



GUIDE FOR

CREW HABITABILITY ON SHIPS

JULY 2012 (Updated September 2014 – see next page)

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Foreword (1 September 2013)

This Guide, originally published in December 2001, has undergone significant revision. Key revision areas include changes to the Whole-body Vibration (WBV) measurement and evaluation methodology and criteria, changes to the ambient Lighting methodology and criteria, and changes to the Noise and 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 Ships* in order to provide a single source for habitability criteria suitable for ships. This Guide may be applied to vessels falling under the categories of oil or chemical tankers, bulk or combination carriers, container carriers, multi-purpose cargo vessels, or passenger vessels. This Guide does not apply to vessels such as offshore support vessels, tug boats, tow boats, dredgers, research vessels, drill ships, anchor handling vessels or any other vessel providing service to offshore oil and gas exploration and production. These types of vessels are addressed in other ABS Habitability Guides*.

This Guide provides the assessment criteria and describes the measurement methodology for obtaining a ship Habitability notation. It is intended for use by vessel Owners or companies requesting the optional notations of ship Habitability (**HAB**), ship Habitability Plus (**HAB+**), or ship Habitability Plus Plus (**HAB++**).

For the **HAB** 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 ships. These categories are: accommodation area, whole-body vibration (separate criteria for accommodation areas and work spaces), noise, indoor climate, and lighting.

For the **HAB+** level, this Guide invokes more stringent accommodation area, whole-body vibration and noise criteria aimed at increasing crew comfort and safety. For the **HAB++** 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 notation **MLC-ACCOM**.

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

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

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

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



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SECTION 1 General

1 Introduction

ABS recognizes the positive impact that **suitable** habitability criteria and design practices **may** have on the safety, productivity, morale, and overall well-being of **seafarers**. The *ABS Guide for Crew Habitability on Ships* 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 September 2013)

This Guide is applicable to new and existing vessels for which an optional **ship Habitability (HAB)**, **ship Habitability Plus (HAB+)**, or **ship Habitability Plus Plus (HAB++)** 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 notation MLC-ACCOM.**

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

3 Scope

This Guide focuses on five (5) habitability aspects of **ship** 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

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 Habitability or Passenger Comfort notations.

Accommodation Areas/Accommodation Block: Vessel areas where the primary purpose is to rest and recreate. Accommodation spaces include cabins and staterooms, 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.

Cargo Vessel: A cargo vessel is any vessel not specifically a passenger vessel and that is involved in commercial trade.

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”.

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.

High-Speed Craft: Vessels that meet the requirements of the ABS Rules for Building and Classing High-Speed Craft.

Manned Space: Any space where a seafarer may be present for twenty (20) minutes or longer at one time during normal, routine daily activities. Such spaces include working or living spaces.

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.

Passenger Vessel: A vessel whose primary purpose is to carry more than twelve (12) passengers for transportation or recreational purposes. This includes cruise ships and ferries (conventional and high-speed craft).

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

Work Spaces: Areas allocated for work. Categories of work spaces include, but are not limited to, navigation spaces, service spaces (galley, laundry) and machinery spaces.

5 Associated Documentation

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

6 Notation

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

A vessel complying with the **HAB** 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+**. A vessel satisfying all the criteria in the Guide may be distinguished in the *Record* by the notation **HAB++**. A summary of the differences among each of these notations is presented below.

	HAB	HAB+	HAB++
Accommodation Areas	HAB Requirements for Accommodation Areas	HAB and HAB+ Requirements for Accommodation Areas	HAB+ and HAB++ 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 with additional requirements	HAB+ 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

The following items are to be submitted for each ambient environmental aspect.

7.3.1 Test Plans

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** 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:

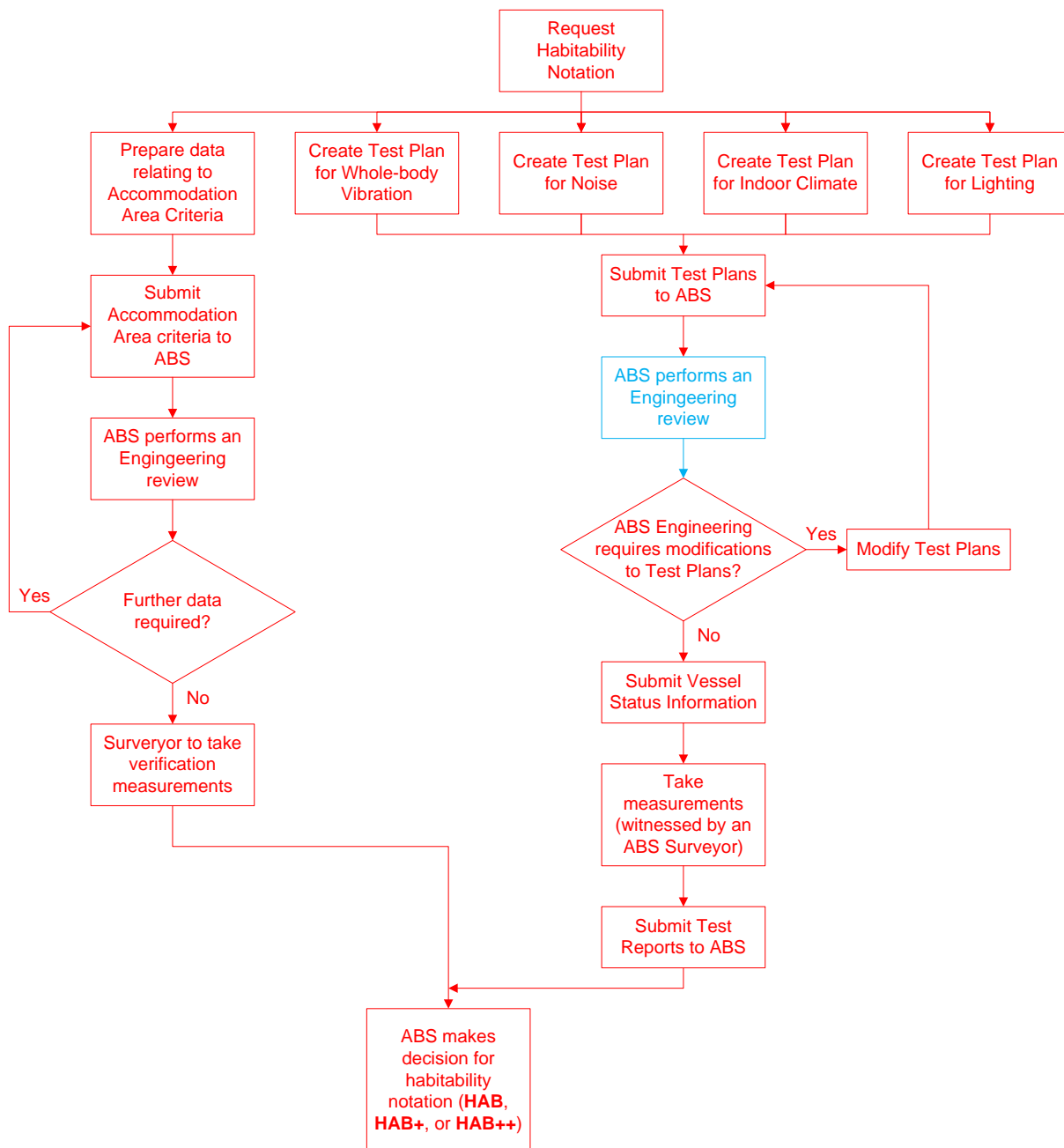
<i>Environmental Aspect</i>	<i>Test Plan Details</i>
Whole-body Vibration	Subsection 3/8
Noise	Subsection 4/8
Indoor Climate	Subsection 5/8
Lighting	Subsection 6/8

