5 ft²), a single measurement shall be taken at the center of the task surface. For larger task surfaces (0.5 m² (5 ft²) or larger), the illuminance shall be measured by dividing the task surface into a grid no larger than 0.5 m² (5 ft²) and averaging the measurements taken at the grid intersections.

For berths and bunks, measurements shall be taken at a point approximately 300 mm (12 in.) above the top of the mattress and 600 mm (24 in.) from the bunk light fixture.

7.4.5 Red and Low-level White Illuminance (1 February 2016)

Guidance for the measurement of red and low-level white is provided in other national and international standards. These measurements are not required for the Habitability notation.

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 lighting levels meet the minimum requirements and whether this part of the notation requirement has been met. The details listed in the following paragraphs shall be provided in the Lighting Test Report.

8.1 Test Details

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

- i) Time of day
- ii) External lighting conditions (e.g., Were measurements taken in port or at sea? Were measurements taken during daylight hours or after dark?)

8.2 Measurement Positions

Actual measurement locations shall be indicated on appropriate drawings.

8.3 Measurement Equipment Details

Details of measuring equipment (e.g., manufacturer, type and serial number, accuracy and resolution) 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 space, shall be provided in table format:

- i) Name and number of space
- ii) Task areas (if any) in space
- iii) Average lighting level for general lighting
- iv) Average lighting level for task lighting on each task surface
- v) Corridor lighting measurements
- vi) Lighting level in cabins with lights turned off and curtains, shutters, deadlights, etc., closed
- vii) Presence of glare at specific workstations within the space and any follow-up activity requirements
- viii) 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 space
- 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 the lighting tests 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 lighting testing were completed to their satisfaction. A copy of the witnessing document shall be given to the person conducting the testing, for insertion into the final Lighting Test Report. The original shall be retained for ABS' files.

9 Results

The Lighting Test Report and test results shall be reviewed by the ABS Surveyor against the lighting criteria for notation confirmation.

APPENDIX 1 References

1 General References

- 1) American Bureau of Shipping. *Guide for Crew Habitability on Ships*. Houston, TX.
- 2) American Bureau of Shipping. *Rules for Materials and Welding: Aluminum and Fiber Reinforced Plastics*. Houston, TX.
- 3) American Bureau of Shipping. *Rules for Building and Classing Marine Vessels*. Houston, TX.
- 4) American Bureau of Shipping. *Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways*. Houston, TX.

2 Accommodation Area References (1 February 2016)

- 1) American Society for Testing and Materials. (2013). *Standard practice for human engineering design for marine systems, equipment and facilities* (ASTM F 1166). West Conshohocken, PA.
- 2) International Labor Office. (1949). *Accommodation of Crews Convention (Revised)* (Convention C92). Geneva.
- 3) International Labor Office. (1970). *Accommodation of Crews (Supplementary Provisions Convention)* (Convention C133). Geneva.
- 4) International Labor Office. (1998). *Maritime labor conventions and recommendations* (4th ed.). Geneva.
- 5) International Labor Organization. *Maritime Labour Convention, 2006*. Geneva.
- 6) International Maritime Organization. *International Convention for the Safety of Life at Sea (SOLAS), 1974: Means of escape* (Chapter II-2, Regulation 13). London.
- 7) International Organization of Masters, Mates, & Pilots. *Contract requirements for both existing and new ship construction*. Linthicum Heights, MD.
- 8) National Fire Protection Association (NFPA). (2015). *Life safety code 101*. Quincy, MA.
- 9) Norwegian Oil Industry Association and The Federation of Norwegian Engineering Industries (NORSOK). (2006). *Architectural components & equipment* (C-002). Oslo.
- 10) Norwegian Oil Industry Association and The Federation of Norwegian Engineering Industries (NORSOK). (2004). *Working environment* (S-002). Oslo.
- 11) Panero, J., and Zelnik, M. (1979). *Human dimension & interior space: A source book of design reference standards*. New York: Whitney Library of Design.
- 12) Sailor's Union of the Pacific. (1996). *Agreement between Sailor's Union of the Pacific and American President Lines, Ltd. In the Offshore and Intercoastal Trades*. San Francisco, CA.
- 13) Seafarers International Union. *Contract requirements for unlicensed seamen*. Camp Springs, MD.

- 14) Tillman, B. and Tillman, P. (2000). Personal Correspondence with ABS.
- 15) U.S. Coast Guard, Department of Transportation. (1998). Coast Guard Regulation 32, Subpart 32.40, *Accommodations for officers and crew*, (Code of Federal Regulations, 46CFR32.40, pp. 398-400). Washington, DC: U.S. Government Printing Office.
- 16) U.S. Coast Guard, Department of Transportation. (1998). Coast Guard Regulation 92, Subparts 92.10 to 92.25, 92.10-1 to 92.25-90 *Construction and arrangement*, (Code of Federal Regulations, 46CFR92.10-92.25, pp. 51-56). Washington, DC: U.S. Government Printing Office.
- 17) U.S. Coast Guard, Department of Transportation. (2011). Coast Guard Regulation 116, Subparts D to I, 116.400-116.970 *Construction and arrangement*, (Code of Federal Regulations, 46CFR116.400-116.970, pp. 339-357). Washington, DC: U.S. Government Printing Office.
- 18) U.S. Coast Guard, Department of Transportation. (2011). Coast Guard Regulation 116, Subpart K, 116.1110-116.1160 *Construction and arrangement*, (Code of Federal Regulations, 46CFR116.1110-116.1160, p.358). Washington, DC: U.S. Government Printing Office.
- 19) U.S. Coast Guard, Department of Transportation. (2008). Coast Guard Regulation 177, Subpart I, 177.900-177.970 *Construction and arrangement*, (Code of Federal Regulations, 46CFR177.900-177.970, pp. 214-216). Washington, DC: U.S. Government Printing Office.
- 20) U.S. Coast Guard, Office of Marine Safety. (2006). *Load Line Technical Manual, Report Number USCG-M-1-90*. Washington, DC
- 21) U.S. Department of Defense. (1999). *Design criteria standard: Human engineering* (MIL-STD-1472F). Washington, DC: U.S. Government Printing Office.
- 22) U.S. Department of Health and Human Service: Centers for Disease Control and Prevention. (2001). *Recommended shipbuilding construction guidelines for cruise vessels destined to call on U.S. Ports*. Atlanta, GA.
- 23) U.S. Department of Health, Education and Welfare: Food & Drug Administration. (1996). *Handbook on sanitation of vessel construction: Standards of sanitation and ratproofing for the construction of vessels*. Washington, DC.
- 24) U.S. Department of Labor (2000). Code of Federal Regulation, 29 CFR 1910. 23. Subpart D- *Walking-Working Surfaces – Guarding floor and wall openings and holes*. Washington, DC.
- 25) U.S. Department of Labor (2000). Code of Federal Regulation, 29 CFR 1910. 24. Subpart D- *Walking-Working Surfaces – Fixed industrial stairs*. Washington, DC.
- 26) U.S. Maritime Administration: National Maritime Resource and Education Center. (1995). *Guideline specification for merchant ship construction, prepared by the Office of Ship Design*. Washington, DC: U.S. Department of Transport.
- 27) U.S. Navy. (2013). *Shipboard habitability design criteria and practices manual (Surface Ships) for new ship designs and modernization* (T9640-AA-PRO-010/HAB). Arlington, VA: Naval Sea Systems Command.
- 28) U.S. Navy. (1995). *General specifications for ships of the United States Navy* (Section 612 – Liferails and Lifelines). Arlington, VA: Naval Sea Systems Command.
- 29) U.S. Navy. (1995). *General specifications for ships of the United States Navy* (Section 622 – Ladders, Handrails, Floor Plates, Staging, Gratings and Service Platforms). Arlington, VA: Naval Sea Systems Command.
- 30) U.S. Navy. (1995). *General specifications for ships of the United States Navy* (Section 640 – General Requirements for Habitability Spaces). Arlington, VA: Naval Sea Systems Command.
- 31) U.S. Navy. (1995). *General specifications for ships of the United States Navy* (Section 644 – Plumbing Fixtures and Fittings). Arlington, VA: Naval Sea Systems Command.
- 32) U.S. Navy. (1995). *General specifications for ships of the United States Navy* (Section 645 – Leisure and Community Facilities). Arlington, VA: Naval Sea Systems Command.

- 33) U.S. Navy. (1995). *General specifications for ships of the United States Navy* (Section 652 – Medical and Dental Spaces). Arlington, VA: Naval Sea Systems Command.
- 34) U.S. Navy. (1995). *General specifications for ships of the United States Navy* (Section 655 – Laundry & Dry Cleaning Facilities). Arlington, VA: Naval Sea Systems Command.
- 35) U.S. Navy. (1995). *Shipboard habitability design criteria manual* (T9640-AB-DDT- 010/HAB). Arlington, VA: Naval Sea Systems Command.
- 36) Woodson, W.E., Tillman, B., and Tillman, P. (1992). *Human factors design handbook: Information and guidelines for the design of systems, facilities, equipment and products for human use* (2nd ed.). New York: McGraw-Hill, Inc.

3 Whole-body Vibrations References (1 February 2016)

- 1) Griffin, M. J. (1990). *Handbook of human vibration*. London: Academic Press.
- 2) International Organization for Standardization. (2000). *Mechanical Vibration and Shock – Guidelines for the Measurement, Reporting and Evaluation of Vibration with Regard to Habitability on Passenger and Merchant Ships*. (ISO 6954:2000). Geneva.
- 3) International Organization for Standardization. (2003). *Mechanical Vibration and Shock – Evaluation of Human Exposure to Whole Body Vibration – Part 2, Vibration in Buildings*. (ISO 2631-2:2003). Geneva.
- 4) International Organization for Standardization. (2008) *Mechanical Vibration on Ships – Part 2: Measurement of Structural Vibration* (ISO 20283-2:2008). Geneva.
- 5) International Organization for Standardization. (1998). *Mechanical mounting of accelerometers for measuring mechanical vibration and shock* (ISO 5348: 1998(E)). Geneva.
- 6) International Organization for Standardization. (2005). *Human response to vibration – Measuring instrumentation* (ISO 8041: 2005). Geneva.
- 7) World Meteorological Organization (WMO) *Manual on Codes*, No. 306, Part A, Alphanumerical Codes (2011 Edition, Updated in 2014).