8 Process for Obtaining a Notation

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 align testing during sea trials with the ambient environmental testing so that all testing is completed during sea trials.**

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

FIGURE 1
Process for Obtaining a Habitability Notation



8.1 Accommodation Areas

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 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

Ambient environmental Test Plans for **whole-body** vibration, noise, indoor climate, and lighting shall be prepared and submitted to ABS Engineering. These Test Plans shall serve as a primary vehicle for verifying the measurement locations and measurement process, as well as specifying the **Testing Specialist** who will perform the ambient environmental testing.

Testing, inspections, and data collection 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.

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 **ship** 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 met, then the appropriate notation **may** be confirmed.

10 Surveys after Construction

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.

10.1 Annual Surveys

In order to maintain the **HAB, HAB+, or HAB++** notation, an Annual Survey shall be made within three (3) months before or after each annual anniversary date of the crediting of the Initial Survey or the previous Special Periodical Survey. The following information shall be reviewed by the attending ABS Surveyor for issues that could affect the ship Habitability notation.

- i)* Collision and grounding reports since previous Initial, Annual or Special Periodical Survey
- ii)* Fire, repair, and damage reports since previous Initial, Annual or Special Periodical Survey
- iii)* A list of all **structural or mechanical modifications** to the vessel since previous Initial, Annual or Special Periodical Survey
- iv)* Verification that equipment and facilities continue to be fit for purpose and are operating in accordance with accommodation **area** criteria stated within this Guide

During the attending ABS Surveyor's review of the submitted information, a determination will be made as to whether changes or alterations have taken place that could affect the ship Habitability notation. As a result, the vessel may be subject to the review, ambient environmental testing, and inspection requirements of this Guide.

10.2 Special Periodic Surveys

In order to maintain the **HAB, HAB+, or HAB++** notation, a Special Periodical Survey shall be completed within five (5) years after the date of build or after the crediting date of the previous Special Periodical Survey. A Special Periodical Survey will be credited as of the completion date of the survey but not later than five (5) years from date of build or from the date recorded for the previous Special Periodical Survey. If the Special Periodical Survey is completed within three (3) months prior to the due date, the Special Periodical Survey will be credited to agree with the effective due date. The Special Periodical Survey may be commenced fifteen (15) months prior to the due date and be continued with completion by the due date.

10.2.1 Survey Requirements

The Survey shall comprise ABS Engineering reviews, ABS Surveyor verifications, and ambient environmental testing. The Survey will cover all five (5) habitability aspects.

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

- i)* Fire, repair, or damage reports since previous Annual Survey
- ii)* A list of all **structural or mechanical modifications** to the vessel since previous Annual Survey
- iii)* Drawings/arrangements of **seafarer** spaces, HVAC, electrical, etc., affected by alterations
- iv)* Copy of approved Initial Test Plans and Test Reports
- v)* Test Plans and Test Reports resulting from Annual Surveys
- vi)* Previous Special Periodical Survey Test Plans and Reports, if applicable
- vii)* Proposed Special Periodical Survey Test Plans for the current survey

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

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

For creation of the Special Periodical Survey Test Plans, Subsection 6, “Test Plan”, and Subsection 7, “Test Requirements”, of this Guide specify the requirements for each ambient environmental aspect (i.e., 3/6, 3/7, 4/6, 4/7, etc.). For specifying measurement locations for the Special Periodical Survey Test Plans, the following changes to 7.4.1, “Selection of Spaces where Measurements are to be Conducted”, of each ambient environmental aspect of Habitability shall be followed:

- i)* Measurements shall be taken in all areas affected by vessel alterations. Measurements **are** limited to the ambient environmental aspect affected by the alteration. For example, structural changes require both **whole-body** vibration and noise measurements. Structural changes **do** not necessarily require indoor climate or lighting measurements. Changes to luminaires require lighting measurements but not **whole-body** vibration, noise, or indoor climate measurements.
- ii)* For whole-body vibration, additional measurements shall be taken in crew cabins and staterooms throughout the vessel. For vessels with fewer than one hundred (100) crew cabins and staterooms, ten (10) percent of cabins and staterooms shall be measured.

For vessels with one hundred (100) or more crew cabins and staterooms, apply the following:

- In the forward one-third ($1/3$) of the vessel, three (3) percent or 1 in 33 of cabins and staterooms shall be measured
- In the midsection (center $1/3$) of the vessel, two (2) percent or 1 in 50 of cabins and staterooms shall be measured
- In the aft one-third ($1/3$) of the vessel, five (5) percent 1 in 20 of the cabins and staterooms shall be measured.

Within each one-third ($1/3$) section of the vessel, measurement locations shall be distributed throughout the length of each section and on each deck.

- iii)* **For all ambient environmental aspects, measurements shall be taken in all worst case or problem area locations based on the requirements set forth in 7.4.1, “Selection of Spaces where Measurements are to be Conducted”, of the appropriate Section of this Guide. [For example, worst case for whole body vibration is described in 3/7.4.1i)].**

- iv) For all ambient environmental aspects, measurements shall be taken in twenty-five (25) percent of crew cabins and staterooms identified in the initial Test Plans. The cabin locations must be representative of locations port, starboard, fore, amidships, and aft. Any worst case locations can be considered part of the representative sample for crew cabins and staterooms, if applicable.
- v) For all ambient environmental aspects, measurements shall be taken where a single instance of one (1) type of a manned space exists within the vessel (e.g., bridge, radio room, officer's mess, gymnasium, library, etc.). The worst case locations can be considered part of the single instance representative sample, if applicable.
- vi) Where multiple instances of the same type space exist, a representative sample of at least twenty-five (25) percent of each type shall be selected for measurement for all ambient environmental aspects. The worst case locations are to be considered part of the representative sample, if applicable.