4 Noise References (1 February 2016)

- 1) International Electrotechnical Commission. (2013). *Electroacoustics – Sound Level Meters – Part 1: Specifications* (International Standard IEC 61672-1). Geneva: IEC Central Office.
- 2) International Maritime Organization. (2012). *Code on noise levels on-board ships* (IMO Resolution MSC.337(91) (2012). London.
- 3) International Organization for Standardization. (1996). *Acoustics – Measurement of noise on-board vessels* (ISO 2923: 1996). Geneva.
- 4) Kryter, K.D. (1994). *The handbook of hearing and the effects of noise: Physiology, psychology and public health*. San Diego: Academic Press.
- 5) World Meteorological Organization (WMO) *Manual on Codes*, No. 306, Part A, Alphanumerical Codes (2011 Edition, Updated in 2014).
- 6) ISO 10140-2: 2010, *Acoustics – Laboratory measurement of sound insulation of building elements – Part 2: Measurements of airborne sound insulation*.
- 7) ISO 717-1: 2013, *Acoustics – Rating of sound insulation in buildings and of building elements – Part 1: Airborne Sound Insulation*.

5 Indoor Climate References (1 February 2016)

- 1) American National Standards Institute. (2013). *Thermal Environmental Conditions for Human Occupancy* (ANSI/ASHRAE 55-2013). Atlanta, GA.

- 2) International Organization for Standardization. (1998). *Ergonomics of the thermal environment – Instruments for measuring physical quantities* (ISO 7726: 1998 (E)). Geneva.
- 3) International Organization for Standardization. (2002). *Ships and Marine Technology – Air-Conditioning and Ventilation of Accommodation Spaces – Design Conditions and Basis of Calculations* (ISO 7547: 2002 (E)). Geneva.
- 4) National Environmental Balancing Bureau. (2005). *NEBB Procedural standards for testing, adjusting, balancing of environmental systems*. Gaithersburg, MD.

6 Lighting References (1 February 2016)

- 1) International Organization for Standardization. (2002). *Lighting of Work Places – Part 1: Indoor* (ISO 8995:2002). Geneva.
- 2) DIN EN 12464-1:2011, Light and Lighting – Lighting of Work Places – Part 1: Indoor Work Places.
- 3) DIN 5032-7:1985, Photometry; Classification of Illuminance Meters and Luminance Meters.
- 4) CIE S 023/E:2013 (ISO/CIE 19476:2014), Characterization of the Performance of Illuminance Meters and Luminance Meters.
- 5) BS 667:2005, Illuminance meters. Requirements and test methods.

APPENDIX 2

Procedural Requirements for ABS Recognized Ambient Environmental Testing Specialists

1 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)**, or **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:

- **HAB, HAB+, HAB++**
- **HAB(OS), HAB+(OS), HAB++(OS)**
- **HAB(MODU), HAB+(MODU), HAB++(MODU)**
- **COMF, COMF+**
- **COMF(Y), COMFY+(Y)**
- **MLC-ACCOM, MLC-ACCOM(SPS), MLC-ACCOM(WB)**

Note that for **COMF+** and **COMF+(Y)**, motion sickness testing is required.

Calibration Checks: Field calibration of a measuring instrument, conducted before and after a field test, using a reference calibrated signal or through zero calibration.

Reference Calibration: Calibration of a measuring instrument, conducted by an accredited Testing and Calibration Laboratory, with traceability to a national or international standard.

2 Objective

The objective of this procedure is to set basic standards for qualifying and certifying Testing Specialists performing ambient environmental testing and evaluation.

3 Application

This procedure applies to the approval of Testing Specialists that provide the following ambient environment test services:

- i)* Whole-body Vibration measurements and analysis
- ii)* Noise measurements and analysis
- iii)* Indoor Climate measurement and analysis
- iv)* Lighting measurement and analysis

General requirements concerning Testing Specialists are given in A2/4.2, “General Requirements”. Specific requirements for the test services listed above are in Subsection A2/8, “Detailed Requirements by Ambient Environmental Aspect”.

4 Procedure for Approval and Certification

4.1 Documentation Requirements

The following documents are to be submitted to ABS for review:

- i)* An outline of the company (e.g., organization and management structure) including subsidiaries or subcontractors to be included in the approval/certification
- ii)* A list of company experience in the specific ambient environmental aspect
- iii)* A list of test personnel documenting training and experience in conducting tests within the relevant ambient environmental aspect and qualifications according to recognized national, international, or industry standards, as applicable
- iv)* Description of equipment used for the measurement and analysis of the particular ambient environmental aspect for which approval is sought (e.g., calibration, accuracy, etc.)

The following documents will be reviewed during the initial approval audit (See A2/4.3, “Auditing of the Testing Specialist”):

- i)* A guide for operators of such equipment
- ii)* Training programs for test personnel
- iii)* Draft checklists and data recording sheets for recording results of the services referred to in Subsection A2/3, “Application”
- iv)* Quality Manual and/or documented procedures covering requirements in A2/4.5, “Quality Assurance System”
- v)* (1 February 2016) Documented procedures for communication with the crew prior to commencing work in order to provide a safe system of work in place as necessary
- vi)* Evidence of approval/acceptance by certifying bodies, if any
- vii)* (1 February 2016) Information about other activities which may present a conflict of interest (i.e., in the case that the Testing Specialist provides, in any capacity or to any extent, input on the design of in part or whole of a vessel)
- viii)* Record of customer claims and of corrective actions requested by certification bodies for the past year
- ix)* Where relevant, list and documentation of licenses granted by equipment’s manufacturer
- x)* Example Test Plan(s) for the ambient environmental quality for which approval is requested
- xi)* Example Test Reports

4.2 General Requirements

4.2.1 Extent of Approval

The Testing Specialist shall demonstrate, as required by A2/4.2.2 “Training of Personnel” through A2/4.2.10, “Reporting”, that they have the competence, quality control, and quality assurance needed to perform the test and analysis services for which approval is sought.

4.2.2 Training of Personnel (1 February 2016)

The Testing Specialist is responsible for the qualification and training of its personnel to a recognized national, international, or industry standard as applicable. Where such standards do not exist, the Testing Specialist is to define standards for the training and qualification of its personnel relevant to the functions each is authorized to perform. The personnel shall also have adequate experience and be familiar with the operation of any necessary equipment. Personnel shall have had a minimum of one year tutored on-the-job training. Where it is not possible to perform internal training, a program of external training may be considered as acceptable.

4.2.3 Supervision (1 February 2016)

The Testing Specialist shall provide supervision for all services provided. The responsible supervisor shall have had a minimum of one (1) year of experience in supervising tests and at least two (2) years of performing tests in the ambient environmental aspect for which the Testing Specialist is recognized.

4.2.4 Personnel Records

The Testing Specialist shall keep records of the recognized test personnel. The records shall contain information about formal education, training, and experience for the ambient environmental test services for which they are recognized.

4.2.5 Equipment and Facilities

The Testing Specialist shall have the necessary equipment and facilities for the ambient environmental aspect to be tested. A record of the equipment used for ambient environmental testing shall be kept. The record shall contain information about maintenance and calibration.

4.2.6 Control of Data (1 February 2016)

When computers are used for the acquisition, processing, recording, reporting, storage, measurement assessment and monitoring of data, the ability of computer software to satisfy the intended application shall be documented and confirmed by the Testing Specialist.

4.2.7 Procedures

The Testing Specialist shall have documented work procedures covering all ambient environmental test services supplied.

4.2.8 Subcontractors

The Testing Specialist shall give information of agreements and arrangements if any parts of the services provided are subcontracted. Particular emphasis shall be given to quality management by the Testing Specialist in following-up of such subcontracts. Subcontractors providing anything other than subcontracted personnel or equipment shall also meet the requirements of A2/4.2, "General Requirements" and A2/4.5, "Quality Assurance System".

4.2.9 Verification

The Testing Specialist shall verify that the services provided are carried out in accordance with approved procedures.

4.2.10 Reporting

The report shall be prepared in a form acceptable to ABS as outlined within this Guide. The report shall include a copy of the Certificate of Approval.

4.3 Auditing of the Testing Specialist

Upon reviewing the submitted documents with satisfactory result, the Testing Specialist shall be audited for the initial certification process and then every three (3) years in order to ascertain that the Testing Specialist is duly organized and managed in accordance with the submitted documents and that it is considered capable of conducting the test services for which approval/certification is sought.

4.4 Certification

Certification is conditional on a practical demonstration to ABS or its agent of the specific ambient environmental test service performance, as well as a sample of a satisfactory report.

4.5 Quality Assurance System

The Testing Specialist shall have a documented system covering at least the following:

- i) Operating instructions for the test equipment
- ii) Maintenance and reference calibration of equipment
- iii) Training programs for test personnel
- iv) Supervision and verification to verify compliance with test procedures
- v) Recording and reporting of information
- vi) Quality management of subsidiaries and subcontractors
- vii) Job preparation
- viii) Periodic review of test process procedures, complaints, corrective actions, and issuance, maintenance, and control of documents
- ix) (1 February 2016) Code of conduct for the relevant activity

A documented Quality Assurance system complying with the applicable ISO 9000 standard or equivalent and including the above items would be considered acceptable.

4.6 Testing Specialist Relations with the Test Equipment Manufacturer

A company which works as a service station and conducts reference calibrations of equipment for a manufacturer (and is a Testing Specialist in this field) shall be assessed by the manufacturer(s) and nominated as their agent. The manufacturer shall verify that appropriate instruction manuals, material, etc., are available for the agent, as well as verifying proper training of the agent's technicians has occurred. Such Testing Specialists shall be recognized either on a case-by-case basis or as follows:

If a manufacturer of equipment (and the Testing Specialist) applies for inclusion of its nominated agents and/or subsidiaries in the approval, then the manufacturer must have implemented a quality assurance system certified in accordance with the relevant ISO 9000 standard or equivalent. The manufacturer must have effective controls of its agents and/or subsidiaries, and these agents/subsidiaries must have an equally effective quality control system complying with the relevant ISO 9000 or equivalent. Such approvals shall be based upon an evaluation of the quality assurance system implemented by the applicable company ISO 9000 or equivalent. ABS shall follow up the adherence to this quality assurance system by performing audits on such agents or subsidiaries against the relevant ISO 9000 standard or equivalent.

5 Certificate of Approval

Upon satisfactory completion of both the audit of the Testing Specialist and practical demonstration, ABS shall issue a Certificate of Approval stating that the Testing Specialist's test and analysis service operation system has been found to be satisfactory and that the results of test and analysis services performed in accordance with that system may be accepted and utilized by ABS in making decisions affecting optional Habitability/Comfort classification notations. The Certificate shall clearly state the type and scope of services and any limitations or restrictions imposed. The Testing Specialist shall also be included in ABS' records of recognized Testing Specialists.

Where several ambient environmental aspect measurements are conducted by a given company, each aspect is to be assessed and recognized, except as specified in A2/4.6, "Testing Specialist Relations with the Test Equipment Manufacturer".

5.1 Renewal

The Certificate of Approval is subject to renewal or endorsement at intervals not exceeding three (3) years per Testing Specialist procedure. The renewal or endorsement shall be accomplished by verification through audits to verify that approved conditions are maintained.

6 Alterations

When any alteration to the certified test and analysis service operation system of the Testing Specialist is made, ABS is to be immediately notified. Re-audit may be required when deemed necessary by ABS.

7 Cancellation of Approval

Approval may be cancelled in the following cases:

- i) Where the service was improperly carried out or the results were improperly reported
- ii) Where deficiencies are found in the recognized services of the Testing Specialist and appropriate corrective action is not taken
- iii) Where the Testing Specialist fails to inform ABS of any alteration, as in Subsection A2/6, "Alterations"
- iv) Where a renewal audit, if requested per A2/5.1, "Renewal", has not been carried out
- v) Where willful acts or omissions are ascertained

ABS reserves the right to cancel the approval if any of these cases are met.

A Testing Specialist whose approval was cancelled may apply for re-approval provided the nonconformities, which resulted in cancellation, have been corrected and that ABS is able to confirm that the corrective action has been effectively implemented.

8 Detailed Requirements by Ambient Environmental Aspect

8.1 Whole-body Vibration

8.1.1 Extent of Engagement

Whole-body vibration measurement Testing Specialists are engaged to conduct vibration measurements and analyses onboard vessels.

8.1.2 Supervisor (1 February 2016)

The supervisor shall:

- i) be qualified to Level II according to a recognized national or international Nondestructive Testing (NDT) standard (ANSI/ASNT CP-189, ISO 9712 or EN 473) or
- ii) have a documented history of at least one (1) year supervising and of at least two (2) years performing vibration testing onboard marine vessels.

The supervisor shall have sufficient knowledge of vessel structures and equipment, measurement, and analysis of whole-body vibration according to ISO 6954, to verify that test procedures are compliant with the required test conditions.

8.1.3 Test Personnel (1 February 2016)

The test personnel carrying out the measurements shall:

- i) be qualified to Level I according to a recognized national or international Nondestructive Testing (NDT) standard (ANSI/ASNT CP-189, ISO 9712 or EN 473) or

- ii) have a documented history of one (1) year experience in performing vibration environmental testing onboard marine vessels.
- iii) have knowledge in the field of vibration, vibration measurements and handling of measurement equipment. In addition, be able to document theoretical and practical training onboard in using a vibration transducer.
- iv) have adequate knowledge of vessel structures and equipment.

8.1.4 Equipment (1 February 2016)

ABS shall verify that the equipment to be used is in accordance with the applicable measurement standard. It shall be demonstrated to ABS that it is fit for the intended purpose. Whole Body Vibration measurement shall be taken using an instrument manufactured to ISO 8041:2005, as amended, type/class (1) standard then frequency weighted and analyzed in accordance with ISO 6954:2000, as amended. It is desirable to employ equipment that records and stores acceleration time histories.

Portable calibrators shall comply with an international or national standard.

Calibration of the vibration transducer and of the portable calibrator, is to be 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.

8.1.5 Procedures

Documented work procedures or test instructions are to contain, at a minimum, information about the following:

- i) Test preparation
- ii) Selection and identification of measurement locations
- iii) Surface preparation
- iv) Calibration checks
- v) Testing methods
- vi) Equipment handling
- vii) Report preparation and content
- viii) Method for handling previous results if subsequent calibration shows instruments to be out of tolerance

8.1.6 Reporting

The report shall be based on the instructions given in Subsection 3/8, “Test Report”.

8.1.7 Access to Documents (1 February 2016)

The Testing Specialist shall have access to the following documents:

- 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.
- ABS Crew Habitability Guides

8.2 Noise

8.2.1 Extent of Engagement

Noise measurement Testing Specialists are engaged to conduct noise measurements and analyses onboard vessels.

8.2.2 Supervisor (1 February 2016)

The supervisor shall:

- i) be qualified to Level II according to a recognized national or international Nondestructive Testing (NDT) standard (ANSI/ASNT CP-189, ISO 9712 or EN 473) or
- ii) have a documented history of at least one (1) year supervising and of at least two (2) years performing noise testing onboard marine vessels.

The supervisor shall have sufficient knowledge of vessel structures, measuring equipment, ISO 2923, IEC 61672-1, and IMO Res. MSC.337(91) to verify that test procedures are compliant with the required test conditions.

8.2.3 Test Personnel (1 February 2016)

The test personnel carrying out the measurements shall:

- i) be qualified to Level I according to a recognized national or international Nondestructive Testing (NDT) standard (ANSI/ASNT CP-189, ISO 9712 or EN 473) or
- ii) have a documented history of one (1) year experience in performing noise testing onboard marine vessels including participation in a minimum of 5 measurement campaigns as an assistant test personnel.
- iii) have knowledge in the field of noise, sound measurements and handling of measurement equipment. In addition, be able to document theoretical and practical training onboard in using a sound level meter.
- iv) have adequate knowledge of the applicable international requirements (SOLAS Regulation II-1/3-12, as amended, and IMO Code on noise levels onboard Ships, as amended) and the requisite ABS Crew Habitability Guides
- v) have training concerning the procedures specified in IMO Code on Noise Level.
- vi) have adequate knowledge of vessel structures and equipment.

8.2.4 Equipment (1 February 2016)

ABS shall verify that the equipment to be used is in accordance with the applicable measurement standard. It shall be demonstrated to ABS that it is fit for the intended purpose. Noise measurement shall be taken using an integrating-averaging sound level meter manufactured to IEC 61672-1:2013, as amended, type/class (1) standard.

When used alone, or in conjunction with a sound level meter, as appropriate, an octave filter set shall conform to IEC 61260-1:2014, as amended, standard.

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.

Calibration of the sound level meter and of the sound calibrator, is to be conducted at least every two (2) years by an accredited Testing and Calibration Laboratory accredited according to ISO 17025:2005, as amended.

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

8.2.5 Procedures

Documented work procedures or test instructions are to contain, at a minimum, information about the following:

- i) Test preparation

- ii)* Selection and identification of measurement locations
- iii)* Surface preparation
- iv)* Calibration checks
- v)* Testing methods
- vi)* Equipment handling
- vii)* Report preparation and content
- viii)* Method for handling previous results if subsequent calibration shows instruments to be out of tolerance

8.2.6 Reporting

The report shall be based on the instructions given in Subsection 4/8, “Test Report”.

8.2.7 Access to Documents (1 February 2016)

The Testing Specialist shall have access to the following documents:

- SOLAS 1974, as amended (Reg.II-1/3-12)
- Resolution A.468(XII) and IMO Resolution MSC.337(91) code on noise levels on board ships
- Resolution A.343(IX) Recommendation on methods of measuring noise levels at listening posts
- ABS Crew Habitability Guides

8.3 Indoor Climate

8.3.1 Extent of Engagement

Indoor climate measurement Testing Specialists are engaged to conduct indoor climate measurements and analyses onboard vessels.

8.3.2 Supervisor (1 February 2016)

The supervisor shall:

- i)* be qualified to Level II according to a recognized national or international Nondestructive Testing (NDT) standard (ANSI/ASNT CP-189, ISO 9712 or EN 473) or
- ii)* have a documented history of at least one (1) year supervising and of at least two (2) years performing ambient environmental testing onboard marine vessels.

The supervisor shall have sufficient knowledge of vessel structures, measuring equipment, ANSI/ASHRAE 55-2013 as well as ISO 7726 and ISO 7547, to verify that test procedures are compliant with the required test conditions.

8.3.3 Test Personnel (1 February 2016)

The test personnel carrying out the measurements shall:

- i)* be qualified to Level I according to a recognized national or international Nondestructive Testing (NDT) standard (ANSI/ASNT CP-189, ISO 9712 or EN 473) or
- ii)* have a documented history of one (1) year experience in performing ambient environmental testing onboard marine vessels.
- iii)* have knowledge in the field of indoor climate, indoor climate measurements and handling of measurement equipment.
- iv)* have adequate knowledge of vessel structures and equipment.

8.3.4 Equipment (1 February 2016)

ABS shall verify that the equipment to be used is in accordance with the applicable measurement standard. It shall be demonstrated to ABS that it is fit for the intended purpose. Indoor Climate measurement shall be taken using an instrument manufactured to meet or exceed the minimum characteristics of instruments for measuring physical quantities characterizing an environment specified in ISO 7726:1998, as amended, or those of an equivalent standard.

Calibration of the measuring instrument is to be 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.

8.3.5 Procedures

Documented work procedures or test instructions are to contain, at a minimum, information about the following:

- i) Test preparation
- ii) Selection and identification of measurement locations
- iii) Surface preparation, if applicable
- iv) Testing methods
- v) Equipment handling
- vi) Report preparation and content
- vii) Method for handling previous results if subsequent calibration shows instruments to be out of tolerance

8.3.6 Reporting

The report shall be based on the instructions given in Subsection 5/8, “Test Report”.

8.3.7 Access to Documents (1 February 2016)

The Testing Specialist shall have access to the following documents:

- ANSI/ASHRAE 55-2013, Thermal Environmental Conditions for Human Occupancy
- ISO 7726:1998, Ergonomics of the Thermal Environment – Instruments for Measuring Physical Quantities
- ABS Crew Habitability Guides

8.4 Lighting

8.4.1 Extent of Engagement

Lighting measurement Testing Specialists are engaged to conduct illuminance measurements and analyses onboard vessels.