For all ambient environmental conditions, visual/walk-through inspections shall be conducted in accordance with 7.4.2 of the appropriate Section of this Guide.

10.3 Requirements for Vessel Alterations

No alterations which affect or may affect the ship Habitability notation awarded, including alterations to the structure, machinery, electrical systems, piping, furnishings or lighting systems, are to be made to the vessel unless plans of the proposed alterations are submitted to and approved by ABS before the work of alteration is commenced. If ABS determines that the alteration will affect the ship Habitability notation, the altered vessel may be subject to the review, verification, and ambient environmental testing requirements of this Guide.

11 Alternatives

11.1 General

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

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

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

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

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 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

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. Appropriate accommodation areas may also enhance morale, recruiting, retention, comfort, and overall quality of life at sea.

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

2 Scope

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

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

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

3 Terminology

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

4 Associated Documentation

- Appendix 3, "Accommodation Area Criteria"
- International Labor Organization (ILO) Conventions 92 and 133 and the ILO MLC, Title 3, 2006

5 Criteria (1 September 2013)

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

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

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

6 Accommodation Area Documentation

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

6.1 Data Requirements

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

6.1.1 New Construction

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

6.1.2 Existing Vessels

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

7 Submittal Review and Verification

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

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

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

8 Results

The results of the ABS Engineering review and **the** ABS Surveyor verification shall be reviewed by the ABS Surveyor against the appropriate **HAB, HAB+, or HAB++** 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 vibration, 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

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.

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

In the case of High-Speed Craft (as defined by the requirements of the ABS *Rules for Building and Classing High-Speed Craft*), crew exposure to impact shock can be assessed according to the requirements expressed in Appendix 4 of this Guide, "Evaluation of Crew Exposure to Shock on High-Speed Craft." The results and findings of the methods presented in Appendix 4 impose no requirements for acquiring a notation; rather, the results are intended to identify threats to mariner health and comfort so as to aid the Owner in identifying means to control or mitigate those threats.

3 Terminology

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

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

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

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

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

- In human response to vibration, various frequency weightings have been defined in order to reflect known or hypothesized relationships between vibration frequency and 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.

Manned Space: Any space where a seafarer may be present for twenty (20) minutes or longer at one time during normal, routine daily activities. Such spaces would include working or living spaces.

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 conducted by an accredited Testing and Calibration Laboratory with traceability to a national or international standard.

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

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:1995, Sea State Code.

Further guidance can be found in:

- ISO 2923: 1996, Acoustics – Measurement of noise onboard vessels.
- ISO 20283-2:2008, Mechanical Vibration – Measurement of Vibration on Ships – Part 2: Measurement of Structural Vibration.

5 Criteria (1 September 2013)

The whole-body vibration criteria for the ship Habitability notations (**HAB**, **HAB+**, or **HAB++**) are provided in Section 3, Table 1, “Maximum Weighted Root-Mean-Square Acceleration Level”. 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. A space is considered “manned” if it is occupied by a crew member for twenty (20) minutes or longer at a time for normal, routine daily activities. Specific locations are referred to in 3/7.4, “Measurement Locations”.

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

For the purpose of this Section, the notation applies to the vibration levels occurring on the deck supporting the human body in the three (3) translational (x-, y- and z-) axes as shown in Section 3, Figure 1, “Measurement Axes”. The vibration levels are computed for each axis individually, as well as combined as a multi-axis acceleration value. Each is expressed as a frequency weighted root-mean-square (a_w) value. To meet the vibration criteria, the multi-axis a_w level must be less than or equal to the maximum level expressed in Section 3, Table 1.

FIGURE 1
Measurement Axes

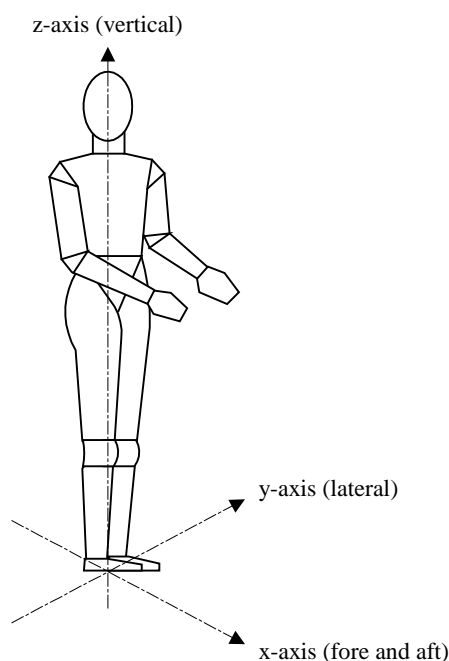


TABLE 1
Maximum Weighted Root-Mean-Square Acceleration Level

Notation	Frequency Range	Acceleration Measurement	Maximum RMS Level	
			Accommodation Areas	Work Spaces
HAB	1 - 80 Hz	a_w	178 mm/s ² (5.0 mm/s)	214 mm/s ² (6.0 mm/s)
HAB+	1 - 80 Hz	a_w	143 mm/s ² (4.0 mm/s)	178 mm/s ² (5.0 mm/s)
HAB++	1 - 80 Hz	a_w	107 mm/s ² (3.0 mm/s)	143 mm/s ² (4.0 mm/s)

6 Test Plan

As stated in 1/7.3.1, “Test Plans”, a Test Plan shall be developed to serve as the principal means for verifying the measurements to be performed to verify compliance with **whole-body** vibration criteria. The Test Plan shall include the following:

6.1 Documentation

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

6.2 Test Personnel

The Test Plan shall provide information about the **Testing Specialist** who will be conducting the test and their approval and certification in accordance with Appendix 2, “Procedural Requirements for **ABS Recognized Ambient Environmental Testing Specialists**”.

6.3 Test Conditions

The Test Plan shall detail the conditions under which the tests will be performed.

6.4 Measurement Locations

The Test Plan shall document, in detail, on appropriate drawings, all spaces where measurements will be taken. In addition, transducer measurement positions shall be indicated. Details on selecting measurement locations and determining transducer measurement 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

The Test Plan shall provide information regarding the proposed test schedule.