8.4.2 Supervisor (1 February 2016)

The supervisor shall:

- i) be qualified to Level II according to a recognized national or international Nondestructive Testing (NDT) standard (ANSI/ASNT CP-189, ISO 9712 or EN 473) or
- ii) have a documented history of at least one (1) year supervising and of at least two (2) years performing ambient environmental testing onboard marine vessels.

The supervisor shall have sufficient knowledge of vessel structures, measuring equipment, ISO 8995:2002 and DIN EN 12464-1:2011 to verify that test procedures are compliant with the required test conditions.

8.4.3 Test Personnel (1 February 2016)

The test personnel carrying out the measurements shall:

- i)* be qualified to Level I according to a recognized national or international Nondestructive Testing (NDT) standard (ANSI/ASNT CP-189, ISO 9712 or EN 473) or
- ii)* have a documented history of one (1) year experience in performing ambient environmental testing onboard marine vessels.
- iii)* have knowledge in the field of lighting, illuminance level measurements and handling of measurement equipment.
- iv)* have adequate knowledge of vessel structures and equipment.

8.4.4 Equipment (1 February 2016)

ABS shall verify that the equipment to be used is in accordance with the applicable measurement standard. It shall be demonstrated to ABS that it is fit for the intended purpose. Lighting measurement shall be taken using an illuminance meter conforming to any of the International Standards specified below (or equivalent):

- DIN 5032-7:1985 (Class A)
- CIE S 023/E:2013 (ISO/CIE 19476:2014)
- BS 667:2005 (Type F)

Calibration of the illuminance meter is to be 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.

8.4.5 Procedures

Documented work procedures or test instructions are to contain, at a minimum, information about the following:

- i)* Test preparation
- ii)* Selection and identification of measurement locations
- iii)* Surface preparation
- iv)* Calibration checks
- v)* Testing methods
- vi)* Equipment handling
- vii)* Report preparation and content
- viii)* Method for handling previous results if subsequent calibration shows instruments to be out of tolerance

8.4.6 Reporting

The report shall be based on the instructions given in Subsection 6/8, "Test Report".

8.4.7 Access to Documents (1 February 2016)

The Testing Specialist shall have access to the following document:

- ABS Crew Habitability Guides

APPENDIX 3

Accommodation Area Criteria (1 February 2016)

The accommodation area criteria are contained in Appendix A3, “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 A3 “Accommodation Area Criteria”.

To use the tables in Appendix A3, first determine which notation is being requested: **HAB(WB)**, **HAB+(WB)**, or **HAB++(WB)**.

- For a **HAB(WB)** notation, the unshaded boxes under “Meets **HAB(WB)** Requirements” must be met.
- For a **HAB+(WB)** notation, the unshaded boxes under “Meets **HAB+(WB)** Requirements” need to be met as well as **HAB(WB)** requirements.
- For a **HAB++(WB)** notation, the unshaded boxes under “Meets **HAB++(WB)** Requirements” need to be met as well as **HAB(WB)** requirements and **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.

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

* Note: tons = Gross Tonnage

Instructions: For a **HAB(WB)** notation, the unshaded boxes under “Meets **HAB(WB)** Requirements” must be met. For a **HAB+(WB)** notation, the unshaded boxes under “Meets **HAB+(WB)** Requirements” need to be met as well as **HAB(WB)** requirements. For a **HAB++(WB)** notation, the unshaded boxes under “Meets **HAB++(WB)** Requirements” need to be met as well as **HAB(WB)** requirements and **HAB+(WB)** Requirements.

<i>Accommodation Area Criteria</i>				
<i>General</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+(WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
# 1	Headroom in all passageways, sleeping rooms, stairs, sanitary spaces, offices, food service areas, and recreational areas is at least 2030 mm (80.0 in.). This height is clear of any obstructions such as cableways, ducting, pipes, etc.			
2	Non-slip type deck covering is supplied where occasional water, oil or liquid on the floors is expected.			
3	Outside corners of bulkheads, doors, etc. are rounded.			
4	All edges that crew members may strike are rounded.			
5	Drawers and internal doors are designed:			
	• to prevent opening and closing due to vessel motion			
	• to be operable with one hand			
# 6	Painted wall surfaces and deck heads are light in color.			
7	Interior finish materials and furnishings are designed to ease cleaning efforts and improve maintenance.			
8	For work stations where seafarers will be working while standing for extended periods of time, a kick space of 100 mm (4 in.) high by 100 mm (4 in.) deep shall be provided			
9	Toilets are conveniently located to workplace, recreation areas, mess rooms, and shower rooms.			
10	A means of escape that is not readily apparent to a person from both the inside and outside of the space is adequately marked.			
# 11	Wall surfaces and decks are washable and impervious to damp or moisture absorption.			
# 12	For accommodation areas and recreational facilities where the floorings are made of composite materials, the joints with the sides shall be profiled to avoid crevices			
# 13	Accommodation areas and recreational and catering facilities shall be located as far as practicable from the engines, steering gear rooms, deck winches, ventilation, heating, and air-conditioning equipment, and other noisy machinery and apparatus.			

Instructions: For a **HAB(WB)** notation, the unshaded boxes under “Meets **HAB(WB)** Requirements” must be met. For a **HAB+(WB)** notation, the unshaded boxes under “Meets **HAB+(WB)** Requirements” need to be met as well as **HAB(WB)** requirements. For a **HAB++(WB)** notation, the unshaded boxes under “Meets **HAB++(WB)** Requirements” need to be met as well as **HAB(WB)** requirements and **HAB+(WB)** Requirements.

<i>Accommodation Area Criteria</i>				
<i>Access/Egress</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets HAB+</i> (WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
GENERAL				
1	Doors, hatches, or scuttles used as a means of escape are capable of being operated by one person, from either side, in both light and dark conditions.			
2	The method of opening a means of escape is obvious and rapid.			
3	Doors in accommodation spaces (with the exception of cabins), stairway, stair tower, passageway, or control spaces, open in the direction of escape, where practicable.			
4	Deck scuttles that serve as a means of escape are fitted with a quick acting release and a holdback device to hold the scuttle in an open position.			
5	High voltage electrical cabinet doors are lockable with keys provided to qualified personnel.			
DOOR DIMENSIONS				
6	Doors have the following dimensions:			
	<ul style="list-style-type: none"> doors (other than emergency egress) used solely by crew members have a clear opening width of approximately 710 mm (28 in.) or ASTM size 4 doors 			
	<ul style="list-style-type: none"> the distance from the deck to the top of the door is at least 1900 mm (75 in.) 			
	<ul style="list-style-type: none"> the distance from the deck to the top of the door is at least 1980 mm (78 in.). 			
RAILINGS				
7	Suitable storm rails/handrails are provided in all interior passageways and at all deckhouse sides where persons onboard might have normal access:			
	<ul style="list-style-type: none"> storm rails/handrails are installed on both sides of passageways that are 1830 mm (72 in.) or more in width 			
	<ul style="list-style-type: none"> storm rails/handrails are 865 mm (34 in.) to 965 mm (38 in.) high 			
	<ul style="list-style-type: none"> the distance between/or behind storm rails/handrails and any obstruction is 75 mm (3 in.) or greater. 			
8	Rails are installed parallel to the deck along deck edges and walkways and around open hatches, elevators, antenna platforms and along other boundaries in the following areas:			

<i>Accommodation Area Criteria</i>				
<i>Access/Egress</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets HAB(WB) Requirements</i>	<i>Meets HAB+ (WB) Requirements</i>	<i>Meets HAB++(WB) Requirements</i>
	<ul style="list-style-type: none"> wherever there is danger of crew members falling to a lower level of 600 mm (23.5 in.) or more in the vessel 			
	<ul style="list-style-type: none"> wherever there is danger of crew members becoming enmeshed with hazardous operating machinery 			
	<ul style="list-style-type: none"> around unprotected openings with a coaming height below 760 mm (30 in.) 			
	<i>Note:</i> Temporary rails can be used around unprotected openings into which a person may slip, trip or fall.			
9	Deck/guard railings have the following design:			
	<ul style="list-style-type: none"> the heights of rails or bulwarks are at least 1000 mm (39.5 in.) from the deck except where this height would interfere with the normal operation of the vessel, and toeboards which are at least 100 mm (4.0 in) in height and have no more than a 6 mm (0.25 in.) clearance between the bottom edge of the toeboard and the walking surface 			
	<ul style="list-style-type: none"> the heights of rails are at least 1070 mm (42 in.) from the deck except where this height would interfere with the normal operation of the vessel and toeboards which are at least 100 mm (4.0 in) in height and have no more than a 6 mm (0.25 in.) clearance between the bottom edge of the toeboard and the walking surface 			
	<ul style="list-style-type: none"> vertical stanchions for railings are spaced no more than 1525 mm (60 in.) apart horizontally 			
	<ul style="list-style-type: none"> at least every third vertical stanchion is supported by a bracket or stay 			
	<ul style="list-style-type: none"> chain or wire rope used as a rail is set such that the sag is not greater than 25 mm (1 in.) at the chain/rope's centerspan 			
	<ul style="list-style-type: none"> maximum lengths of openings protected by wire or chain are 1830 mm (72 in.). A removable stanchion will constitute the start of a new opening. 			
STAIRS				
10	A clear landing at least as wide as the tread width and a minimum of 915 mm (36 in.) long is provided at the top and bottom of each stairway.			

<i>Accommodation Area Criteria</i>				
<i>Access/Egress</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets HAB(WB) Requirements</i>	<i>Meets HAB+ (WB) Requirements</i>	<i>Meets HAB++(WB) Requirements</i>
11	Any change of direction in a stairway is accomplished by means of an intermediate landing at least as wide as the tread width and a minimum of 915 mm (36 in.) long.			
12	An intermediate landing is provided at each deck level serviced by a stair, or a maximum of every 3600 mm (144 in.) of vertical travel for stairs with a vertical rise of 6100 mm (240 in.).			
13	Accommodation area stairways have a maximum angle of inclination from the horizontal of:			
	• 50 degrees			
	• 45 degrees			
	• 40 degrees			
14	Stair risers and treads have the following design:			
	• the riser height is no more than 230 mm (9 in.) and the tread depth is approximately 190 mm (7.5 in.), with an additional 25 mm (1 in.) tread nosing			
	• the riser height is no more than 230 mm (9 in.) and the tread depth is approximately 230 mm (9 in.), with an additional 25 mm (1 in.) tread nosing			
	• the riser height is no more than 230 mm (9 in.) and the tread depth is approximately 275 mm (10.75 in.), with an additional 25 mm (1 in.) tread nosing			
	• stairs in a stairway or stair tower, the depth of the tread and the height of riser are consistent			
	• the minimum tread width on one-way (one person) stairs is at least 610 mm (24 in.)			
	• the minimum tread width on two-way (two person) stairs is at least 915 mm (36 in.)			
	• the minimum tread width on two-way (two person) stairs is at least 1,015 mm (40 in.)			
	• once a minimum tread width has been established at any deck, in that stair run, it is not decreased in the direction of escape			
	• all nosings have a non-slip surface			
15	Stairway or stair towers are fitted with handrails with the following design:			

<i>Accommodation Area Criteria</i>				
<i>Access/Egress</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets HAB(WB) Requirements</i>	<i>Meets HAB+ (WB) Requirements</i>	<i>Meets HAB++(WB) Requirements</i>
	<ul style="list-style-type: none"> a handrail is provided on one side of the stair 			
	<ul style="list-style-type: none"> a handrail is provided on both sides of the stair 			
	<ul style="list-style-type: none"> the handrails are parallel to the pitch line of the stair flight and level at landings 			
	<ul style="list-style-type: none"> the handrail is continuous from the top to the bottom of the stair and terminates in a safe manner at both ends 			
	<ul style="list-style-type: none"> the vertical height above the tread at its nosing is at least 940 mm (37 in.) to 990 mm (39 in.) 			
	<ul style="list-style-type: none"> the distance between handrails and any obstruction is 75 mm (3 in.) or greater 			
	<ul style="list-style-type: none"> handrails on adjacent, parallel stair flights have a minimum of 100 mm (4 in.) clear distance between rails. 			
LADDERS				
16	All inclined ladders and handrails are located so as not to interfere with the opening and closing of hatches, doors, gratings, or other types of access; in all areas of the vessel other than accommodation block.			
17	Inclined ladders are between 50° and 60° from the horizontal.			
18	Each vertical ladder used as a means of escape has the following design features:			
	<ul style="list-style-type: none"> the ladder is mounted at least 180 mm (7 in.) from the nearest permanent object in the back of the ladder (distance behind each rung) 			
	<ul style="list-style-type: none"> rungs are at least 410 mm (16 in.) in width 			
	<ul style="list-style-type: none"> rungs are between 275 mm (11 in.) and 300 mm (12 in.) apart 			
	<ul style="list-style-type: none"> rungs are uniformly spaced for the length of the ladder. 			
	<ul style="list-style-type: none"> at least 760 mm (30 in.) clearance in front of the ladder (climbing space) 			
	<ul style="list-style-type: none"> each ladder rung is skid/slip resistant. 			
	<ul style="list-style-type: none"> grab bars are provided that extend at least 1070 mm (42 in.) above the landing platform. 			

<i>Accommodation Area Criteria</i>				
<i>Access/Egress</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets HAB(WB) Requirements</i>	<i>Meets HAB+ (WB) Requirements</i>	<i>Meets HAB++(WB) Requirements</i>
19	Ladder landings at the top and bottom of inclined ladders:			
	• at least 760 mm (30 in.) clear in length			
	• at least 915 mm (36 in.) clear in length.			
RAMPS				
20	Ramps are sloped < 15 degrees for inclined walking surfaces			
21	Ramps have a non-skid surface.			
22	Ramps have a handrail on any open side of the ramp if the distance from the ramp to the nearest adjacent surface is 600 mm (23.5 in.) or more.			
23	Access to lifeboats is provided such that a person in a stretcher can be easily embarked into the survival craft (e.g., ramp)			
PASSAGEWAY/WALKWAY DESIGN				
24	The clear walkway width for one person in an unrestricted area, where two persons could pass is at least 710 mm (28 in.).			
25	The clear walkway width for normal two-way traffic or any means of egress that leads to an exit or entrance is at least 915 mm (36 in.).			
26	The clear walkway width for normal two-way traffic or any means of egress that leads to an exit or entrance is at least 1015 mm (40 in.).			

Instructions: For a **HAB(WB)** notation, the unshaded boxes under “Meets **HAB(WB)** Requirements” must be met. For a **HAB+(WB)** notation, the unshaded boxes under “Meets **HAB+(WB)** Requirements” need to be met as well as **HAB(WB)** requirements. For a **HAB++(WB)** notation, the unshaded boxes under “Meets **HAB++(WB)** Requirements” need to be met as well as **HAB(WB)** requirements and **HAB+(WB)** Requirements.

<i>Accommodation Area Criteria</i>				
<i>Crew Cabins</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets HAB(WB) Requirements</i>	<i>Meets HAB+(WB) Requirements</i>	<i>Meets HAB++(WB) Requirements</i>
NON-SPECIAL PURPOSE SHIP FLOOR AREA FOR VARIOUS VESSEL SIZES				
	< 3,000 tons	3,000 to 10,000 tons	Over 10,000 tons	
One Person Room (seafarers not performing the duties of officers)				

Accommodation Area Criteria							
Crew Cabins							
Requirement # = Related to ILO MLC 2006, Title 3 Requirement					Meets HAB(WB) Requirements	Meets HAB+(WB) Requirements	Meets HAB++(WB) Requirements
#	1	4.5 m ² (48.5 ft ²)	5.5 m ² (60 ft ²)	7.0 m ² (75 ft ²)			
		5.5 m ² (60 ft ²)	6.5 m ² (70 ft ²)	7.5 m ² (80.5 ft ²)			
		6.5 m ² (70 ft ²)	7.5 m ² (80.5 ft ²)	8.5 m ² (91.5 ft ²)			
Two Person Room (seafarers not performing the duties of officers)							
#	2	7.0 m ² (75 ft ²)	7.0 m ² (75 ft ²) *	7.0 m ² (75 ft ²) *			
		7.5 m ² (80.5 ft ²)	8.0 m ² (86 ft ²) *	8.0 m ² (86 ft ²) *			
		8.0 m ² (86 ft ²)	9.0 m ² (97 ft ²) *	9.0 m ² (97 ft ²) *			
		Note: * Only if allowed by the flag State.					
Junior Officer and Senior Officer (where no private sitting/day room is provided) – One Person Room							
#	3	7.5 m ² (80.5 ft ²)	8.5 m ² (91.5 ft ²)	10 m ² (107.5 ft ²)			
Junior Officer – Two Person Room							
	4	9.0 m ² (97 ft ²)	10.0 m ² (107.5 ft ²)	11.5 m ² (127 ft ²)			
SPECIAL PURPOSE SHIP FLOOR AREA FOR VARIOUS VESSEL SIZES							
		< 3,000 tons	3,000 to 10,000 tons	Over 10,000 tons			
One Person Room (seafarers not performing the duties of officers)							
#	5	4.5 m ² (48.5 ft ²)	5.5 m ² (60 ft ²)	7.0 m ² (75 ft ²)			
		5.5 m ² (60 ft ²)	6.5 m ² (70 ft ²)	7.5 m ² (80.5 ft ²)			
		6.5 m ² (70 ft ²)	7.5 m ² (80.5 ft ²)	8.5 m ² (91.5 ft ²)			
Two Person Room (seafarers not performing the duties of officers)							
#	6	7.5 m ² (80.5 ft ²)	7.5 m ² (80.5 ft ²)	7.5 m ² (80.5 ft ²)			
		8.5 m ² (91.5 ft ²)	8.5 m ² (91.5 ft ²)	8.5 m ² (91.5 ft ²)			
		9.5 m ² (102.5 ft ²)	9.5 m ² (102.5 ft ²)	9.5 m ² (102.5 ft ²)			

Accommodation Area Criteria							
Crew Cabins							
Requirement # = Related to ILO MLC 2006, Title 3 Requirement					Meets HAB(WB) Requirements	Meets HAB+(WB) Requirements	Meets HAB++(WB) Requirements
Three Person Room (seafarers not performing the duties of officers)							
#	7	11.5 m ² (124 ft ²)	11.5 m ² (124 ft ²)	11.5 m ² (124 ft ²)			
		12.5 m ² (134.5 ft ²)	12.5 m ² (134.5 ft ²)	12.5 m ² (134.5 ft ²)			
		13.5 m ² (145.5 ft ²)	13.5 m ² (145.5 ft ²)	13.5 m ² (145.5 ft ²)			
Four Person Room (seafarers not performing the duties of officers)							
#	8	14.5 m ² (156 ft ²)	14.5 m ² (156 ft ²)	14.5 m ² (156 ft ²)			
		15.5 m ² (167 ft ²)	15.5 m ² (167 ft ²)	15.5 m ² (167 ft ²)			
		16.5 m ² (177.5 ft ²)	16.5 m ² (177.5 ft ²)	16.5 m ² (177.5 ft ²)			
Five Person or more (seafarers not performing the duties of officers)							
#	9	3.6 m ² (38.8 ft ²) per person					
Junior Officer (where no private sitting/day room is provided) – One Person Room							
#	10	7.5 m ² (80.5 ft ²)	7.5 m ² (80.5 ft ²)	7.5 m ² (80.5 ft ²)			
Junior Officer – Two Person Room							
#	11	9 m ² (97 ft ²)	9 m ² (97 ft ²)	9 m ² (97 ft ²)			
Senior Officer (where no private sitting/day room is provided)							
#	12	8.5 m ² (91.5 ft ²)	8.5 m ² (91.5 ft ²)	8.5 m ² (91.5 ft ²)			
OCCUPANCY LEVEL							
#	13	Individual berths are provided for each crew member.					
	14	Individual sleeping rooms are provided (as appropriate) for:					
		• The Master					
		• The Chief Engineer					
	15	For non-Special Purpose Ships, when practicable, due to the size of the vessel, individual sleeping rooms are provided for:					
		• Officers					
		• Ratings					