7 Test Requirements

7.1 General

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

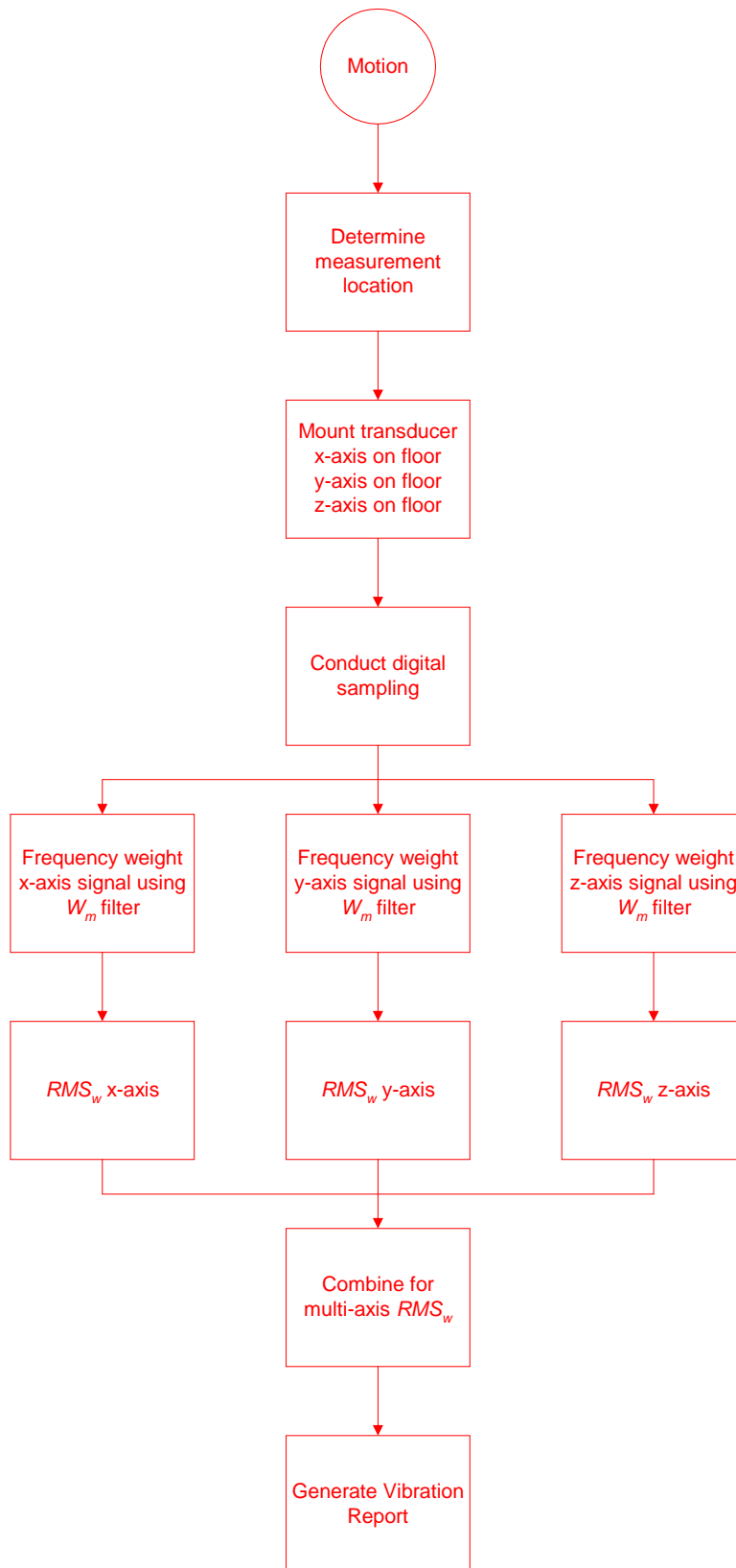
The relationship between the various factors to be considered when taking whole-body vibration measurements and computing results is illustrated in Section 3, Figure 2, “Process for the Measurement and Analysis of Whole-body Vibration”.

7.2 Data Acquisition and Instruments

For the **HAB**, **HAB+**, or **HAB++** 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 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.

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



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

The propulsion machinery shall run at **contractual service conditions**.

7.3.2 Equipment Operation

All other rotating 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 steady state transit conditions. The vessel shall maintain a single heading and a constant speed during the test.

7.3.4 Rudder **Conditions**

The rudder **action** shall be **minimized**.

7.3.5 Sea 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*.

7.3.6 Loading Conditions

The loading condition of a passenger vessel shall be as close as possible to normal operating conditions. For cargo vessels, measurements shall be taken under ballast 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

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 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 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 and staterooms throughout the vessel. For vessels with fewer than one hundred (100) crew cabins and staterooms, twenty (20) percent of cabins and staterooms shall be measured.

For vessels with one hundred (100) or more crew cabins and staterooms, apply the following:

- In the forward one-third ($\frac{1}{3}$) of the vessel, seven (7) percent or 1 in 15 of cabins and staterooms shall be measured
- In the midsection (center $\frac{1}{3}$) of the vessel, five (5) percent or 1 in 25 of cabins and staterooms shall be measured
- In the aft one-third ($\frac{1}{3}$) of the vessel, ten (10) percent 1 in 10 of the cabins and staterooms shall be measured.

Within each one-third ($\frac{1}{3}$) section of the vessel, measurement locations shall be distributed throughout the length of each section and on each deck.

- iv) Regardless of the number of crew cabins and staterooms on a vessel, attention must be given to selecting a variety of locations port, starboard, fore, amidships and aft. The worst case locations can be considered part of the representative sample for crew cabins and staterooms, if applicable.
- v) 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 Measurement Positions

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 5384. 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 or staterooms, 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 or stateroom).

For larger spaces (public rooms, messes, recreation areas, etc.) it shall be necessary to place transducers at a number of locations in order to obtain a representative sample of the whole-body vibration levels for that space. Transducer locations shall be evenly distributed throughout the space. For a specific room size, the minimum number of measurement locations shall be as indicated in Section 3, Table 2, “Distribution of Transducer Positions Within Spaces”.