<i>Accommodation Area Criteria</i>				
<i>Crew Cabins</i>				
	<i>Requirement</i> # = <i>Related to ILO MLC 2006, Title 3 Requirement</i>	<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+(WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
16	For Special Purpose Ships, when practicable, due to the size of the vessel, individual sleeping rooms are provided for:			
	• Officers			
# 17	Separate sleeping rooms shall be provided for men and for women.			
# 18	Crew members sharing rooms are in same occupation group and day persons do not share a room with watch-keepers.			
19	Maximum number of persons to be accommodated in any sleeping room is marked indelibly and legibly in some conveniently seen place:			
	• in the room			
	• outside the room.			
CREW CABIN LOCATION				
20	Location, means of access, structure and arrangement in relation to other spaces of crew accommodation areas is to:			
	• provide adequate security			
	• protect against weather and sea			
	• insulate from heat and cold			
	• insulate from undue noise and effluvia (odors) from other spaces.			
# 21	There is no direct communication into sleeping areas from cargo areas, machinery spaces, chain lockers, galleys, lamp and paint rooms or from engine, deck and other bulk storerooms, drying rooms, communal wash places or water closets.			
22	Crew quarters are not located:			
	• further forward in the vessel than a vertical plane located at 5 percent of the vessel's length abaft of the forward side of the stem at the designed summer load water line			
#	• immediately beneath working alleyways			
#	• below load line amidships or aft, unless satisfactory arrangements are made for lighting and ventilation and approved by the flag Administration			
#	• forward of the collision bulkhead.			
ROOM DESIGN				

<i>Accommodation Area Criteria</i>				
<i>Crew Cabins</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets HAB(WB) Requirements</i>	<i>Meets HAB+(WB) Requirements</i>	<i>Meets HAB++(WB) Requirements</i>
General				
# 23	Internal bulkheads are of approved material that is not likely to harbor vermin.			
24	Wall surfaces are not constructed from tongued and grooved boarding or any other form of construction likely to harbor vermin.			
# 25	Where practicable a sitting or day room, adjoining the sleeping room is provided for the Master, Chief Engineer, the Chief Navigating officer and the Second Engineer Officer (ships of less than 3,000 tons may be exempted from this requirement).			
26	Pipes, ventilation ducts, or other installations do not obstruct berths.			
27	Sleeping rooms are ventilated and heated.			
28	HVAC vents shall not be directed at the heads of berths.			
29	Radiators and other heating apparatus are so placed and, where necessary, shielded as to avoid risk of fire or danger or discomfort to the occupants.			
Berths				
30	Multi-crew cabin berths are not side by side so that access to one berth can only be obtained over another.			
31	Berths are generally oriented fore and aft			
32	Multi-crew cabin berths contain individually operated privacy curtains			
33	Multi-crew cabin berths contain individually operated fans/blowers.			
# 34	Multi-crew cabin arrangements are either single tier or double tiered.			
# 35	Multi-crew cabin berths with portlights above them are only allowed in a single tier arrangement.			
Emergency				
36	An emergency alerting system (e.g., an audible alarm) is present for all crew cabin spaces.			
Outfitting				
# 37	Sleeping rooms with portlights, have curtains that completely block out light.			

Accommodation Area Criteria					
Crew Cabins					
Requirement # = Related to ILO MLC 2006, Title 3 Requirement			Meets HAB(WB) Requirements	Meets HAB+(WB) Requirements	Meets HAB++(WB) Requirements
#	38	Sleeping rooms are lighted with natural light and are provided with artificial light (subject to special arrangements as may be permitted in special purpose ships).			
	39	Grab bars and stepping surfaces are provided for access to upper berths.			
#	40	An electric reading light is provided at the head of each berth.			
#	41	The top berth in a tier has a dust-proof bottom of wood, canvas, or other suitable material.			
	42	In sleeping rooms with more than one occupant, furniture (beds, lockers, drawers, etc.) are labeled identifying which furniture is dedicated to which berth.			
	43	Each sleeping room is provided with at least the following furniture (in addition to berths and clothes lockers):			
#		• a table or desk			
#		• chair			
#		• a mirror with a light			
#		• a small cabinet for toilet requisites for each person in the room			
#		• a book rack			
#		• coat hooks.			
#	44	Furniture is of smooth, hard material not liable to warp or corrode.			
#	45	In vessels regularly trading to mosquito-infested ports, suitable screens are fitted to all ventilation inlets and doors to the open deck.			
DIMENSIONAL ASPECTS					
Aisles					
	46	Aisle widths in sleeping areas are:			
		• at least 610 mm (24 in.), between a single berth and the nearest obstruction			
		• at least 915 mm (36 in.), between facing berths			
Berths					
#	47	The lower berth in a tier is at least 300 mm (12 in.) above the deck.			

Accommodation Area Criteria					
Crew Cabins					
Requirement # = Related to ILO MLC 2006, Title 3 Requirement			Meets HAB(WB) Requirements	Meets HAB+(WB) Requirements	Meets HAB++(WB) Requirements
#	48	The upper berth is placed approximately midway between the bottom of the lower berth and the lower side of the deck head beams.			
	49	Head clearance above each berth is:			
		• at least 610 mm (24 in.)			
		• at least 810 mm (32 in.)			
	50	Berth inside dimensions are:			
#		• at least 1980 mm (78 in.) by 800 mm (31.5 in.)			
		• at least 2030 mm (80 in.) by 965 mm (38 in.)			
#	51	The framework and leeboard of a berth is of approved material, hard, smooth and not likely to corrode or to harbor vermin.			
#	52	Berths constructed from tubular frames are completely sealed and without perforations which would give access to vermin.			
Storage Space					
	53	Sleeping rooms provide storage space for each occupant:			
		• the clothes locker is fitted with a shelf and hasp			
#		• the clothes locker is at least 0.475 m ³ (16.75 ft ³),			
#		• a drawer or equivalent space of at least 56 liters; if the drawer is incorporated in the clothes locker then the combined minimum volume of the clothes locker shall be 500 liters; it shall be fitted with a shelf and be able to be locked by the occupant so as to provide privacy.			
	54	Accommodation areas for the hanging of oilskins (wet weather gear) are:			
		• sufficient			
		• adequately ventilated			
		• provided outside but convenient to the sleeping rooms.			

Instructions: For a **HAB(WB)** notation, the unshaded boxes under "Meets **HAB(WB)** Requirements" must be met. For a **HAB+(WB)** notation, the unshaded boxes under "Meets **HAB+(WB)** Requirements" need to be met as well as **HAB(WB)** requirements. For a **HAB++(WB)** notation, the unshaded boxes under "Meets **HAB++(WB)** Requirements" need to be met as well as **HAB(WB)** requirements and **HAB+(WB)** Requirements.

<i>Accommodation Area Criteria</i>				
<i>Sanitary Spaces</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+(WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
GENERAL				
1	Sanitary spaces are:			
#	• lighted			
#	• heated			
#	• ventilated.			
2	Floors in sanitary spaces are:			
#	• non-slip type deck covering			
#	• easily cleaned			
#	• impervious to damp or moisture absorption			
#	• properly drained			
3	For every six crew members who do not have a private sanitary space, there is:			
#	• one or more tubs and/or shower baths			
#	• one or more toilets			
#	• washbasins.			
4	Where the radio officers or operators are accommodated in an isolated position, sanitary facilities are provided near or adjacent thereto.			
5	Someone standing on a wet deck in sanitary spaces cannot reach light switches or electrical outlets without ground fault interrupters (GFI).			
6	Common/Shared spaces are gender identifiable without entering the space.			
# 7	Separate multiple occupancy sanitary spaces are provided for men and women.			
8	Bulkheads in sanitary spaces are:			
#	• steel or other approved material			
#	• watertight up to 230 mm (9 in.) above deck level.			
9	A public sanitary facility shall be situated near the ship's office(s) if the office(s) is not conveniently located near the navigation bridge.			
	Note: In this context, near is defined as being on the same deck or on the deck below (or above) adjacent to the stairway			

Accommodation Area Criteria					
Sanitary Spaces					
Requirement # = Related to ILO MLC 2006, Title 3 Requirement			Meets HAB(WB) Requirements	Meets HAB+(WB) Requirements	Meets HAB++(WB) Requirements
#	10	All sanitary spaces shall have ventilation to the open air, independently of any other part of the accommodation areas			
	11	Free space (space available for movement without hindrance of any objects) in a common sanitary space per person is:			
		• at least 0.75 m ² (8 ft ²)			
		• at least 1.1 m ² (12 ft ²)			
	12	Single or double occupancy sleeping rooms have a private sanitary space with a toilet, shower or tub and sink modules.			
GENERAL – BASED ON VESSEL'S SIZE					
	13	On vessels over 1,600 tons, a toilet and washbasin having hot and cold running potable water is within easy access of the:			
#		• navigation bridge deck and primarily for those on duty in the area			
#		• machinery space if not fitted near the engine room control center.			
		• galley/mess room(s)			
		• recreation room(s)			
		• gymnasium			
		Note: In this context, easy access is defined as being on the same deck or on the deck below (or above) adjacent to the stairway			
	14	On vessels over 1,600 tons, without private or semi-private sleeping rooms or sanitary spaces, clothes changing facilities are provided for engine department personnel. These facilities are:			
#		• outside but within easy access of the machinery space and navigating bridge			
#		• fitted with individual lockers			
#		• fitted with tubs and/or showers and washbasins.			
	15	In vessels between 5,000 and 15,000 tons, at least five officers have sleeping rooms with an attached private sanitary space with a toilet, tub and/or shower and washbasin. The washbasin may be in the sleeping room.			