**TABLE 2
Distribution of Transducer Positions Within Spaces**

<i>Space Size</i>	<i>Minimum Number of Measurement Positions in Room</i>
Less than 40 m ² (431 ft ²)	1
Less than 80 m ² (861 ft ²)	2
Less than 200 m ² (2142 ft ²)	3
Greater than or equal to 200 m ² (2142 ft ²)	4

For vessels without crew cabins and staterooms, 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 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

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

- i)* Loading (mean draft and trim)
- ii)* Number of crew and other persons onboard during tests
- iii)* **Bridge confirmation that operating conditions complied with contractual service conditions**
- iv)* Vessel course and speed as well as latitude and longitude coordinates of tests
- v)* Average water depth under keel
- vi)* 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 (if needed) during any data collection period. Weather conditions shall also be reported at the end of each data collection period**
- 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)* Vessel equipment operated during the test.

8.2 Transducer Measurement Positions

Actual transducer positions within the measured spaces 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

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

- i)* Measurement position (i.e., space and location within space)
- ii)* Measurement period **if different from requirements**
- iii)* Sample number
- iv)* Multi-Axis weighted **RMS** values
- v)* Equipment operating in proximity to the measurement position

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

The equipment calibration and data collection process of vibration tests conducted at sea shall be witnessed by an ABS Surveyor. The ABS Surveyor shall provide documentation 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, HAB+, or HAB++** 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

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 A.468(XII) (1981) *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 and **other areas** occupied by **seafarers** for twenty (20) minutes or longer at any one time **during normal, routine daily activities**. Examples of such spaces include cabins, staterooms, **work spaces (duty stations)**, mess areas, and recreation spaces, **both inside and in other vessel locations outside the accommodation block**.

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

3 Terminology

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**.

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

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

4 Associated Documentation

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

- ISO 2923:1996, Acoustics – Measurement of noise onboard vessels
- IEC 61672-1:2004, Electroacoustics – Sound Level Meters – Part 1: Specifications IEC 61672-1 (2004)
- IMO Resolution A.468(XII): 1981, Code on noise levels onboard ships.
- WMO: 1995, Sea State Code.

5 Criteria

5.1 Equivalent Continuous A-weighted Sound Pressure Level (1 September 2013)

The noise criteria for the ship Habitability notations (**HAB**, **HAB+**, and **HAB++**) are provided in Section 4, Table 1, “Noise Criteria for Ships”.

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, Table 1, “Noise Criteria for Ships”, for each type of space or area. The maximum acceptable noise levels given in Section 4, Table 1, “Noise Criteria for Ships” 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 sea-going conditions only and do not include any in-port activities.

TABLE 1
Noise Criteria for Ships

<i>Space ^(1,2)</i>	<i>Maximum Acceptable Noise L_{Aeq} Level dB(A)</i>		
Crew Accommodation Spaces and Open Deck Recreation Areas			
	HAB	HAB+	HAB++
Cabins	60	55	50
Sanitary Spaces (if separate from the cabin)	65	60	55
Dining (Mess) Spaces	65	60	55
Indoor Recreation Spaces	65	60	55
Gymnasiums	65	60	60
Medical and First Aid Center	60	55	55
Open Deck	75	70	70
Navigation and Control Spaces			
Wheelhouse, Pilothouse, Bridge	65	60	55
Radio Room	60	55	55
Offices	65	60	60
Cargo Control Rooms	65	60	60
Machinery Control Rooms	75	70	70
Service Spaces			
Food Preparation (e.g., Galley, Scullery)	75	70	65
Pantries ⁽²⁾	75	70	70
Storerooms	75	70	70
Laundry Areas	75	70	70
Operating and Maintenance Spaces			
Continuously Manned Machinery Spaces	90	90	90
Not Continuously Manned Machinery Spaces	110	110	110
Workshops	85	80	80
Fan and Generator Rooms	90	90	90

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 ship Habitability notations are required.

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

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 Surveyor to verify compliance with the criteria set in this Guide.

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 2, “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. 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

The Test Plan shall provide information regarding the proposed test schedule.

7 Test Requirements

7.1 General

In general, the noise measurements shall be carried out in accordance with the requirements of IMO Resolution A.468(XII) *Code on Noise Levels On-board Ships*. However, where the IMO requirements differ from those in this Guide, **the more stringent requirement** 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 in accordance with the requirements in 4/7.3, “Test Conditions”.

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

The propulsion machinery shall run at **contractual service conditions**.

7.3.2 Equipment Operation

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**) need not be running during the noise measurements. Note the equipment that is running in the Noise Test Report.

7.3.3 Course and Water Depth

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 course of the vessel shall be as straight as possible and at a constant speed.

7.3.4 Rudder **Conditions**

The rudder **action** shall be **minimized**.

7.3.5 Sea 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*.

7.3.6 Loading Conditions

The loading condition of a passenger vessel shall be as close as possible to normal operating conditions. For cargo vessels, measurements shall be taken under ballast 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)* **Select a representative sample of crew cabins and staterooms 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 can be considered part as the representative sample for crew cabins and staterooms, if applicable.**

- iv) Measurements in passageways shall be conducted at distances not smaller than 2 m (6.5 ft) and not greater than 7 m (23 ft) throughout the space. The worst case locations (e.g., inlets and outlets of air-circulation systems, locations adjacent to stairwells and elevator shafts) shall be considered part of the measurements, if applicable.
- v) If any of the spaces or passageways identified for measurement extend or are situated over a large portion of the vessel, measurement locations shall be selected throughout the length of the vessel and on each deck.
- vi) 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

The measurement positions described below are taken or adapted from ISO 2923 and IMO Resolution A.468(XII).

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

When Testing Specialist personnel are conducting noise level measurements in any space, only crew members necessary for the operation of 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

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

- i)* Loading (mean draft and trim)
- ii)* Number of crew and number of other persons onboard during testing
- iii)* **Bridge confirmation that operating conditions complied with contractual service conditions.**
- iv)* Vessel course and speed
- v)* Average water depth under keel
- vi)* 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 (if needed) during any data collection period. Weather conditions shall also be reported at the end of each data collection period.**
- vii)* Sea state
- viii)* Any indications of abnormal activity during the test that might skew results
- ix)* Vessel’s equipment operated during the test

8.2 Measurement Positions

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

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

- i)* Measurement position (i.e., space and location within space)
- ii)* Number of people present in the space at time of measurement
- iii)* Measurement period
- iv)* Time at start and finish of measurement
- v)* Equivalent continuous A-weighted sound pressure level (L_{Aeq})
- vi)* Note any open doors and windows
- vii)* Note equipment operating in proximity to the measurement position
- viii)* **Note observed direct sources of noise (such as ventilation devices) and any measurement data collected**

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

The equipment calibration and data collection process of the noise level tests shall be witnessed by an ABS Surveyor. The ABS Surveyor shall provide documentation 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

This Section provides the assessment criteria, verification and measurement methodology for indoor climate relating to habitability on **ships**. 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 occupied by crew members for twenty (20) minutes or longer at any one time for normal, routine daily activities. Examples of **seafarer** spaces include crew accommodation **areas**, bridge, engine control room, and indoor work spaces.