<i>Accommodation Area Criteria</i>				
<i>Sanitary Spaces</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+(WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
16	In vessels between 10,000 and 15,000 tons, all officers without private sanitary spaces have private intercommunicating sanitary spaces fitted with a toilet, tub and/or shower and washbasin.			
17	In vessels over 15,000 tons, all officers have sleeping rooms with an attached private sanitary space fitted with a toilet, tub and/or shower and washbasin. The washbasin may be in the sleeping room.			
18	In vessels over 25,000 tons, a sanitary space is provided for every two ratings, either in an intercommunicating space between adjoining sleeping rooms or opposite the entrance of such rooms. The sanitary spaces are fitted with a toilet, tub and/or shower and washbasin.			
# 19	Each sleeping room (both officer and rating) is provided with a washbasin with hot and cold running potable water (except when a private sanitary space is provided).			
SHOWERS/BATHS				
20	Water heaters supplying showers:			
	<ul style="list-style-type: none"> do not support areas that have higher water temperature requirements, such as food service areas 			
	<ul style="list-style-type: none"> are provided with anti-scalding devices. 			
21	Handholds are provided for shower and bath sanitary spaces.			
22	In sanitary spaces intended for more than one person, the shower is screened.			
TOILETS				
23	Where there is more than one toilet in a space, they are sufficiently screened to provide privacy.			
24	All toilets:			
	<ul style="list-style-type: none"> have flush water available at all times 			
	<ul style="list-style-type: none"> are independently controllable 			
	<ul style="list-style-type: none"> have a hand washing station. 			
25	Toilets, intended for more than one crew member, are situated convenient to, but separate from, sleeping rooms and wash rooms without direct access from:			
#	<ul style="list-style-type: none"> the sleeping rooms 			

<i>Accommodation Area Criteria</i>				
<i>Sanitary Spaces</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+(WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
#	<ul style="list-style-type: none"> toilets to which there is no other access. (This requirement does not apply where a toilet is located in a space between two sleeping rooms having a total of not more than four persons.) 			
26	All toilet spaces shall be ventilated sufficiently to be reasonably free of disagreeable odors and condensation.			
WASHBASINS				
27	Water heaters supplying washbasins:			
	<ul style="list-style-type: none"> do not support areas that have higher water temperature requirements 			
	<ul style="list-style-type: none"> are provided with anti-scalding devices. 			
28	The following at a minimum are provided for each washbasin:			
	<ul style="list-style-type: none"> a mirror 			
	<ul style="list-style-type: none"> toiletary shelf 			
	<ul style="list-style-type: none"> electrical outlets that crew members have ready access to are equipped with ground fault interrupters (GFI) 			
29	Facilities to dry hands (e.g., towel bars, etc.) are provided at all washbasins.			
30	Washbasins are:			
	<ul style="list-style-type: none"> constructed of approved material 			
	<ul style="list-style-type: none"> smooth surfaced 			
	<ul style="list-style-type: none"> not liable to crack, flake or corrode. 			
URINALS				
31	Urinals have privacy partitions between units and at the end of rows if not provided by sanitary space structures.			
32	The dimension between the centerline of two urinals side-by-side is 690 mm (27 in.) or greater.			
33	The dimension between the centerline of a urinal and bulkhead next to the urinal is 380 mm (15 in.) or greater.			
34	The height of the front edge of a urinal is between 455 mm (18 in.) and 605 mm (24 in.) above the deck surface			

Instructions: For a **HAB(WB)** notation, the unshaded boxes under "Meets **HAB(WB)** Requirements" must be met. For a **HAB+(WB)** notation, the unshaded boxes under "Meets **HAB+(WB)** Requirements" need to be met as well as **HAB(WB)** requirements. For a **HAB++(WB)** notation, the unshaded boxes under "Meets **HAB++(WB)** Requirements" need to be met as well as **HAB(WB)** requirements and **HAB+(WB)** Requirements.

<i>Accommodation Area Criteria</i>				
<i>Office</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets HAB(WB) Requirements</i>	<i>Meets HAB+(WB) Requirements</i>	<i>Meets HAB++(WB) Requirements</i>
GENERAL				
1	In vessels of over 3000 tons:			
#	<ul style="list-style-type: none"> One room is provided and equipped for use as an office for the deck department 			
#	<ul style="list-style-type: none"> One room is provided and equipped for use as an office for the engine department. 			

Instructions: For a **HAB(WB)** notation, the unshaded boxes under "Meets **HAB(WB)** Requirements" must be met. For a **HAB+(WB)** notation, the unshaded boxes under "Meets **HAB+(WB)** Requirements" need to be met as well as **HAB(WB)** requirements. For a **HAB++(WB)** notation, the unshaded boxes under "Meets **HAB++(WB)** Requirements" need to be met as well as **HAB(WB)** requirements and **HAB+(WB)** Requirements.

<i>Accommodation Area Criteria</i>				
<i>Food Service Areas</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets HAB(WB) Requirements</i>	<i>Meets HAB+(WB) Requirements</i>	<i>Meets HAB++(WB) Requirements</i>
GENERAL				
1	Access is provided to all areas requiring cleaning, painting, or treating with pesticide/insecticide.			
2	There are no crevices or inaccessible voids, which might harbor vermin, cooking or food waste, or other extraneous matter.			
3	Places where food is prepared, served or stored are not used as sleeping areas.			
4	Deck drains are provided in all food service areas subject to flood type cleaning or where normal operations release or discharge water or other liquid onto the deck.			
5	Deck drains for food service areas are provided in number and location so that complete drainage is possible under normal conditions of list and trim.			
6	Where distributive systems are located in food service areas, they are installed as close as practicable to the overhead in order to provide maximum headroom.			

<i>Accommodation Area Criteria</i>				
<i>Food Service Areas</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+(WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
7	Flow of food through vessel:			
	<ul style="list-style-type: none"> is arranged in logical sequence that minimizes cross-traffic or backtracking 			
	<ul style="list-style-type: none"> allows for adequate separation of clean and soiled operations 			
FOOD SERVICE DOORS				
8	Toilet room doors opening directly into food preparation or serving areas are self-closing and tight.			
FOOD SERVICE PASSAGEWAYS				
9	The passage width between storage shelves is at least 710 mm (28 in.).			
MESS ROOM				
General				
10	Mess rooms are:			
#	<ul style="list-style-type: none"> located apart from sleeping rooms 			
	<ul style="list-style-type: none"> adequately ventilated 			
	<ul style="list-style-type: none"> adequately insulated to prevent condensation or overheating 			
#	<ul style="list-style-type: none"> located as near to the galley as is practicable except where the mess room is equipped with a steam table. 			
# 11	Mess rooms have tables and seats sufficient for the number of persons likely to use them at any one time.			
12	Mess lines and mess rooms are protected from weather, objectionable sights (such as garbage disposal areas) and objectionable odors (such as from engines, holds, toilets, fire room, etc.).			
13	Lighting in mess rooms is provided by means of natural light and artificial light (subject to special arrangements as may be permitted in special purpose ships).			
14	The following is available for crew use at all times:			
#	<ul style="list-style-type: none"> refrigerator 			
#	<ul style="list-style-type: none"> facilities for hot beverages 			
#	<ul style="list-style-type: none"> facilities for cool water. 			
# 15	Common or separate mess room facilities are to be provided.			

<i>Accommodation Area Criteria</i>				
<i>Food Service Areas</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+(WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
	<i>Note:</i> Also refer to flag State requirements for applicability of separate mess rooms.			
16	The tops of tables and seating are capable of being easily cleaned.			
# 17	Where available pantries are not accessible to mess rooms, adequate lockers for mess utensils and proper facilities for washing utensils are provided.			
Outfitting				
18	A transparent sanitation shield is installed to completely shield the entire length of the food serving lines if provided with a tray slide or rail.			
19	Tray slides (or rails) if provided are placed along food and beverage serving lines.			
20	Adequate lockers for mess utensils are provided.			
MESS ROOM DIMENSIONAL ASPECTS				
21	Rectangular table space for each diner is:			
	• at least 610 mm (24 in.) wide by 380 mm (15 in.) deep			
	• at least 740 mm (29 in.) wide by 430 mm (17 in.) deep			
22	Round Table diameter is:			
	• for seating 4 persons at least 1220 mm (48 in.)			
	• for seating 4 persons at least 1370 mm (54 in.)			
	• for seating 6 persons at least 1520 mm (60 in.)			
	• for seating 6 persons at least 1680 mm (66 in.)			
	• for seating 8 persons at least 1830 mm (72 in.)			
	• for seating 8 persons at least 1980 mm (78 in.)			
23	Distance between tables with back to back seating is:			
	• at least 1195 mm (47 in.)			
	• at least 1525 mm (60 in.)			
24	Deck area requirements for planned seating capacity are:			
#	• at least 1.5 m ² (16.2 ft ²) per person			
	• at least 1.7 m ² (18.4 ft ²) per person			

<i>Accommodation Area Criteria</i>				
<i>Food Service Areas</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+(WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
	• at least 1.9 m ² (20.5 ft ²) per person			
GALLEY/SCULLERY				
General				
# 25	The galley comprises space for food preparation, cooking, service and wash-up facilities. These should include areas for:			
	• baking and pastry preparation			
	• vegetable preparation			
	• meat, fish and poultry preparation			
	• hot services			
	• dish wash facilities			
	• pan wash facilities			
	• equipment storage			
26	Ice making facilities for at least 0.57 kg (1.25 pounds) of ice per person per day are provided.			
27	Hand washing stations located so that no crew member must walk more than 7.5 m (25 ft) to a station are to be provided. Slop sinks and scullery sinks are not satisfactory hand washing stations.			
28	Tops of food dressing tables, counters and drain boards are constructed with an integral back splash			
Potable Water				
29	Only potable water is piped to food storage, preparation, or service areas. The exceptions are a food waste grinder eductor (garbage disposal) line and deck washing facilities. The grinder delivery line is protected against back flow.			
30	If the vessel has a garbage room, hot and cold potable water is available for washing garbage cans.			
31	Potable water tanks are identified with a number and the words "POTABLE WATER" adequately sized.			
32	Potable water piping and fittings are labeled.			
Maintenance/Cleaning				
33	Drawers and bins used as food contact surfaces are readily removable and easily cleaned.			

<i>Accommodation Area Criteria</i>				
<i>Food Service Areas</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+(WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
34	Covers, insets, or receptacles for unpackaged foods or beverages are easily removable or designed for easy cleaning in place.			
35	Stove top or range sea rails are readily removable and easily cleanable and brackets for sea rails are easily cleanable.			
36	Ventilation baffles, vanes, louvers, dampers, filters, etc., are easily accessible or removable (without tools) for cleaning.			
Refrigeration/Freezer				
37	It is possible to open the doors of the refrigerated or cold storage rooms from the inside even though they are locked from the outside.			
38	There is an alarm in each freezer and cold storage room to warn when the temperature is out of specification.			
Dishwashing				
39	Easy access is provided to a sink or dish washing machine.			