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

3 Terminology

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.

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 within the cabin.

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 by an accredited Testing and Calibration Laboratory, 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

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

- ANSI/ASHRAE 55a, (2010). Thermal environmental conditions for human occupancy
- ANSI/ASHRAE (15) (2010). **Practices for Measuring, Testing, Adjusting, and Balancing Shipboard HVAC&R Systems**
- ISO 7726 (E), (1998), Ergonomics of the thermal environment – Instruments for measuring physical quantities
- NEBB, (2005). Procedural standards for testing, adjusting, balancing of environmental Systems.

5 Criteria (1 September 2013)

The indoor climate criteria for the **ship Habitability notations (HAB, HAB+, and HAB++)** are provided in Section 5, 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** manned spaces.

The **HAB** and **HAB+** notations criteria provide for a preset return air temperature **range** 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++** 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

5.1.1 For a **HAB** or a **HAB+** Notation

The HVAC system shall be capable of providing a preset return air temperature of 20 to 25°C (68 to 77°F) during winter months and 22 to 27°C (71.5 to 80°F) during summer months to an HVAC zone for a set of habitable spaces. 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++** Notation

The HVAC system shall be capable of sustaining an adjustable range of air temperatures between 20 to 25°C (68 to 77°F) inclusive during winter months and 22 to 27°C (71.5 to 80°F) during summer months in all indoor manned spaces. This temperature shall be maintained by a temperature controller. Each manned 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 Exchange Rate

The rate of air exchange for enclosed spaces shall be at least six (6) complete changes-per-hour.

5.7 Summary

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

**TABLE 1
Summary of Indoor Climate Requirements**

Item	Requirement or Criterion	
	HAB & HAB+	HAB++
Adjustability	Non-adjustable air temperature	Adjustable range of air temperatures
Air Temperature	Winter: 20 to 25°C (68 to 77°F) Summer: 22 to 27°C (71.5 to 80°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 Exchange Rate	The rate of air change for enclosed spaces shall be at least six (6) complete changes-per-hour.	

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 submitting design details of the HVAC system for review by ABS Engineering and for verifying the measurements to be performed to verify compliance with indoor climate criteria.

6.1 Documentation

The Test Plan shall **identify spaces where measurements shall be taken and** include the following documentation and data to enable **ABS Engineering** to verify compliance to the indoor climate criteria set in this Guide:

- i) Appropriate vessel and HVAC system design specifications
- ii) Schematics/layout drawings of the HVAC system
- iii) General arrangement drawings of the vessel

A report of the total system Testing, Adjusting, and Balancing (TAB) shall be provided to ABS Engineering. The total system 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 standards.

6.2 Test Personnel

The Test Plan shall provide information about the **Testing Specialist** who will be conducting the test and their approval and certification in accordance with Appendix 2, “Procedural Requirements for **ABS Recognized Ambient Environmental Testing Specialists**”.

6.3 Test Conditions

The Test Plan shall detail the conditions under which the tests will be performed. Details about test conditions are given in 5/7.3, “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. Details on selecting measurement locations and determining transducer 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

The Test Plan shall provide information regarding the proposed test schedule.

7 Test Requirements

7.1 General

Indoor climate measurements shall be in accordance with the requirements of ANSI/ASHRAE 55a and ANSI/ASHRAE 15. When the procedures described in this Guide deviate from those in ANSI/ASHRAE 55a and ANSI/ASHRAE 15, the more stringent requirement shall take precedence.

7.2 Data Acquisition and Instruments

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++ notation, the temperature control for a specific space shall be set to the lower requirement level of 20°C (68°F) for the first half-hour and to 27°C (80°F) for the second half-hour of measurement.

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 crew cabins shall be measured for determining the horizontal gradient in crew cabin spaces.

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

Testing of identified spaces can be performed in port and at sea, provided the provisions of 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 with all normally functioning operations. This testing will consist of a sample of manned spaces on the weather boundary and will be selected by the ABS Surveyor.

7.3.2 Equipment Operation

The HVAC system shall be operating in the normal operation or mode.

7.3.3 Doors and Windows

The space doors 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

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 manned spaces, accommodation **areas** and recreation areas. 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/staterooms, 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 can be considered part of the representative sample for crew cabins and staterooms, 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 Measurement Positions

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 simultaneously 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 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

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

- i)* Vessel latitude and longitude coordinates during testing
- 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 (if needed) 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 Measurement Positions

Actual measurement locations and transducer 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

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
- iv)* Time at start and end of measurement
- v)* Air temperature (minimum, maximum, and average) at 100 mm (4 in.) above deck
- vi)* Air temperature (minimum, maximum, and average) at 1100 mm (43 in.) above deck
- vii)* Air temperature (minimum, maximum, and average) at 1700 mm (67 in.) above deck

- viii)* Relative humidity (minimum, maximum, and average) at 1700 mm (67 in.) above deck
- ix)* Air velocity at 100, 1100, and 1700 mm (4, 43, and 67 in.) above deck at measurement positions
- x)* Vertical gradient (Average air temperature at 1700 mm (67 in.) minus average air temperature at 100 mm (4 in.) above deck)
- xi)* Horizontal gradient (Side wall surface temperature in crew cabin spaces minus average air temperature at 1100 mm (43 in.) above deck crew cabin areas)
- xii)* Wind speed and direction, ambient outdoor air temperature, outdoor humidity, and barometric pressure corresponding to indoor measurement periods.

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

The equipment calibration and data collection process of the indoor climate tests shall be witnessed by an ABS Surveyor. The ABS Surveyor shall provide documentation 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, HAB+, and HAB++** criteria for notation confirmation.

SECTION 6 Lighting

1 Background

The lighting of **seafarer** spaces should facilitate visual task performance, 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.

Visual tasks encountered on vessels vary **and lighting provided can influence 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 attending 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".**

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

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 based on currently available objective standards and research data. Compliance with this Section is a prerequisite for the **ship** Habitability (**HAB**), **ship** Habitability Plus (**HAB+**), or **ship** Habitability Plus Plus (**HAB++**) notation confirmation.

3 Terminology

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 by an accredited Testing and Calibration Laboratory, 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.

4 Associated Documentation

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

- IESNA RP-12-97, Recommended Practice for Marine Lighting
- ISO 8995:2000 (CIES 008/E), Lighting of indoor work places

5 Criteria (1 September 2013)

The lighting criteria for the **ship** Habitability notation are provided in:

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

For lighting, the criteria for **HAB**, **HAB+**, and **HAB++** 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

The minimum maintained illuminance levels in Lighting Criteria Tables 1 through 4 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 daylight 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 Section 6, Table 5, “Lighting for Red or Low-level White Illuminance”, are provided for guidance only and are not required for a **HAB**, **HAB+**, and **HAB++** notation.

**TABLE 1
Lighting Criteria for Crew Accommodation Spaces**

<i>Space</i>	<i>Illuminance Level in Lux</i>	<i>Space</i>	<i>Illuminance Level in Lux</i>
Entrances and Passageways			
Interior Walkways, Passageways, Stairways and Access Ways	100	Exterior Walkways, Passageways, Stairways and Access Ways (Night)	100
Corridors in Living Quarters and Work Areas	100	Stairs, Escalators	150
		Muster Area	200
Cabins, Staterooms, and Sanitary Spaces*			
General Lighting	150	Bath/Showers (General Lighting)	150
Reading and Writing (Desk or Bunk Light)	500	All other Areas within Sanitary Space (e.g., Toilets)	200
Mirrors (Personal Grooming)	500	Light During Sleep Periods	<30
Dining Spaces			
Mess Room and Cafeteria	300	Snack or Coffee Area	150
Recreation Spaces			
Lounges	200	Gymnasiums	300
Library	500	Bulletin Boards/Display Areas	150
Multimedia Resource Center	300	All other Recreation Spaces (e.g., Game Rooms)	200
TV Room	150	Training/Transit Room Office/Meeting rooms	500
Medical, Dental and First Aid Center			
Dispensary Hospital/Ward	500	Wards - General Lighting - Critical Examination - Reading Hospital/Ward	150
Medical and Dental Treatment/ Examination Room Hospital/Ward	500		500
Medical Waiting Areas	200		500
Laboratories	500	Other Medical & Dental Spaces	300

* *Note:* If there is any opportunity for light to enter cabins or staterooms 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 Navigation and Control Spaces

<i>Space</i>	<i>Illuminance Level in Lux</i>	<i>Space</i>	<i>Illuminance Level in Lux</i>
Wheelhouse, Pilothouse, Bridge	300	Offices	
Chart Room		- General Lighting	300
- General Lighting	150	- Computer Work	300
- On Chart Table	500	- Service Counters	300
Other Control Rooms (e.g., Cargo Transfer etc.)		Control Stations	
- General Lighting	300	- General Lighting	300
- Computer Work	300	- Control Consoles and Boards, Panels, Instruments	300
Central Control Room	500	- Switchboards	500
Radar Room	200	- Log Desk	500
Radio Room	300	Local Instrument Room	400
		Gyro Room	200

TABLE 3
Lighting Criteria for Service Spaces

<i>Space</i>	<i>Illuminance Level in Lux</i>	<i>Space</i>	<i>Illuminance Level in Lux</i>
Food Preparation		Laundries	
- General Lighting	500	- General Lighting	300
- Galley	500	- Machine, Pressing, Finishing and Sorting	300
- Pantry	300	Chemical Storage	300
- Butcher Shop	500	Storerooms	
- Thaw Room	300	- Large Parts	200
- Working Surfaces, Food Preparation Counter and Range Tops	750	- Small Parts	300
- Food Serving Lines	300	- Issue Counters	300
- Scullery (Dishwashing)	300	Elevators	150
- Extract Hood	500	Food Storage	
Store Rooms	100	- Non-refrigerated	200
Package Handling/Cutting	300	- Refrigerated	100
Mail Sorting	500		

TABLE 4
Lighting Criteria for Operating and Maintenance Spaces/Areas

<i>Space</i>	<i>Illuminance Level in Lux</i>	<i>Space</i>	<i>Illuminance Level in Lux</i>
Machinery Spaces (General)	200	Cargo Holds (Portable Lighting)	30 300 80
Unmanned Machinery Spaces	200		
Engine Room	300		
Generator and Switchboard Room	300		
Switchboard, Transformer Room	500		
Main Generator Room/Switch Gear	200		
Fan Room	200	Inspection and Repair Tasks	300 500 750 1000
HVAC Room	200		
Motor Room	300		
Motor-Generator Room (Cargo Handling)	150		
Pump Room, Fire Pump Room	200	Workshops	300
Steering Gear Room	200	Paint Shop	750
Windlass Rooms	200	Workshop Office	500
Battery Room	200	Mechanical Workshop	500
Emergency Generator Room	200	Inst/Electrical Workshop	500
Boiler Rooms	100		
Bilge/Void Spaces	75	Unmanned Machinery Room	200
Muster/Embarkation Area	200	Shaft Alley	100
		Escape Trunks	50
Cargo Handling (Weather Decks)	200	Crane Cabin	400
Lay Down Area	200		
General Process and Utility Area	200		
Loading Ramps/Bays	200		
Cargo Storage and Maneuvering Areas	350	Hand signaling areas between crane shack and ship deck	300

TABLE 5
Lighting 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

As stated in 1/7.3.1, “Test Plans”, a Test Plan shall be developed to serve as the principal means for submitting design details of the lighting system for review by ABS Engineering and for verifying the measurements to be performed to verify compliance with lighting criteria. The Test Plan shall include the following:

6.1 Documentation

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 survey 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 2, “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

The Test Plan shall provide information regarding the proposed test schedule.

7 Test Requirements

7.1 General

Illuminance measurements shall be carried out as described below.

7.2 Data Acquisition and Instruments

The illuminance meter (light meter) should meet the requirements specified in Section B.5 of IESNA RP-12-97. This defines the instrumentation requirements for measuring white light.

Instruments used to measure red illuminance should meet the requirements specified in Section B.8.4 of IESNA RP-12-97.

Note: The measurement of red and/or low level white illuminance is not required for ship 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

Lighting measurements may be taken in port, at sea, or both, since the measurements are not dependent on vessel operation.

7.3.2 Spaces with Windows/Portlights

In spaces with windows or portlights where the minimum lighting level should 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

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

7.3.6 Test Interference

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 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 Lighting Test Report. Spaces shall be furnished with all usual equipment and furnishings normally found in the space.

7.3.7 External (Deck) Lighting

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 (excepting star and moon light contributions).