Instructions: For a **HAB(WB)** notation, the unshaded boxes under "Meets **HAB(WB)** Requirements" must be met. For a **HAB+(WB)** notation, the unshaded boxes under "Meets **HAB+(WB)** Requirements" need to be met as well as **HAB(WB)** requirements. For a **HAB++(WB)** notation, the unshaded boxes under "Meets **HAB++(WB)** Requirements" need to be met as well as **HAB(WB)** requirements and **HAB+(WB)** Requirements.

<i>Accommodation Area Criteria</i>				
<i>Recreation</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+(WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
GENERAL				
1	Recreation accommodation areas, conveniently situated and appropriately furnished are provided for the crew. (Where this is not provided separately from the mess rooms the latter is planned, furnished and equipped to give recreational facilities).			
# 2	Vessel has an open deck space or spaces to which the crew can have access when off duty. The space or spaces are of adequate area, having regard to the size of the vessel and the crew.			

Accommodation Area Criteria					
Recreation					
Requirement # = Related to ILO MLC 2006, Title 3 Requirement			Meets HAB(WB) Requirements	Meets HAB+(WB) Requirements	Meets HAB++(WB) Requirements
#	3	Recreation rooms in the crew accommodation spaces are adequately insulated to prevent condensation or overheating.			
RECREATIONAL & EXERCISE AREAS					
#	4	Furnishing for recreational facilities should as a minimum include a book-case and facilities for reading, writing and, where practicable, table and deck games			
#	5	Television and DVD/CD player facilities are to be provided. The stock of films should be adequate for the duration of the voyage and, where necessary, changed at reasonable intervals			
#	6	Consideration should be given to include the following recreational facilities onboard, where practicable:			
		<ul style="list-style-type: none">a smoking room			
		<ul style="list-style-type: none">sport equipment including exercise equipment			
		<ul style="list-style-type: none">facilities for swimming			
		<ul style="list-style-type: none">a library containing vocational and other books, the stock of which should be adequate for the duration of the voyage and changed at reasonable intervals			
		<ul style="list-style-type: none">facilities for recreational handicrafts			
		<ul style="list-style-type: none">canteen			
		<ul style="list-style-type: none">where appropriate, the provision of bars on board for seafarers unless these are contrary to national, religious or social customs			
	7	Approximately 1.0 m ² (11 ft ²) is provided for each seat in the lounge.			
	8	Approximately 1.25 m ² (14 ft ²) is provided for each seat in the lounge.			
	9	Vessels regularly trading to or in the tropics and the Persian Gulf, are equipped with awnings for use over exposed recreation deck areas.			

Instructions: For a **HAB(WB)** notation, the unshaded boxes under "Meets **HAB(WB)** Requirements" must be met. For a **HAB+(WB)** notation, the unshaded boxes under "Meets **HAB+(WB)** Requirements" need to be met as well as **HAB(WB)** requirements. For a **HAB++(WB)** notation, the unshaded boxes under "Meets **HAB++(WB)** Requirements" need to be met as well as **HAB(WB)** requirements and **HAB+(WB)** Requirements.

<i>Accommodation Area Criteria</i>				
<i>Laundry</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+(WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
GENERAL				
1	Facilities exist for washing and drying clothes on a scale appropriate to the size of the crew and the normal duration of the voyage.			
2	Laundry facilities are located within easy access of crew accommodation areas.			
3	Laundry facilities shall be sufficient to allow seafarers to be provided with clean and dry underwear once per day and clean and dry outerwear and bedding once per five (5) days.			
4	Appropriate clearance has been provided for equipment maintenance.			
5	Coamings and/or deck drains are provided around washing machines, water heaters, etc.			
6	Washer and dryer capacities are matched to assure a smooth workflow.			
7	Washers and dryers are placed relative to each other to facilitate the transfer of clothing from the washer to the dryer.			
OUTFITTING				
8	Tumble dryers, if provided, are exhausted directly into the weather, not into the vessel.			
9	Tumble dryers, if provided, are equipped with lint filters.			
10	The laundry facilities include at a minimum:			
#	• clothes washing machines			
#	• clothes drying machines (or adequately heated and ventilated drying rooms)			
#	• irons and ironing boards (or their equivalent)			
	• suitable sinks with an adequate supply of cold potable water and hot potable water or means of heating water			
	• sinks are installed in wash rooms, if a separate laundry accommodation area is not reasonably practical.			
11	The facilities for drying clothes are:			
	• equipped with lines or other fittings for hanging clothes			

<i>Accommodation Area Criteria</i>				
<i>Laundry</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+(WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
	• separate from sleeping rooms and mess rooms			
	• ventilated and heated.			

Instructions: For a **HAB(WB)** notation, the unshaded boxes under "Meets **HAB(WB)** Requirements" must be met. For a **HAB+(WB)** notation, the unshaded boxes under "Meets **HAB+(WB)** Requirements" need to be met as well as **HAB(WB)** requirements. For a **HAB++(WB)** notation, the unshaded boxes under "Meets **HAB++(WB)** Requirements" need to be met as well as **HAB(WB)** requirements and **HAB+(WB)** Requirements.

<i>Accommodation Area Criteria</i>				
<i>Medical</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+(WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
GENERAL				
# 1	In vessels of less than 500 gross tonnage a medical chest, medical equipment and a medical guide shall be carried on board as a minimum. The type of ship, the number of persons on board and the nature, destination and duration of voyages and relevant national and international recommended medical standards shall be taken into account			
# 2	Separate medical accommodation area used exclusively for medical purposes is provided in vessels of 500 or more gross tonnage, carrying 15 or more seafarers and engaged in a voyage of more than three days' duration.			
3	Medical accommodation area is not used as a storage area except for medical supplies.			
4	Medical accommodation area is suitably located to allow for safe and efficient:			
	• access for sick or injured crew members			
	• stretcher transportation from accommodation areas or work areas.			
5	Medical accommodation area is suitably separated from other spaces and are used for the care of the sick and for no other purpose.			
6	Medical accommodation area is suitably designed so that the occupant can be comfortably housed and may receive proper attention in all weather.			

<i>Accommodation Area Criteria</i>				
<i>Medical</i>				
<i>Requirement</i> # = Related to ILO MLC 2006, Title 3 Requirement		<i>Meets</i> HAB(WB) <i>Requirements</i>	<i>Meets</i> HAB+(WB) <i>Requirements</i>	<i>Meets</i> HAB++(WB) <i>Requirements</i>
7	The arrangement of the entrance, berths, lighting, ventilation, heating and water supply is designed to provide comfort and facilitate the treatment of crew members.			
OUTFITTING				
8	If the vessel does not carry a doctor, it must have an approved medicine chest with readily understandable instructions.			
# 9	Medical accommodation area has a toilet, washbasin and bathtub or shower conveniently situated for the use of patients.			
10	The door to the toilet and washbasin shall open outwards and any door latch shall be capable of being opened from the outside if equipped.			
11	Medical accommodation area is appropriately equipped to render the necessary medical attention.			
12	Medical accommodation area is equipped with stretchers that meet the following:			
	<ul style="list-style-type: none"> the ability to winch a sick person into a helicopter or vessel, and the capability of floating and righting itself in the water 			
	<ul style="list-style-type: none"> collapsible and suitable for use in confined spaces 			
# 13	Toilet accommodation area is provided for the exclusive use of the occupants of the hospital accommodation area.			
14	Hospital and medical/first aid accommodation area is situated and arranged so that a stretcher can be easily carried into it and placed alongside an examination table or bed.			
15	Medical accommodation area has lockable storage for drugs, dressings and medical equipment.			
16	Medical accommodation area has an intercom or signaling system (e.g., an emergency call device) to the navigation bridge.			

APPENDIX 4 Acronyms and Abbreviations

°C	Degrees Celsius
°F	Degrees Fahrenheit
ABS	American Bureau of Shipping
ANSI	American National Standards Institute
ASNT	American Society of Nondestructive Testing
ASTM	American Society of Testing and Materials
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
Avg	Average
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
cd/m ²	Candela-per-square meter
CIH	Certified Industrial Hygienist
dB(A)	Decibels measured using the A-weighted scale
DP	Dynamic Positioning
ed.	Edition
EN	European Norms
ft/s	Feet-per-second
fc	Foot-candle
ft	Feet
ft ²	Square feet
GFI	Ground Fault Interrupter
HAB(WB)	Workboat Habitability notation
HAB+(WB)	Workboat Habitability Plus notation
HAB++(WB)	Workboat Habitability Plus Plus notation

HVAC	Heating, Ventilation, and Air Conditioning
Hz	Hertz
IEC	International Electrotechnical Commission
IESNA	Illuminating Engineering Society of North America
ILO	International Labor Organization
IMO	International Maritime Organization
in.	Inch
ISO	International Organization for Standardization
L_{Aeq}	Equivalent continuous A weighted sound pressure level
lm/m ²	Lumens-per-square meter
lm/ft ²	Lumens-per-square foot
m	Meter
m ²	Square meter
m/s	Meters-per-second
m/s ²	Meters-per-second squared
Max	Maximum
Min	Minimum
MLC	Maritime Labour Convention
mm	Millimeter
NDT	Nondestructive Testing
NEBB	National Environmental Balancing Bureau
NORSOK	Norwegian Engineering Industries
OSV	Offshore Support Vessel
psi	Pounds-per-square inch
RH	Relative humidity
RMS	Root-mean square
RP	Recommended Practice
SI	International System of Units
SOLAS	Safety Of Life At Sea
TAB	Testing, Adjusting and Balancing
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 5

Associated Documentation (1 February 2016)

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

ANSI/ASHRAE	www.ansi.org
BS	www.bsigroup.com
DIN	www.din.de
IEC	www.iec.org
IESNA	www.iesna.org
ILO	www.ilo.org
IMO	www.imo.org
ISO	www.iso.org
NEBB	www.NEBB.org