7.4 Measurement Locations

7.4.1 Selection of Spaces where Measurements are to be Conducted

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 4 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). 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/staterooms, 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/stateroom 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 can be considered part as the representative sample for crew cabins and staterooms, if applicable.
- vii) Where external nighttime measurements are taken, spaces shall be selected according to human presence in the space or task location, including: operating consoles, hand signaling locations, anchor handling locations, mooring locations, crew embarkation and debarkation areas, and cargo handling.

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 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 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 place 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 Section 6, Table 6, “Distribution of Measurement Positions within Spaces”.

**TABLE 6
Distribution of Measurement Positions within Spaces**

<i>Space Size</i>	<i>Minimum Number of Measurement Positions in Room</i>
Less than 40 m ² (431 ft ²)	1
Less than 80 m ² (861 ft ²)	2
Less than 200 m ² (2142 ft ²)	3
Greater than or equal to 200 m ² (2142 ft ²)	4

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

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.

Measurements for mirrors shall be taken approximately 400 mm (16 in.) away from the surface of the mirror. 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 head of the bed.

7.4.5 Red and Low-level White Illuminance

Guidance for the measurement of red and low-level white is provided in B.8.4 in IESNA RP-12-97. 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

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 or plane in space
- v) **Corridor lighting measurements**
- vi) Lighting level in cabins/staterooms 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**

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

An ABS Surveyor shall witness the equipment calibration and data collection process of the lighting tests. The ABS Surveyor shall provide documentation 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 Workboats*. 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 Steel Vessels*. Houston, TX.
- 4 American Bureau of Shipping. *Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways*. Houston, TX.
- 5 American Bureau of Shipping. *Rules for Building and Classing Steel Vessels Under 90 Meters (295 Feet) in Length*. Houston, TX.

2 Accommodation **Area** References

- 1 American Society for Testing and Materials. (2006). *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.
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- 17 U.S. Coast Guard, Department of Transportation. (1998). 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.
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3 Whole-body Vibrations References

- 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. (1996). *Acoustics – Measurement of noise shipboard vessels (ISO 2923: 1996)*. Geneva.
- 5 International Organization for Standardization. (2008) *Mechanical Vibration on Ships – Part 2: Measurement of Structural Vibration (ISO 20283-2:2008)*. Geneva.
- 6 International Organization for Standardization. (1998). *Mechanical mounting of accelerometers for measuring mechanical vibration and shock (ISO 5348:1998(E))*. Geneva.
- 7 International Organization for Standardization. (2005). *Human response to vibration – Measuring instrumentation (ISO 8041:2005)*. Geneva.
- 8 World Meteorological Organization (1995). *International Codes Vol I.1 Part A Alphanumeric Codes*. Boston, MA: American Meteorological Society.

4 Noise References

- 1 International Electrotechnical Commission. (2004). *Electroacoustics – Sound Level Meters – Part 1: Specifications (International Standard IEC 61672-1)*. Geneva: IEC Central Office.
- 2 International Electrotechnical Commission. (2000). *Integrating-averaging sound level meters (International Standard IEC 60804(2000-10))*. Geneva: IEC Central Office.
- 3 International Maritime Organization. (1981). *Code on noise levels on-board ships* (IMO Resolution A.468(XII)). London.
- 4 International Organization for Standardization. (1996). *Acoustics – Measurement of noise on-board vessels (ISO 2923: 1996)*. Geneva.
- 5 Kryter, K.D. (1994). *The handbook of hearing and the effects of noise: Physiology, psychology and public health*. San Diego: Academic Press.
- 6 World Meteorological Organization (1995). *International Codes Vol I.1 Part A Alphanumeric Codes*. Boston, MA: American Meteorological Society.

5 Indoor Climate References

- 1 American National Standards Institute. (2010). *Thermal environmental conditions for human occupancy* (ANSI/ASHRAE 55a-2010). Atlanta, GA: The American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
- 2 American National Standards Institute. (2010). *Practices for Measuring, Testing, Adjusting, and Balancing Shipboard HVAC&R Systems*. (ANSI/ASHRAE 15-2010). Atlanta, GA: The American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
- 3 International Organization for Standardization. (1998). *Ergonomics of the thermal environment – Instruments for measuring physical quantities* (ISO 7726: 1998 (E)). Geneva.
- 4 National Environmental Balancing Bureau. (2005). *NEBB Procedural standards for testing, adjusting, balancing of environmental systems*. Gaithersburg, MD.

6 Lighting References

- 1 Illuminating Engineering Society of North America. (1997). *Recommended practice for marine lighting* (IESNA RP-12-97). New York.
- 2 International Organization for Standardization. (2000). *Lighting of Indoor Work Places* (ISO 8995:2000). Geneva.



APPENDIX 2 Procedural Requirements for **ABS Recognized Ambient Environmental Testing Specialists**

1 Terminology

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 ABS Habitability (**HAB, HAB+, HAB++**), notation requirements. Approval of the Testing Specialist for ships may also allow for testing and measurement services for other ABS Habitability, Comfort, and MLC notations:

- **HAB(WB), HAB+(WB), HAB++(WB)**
- **HAB(OS), HAB+(OS), HAB++(OS)**
- **HAB(MODU), HAB+(MODU), HAB++(MODU)**
- **COMF, COMF+**
- **COMF(Y), COMF+(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) Evidence of approval/acceptance by certifying bodies, if any
- vi) Information about other activities which may present a conflict of interest
- vii) Record of customer claims and of corrective actions requested by certification bodies for the past year
- viii) Where relevant, list and documentation of licenses granted by equipment’s manufacturer
- ix) **Example Test Plan(s) for the ambient environmental quality for which approval is requested.**
- x) **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 **A2/4.2.9, “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

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.

4.2.3 Supervision

The **Testing Specialist** shall provide supervision for all services provided. The responsible supervisor shall have had a minimum of two (2) years experience in supervising 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 Procedures

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

4.2.7 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”.

4.2.8 Verification

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

4.2.9 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

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 the 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 non-conformities, 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

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)* be a Certified Industrial Hygienist (CIH) with experience in this ambient environmental aspect or
- iii)* have a documented history of at least two (2) years supervising 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

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 experience in performing vibration environmental testing onboard marine vessels.
- iii)* have adequate knowledge of vessel structures and equipment.

8.1.4 Equipment

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.

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".

8.2 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

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)* be a Certified Industrial Hygienist (CIH) with experience in this ambient environmental aspect or
- iii)* have a documented history of at least two (2) years supervising noise testing onboard marine vessels.

The supervisor shall have sufficient knowledge of vessel structures, measuring equipment, ISO 2923, **IEC 61672-1**, and IEC 60804, to **verify** that test procedures are compliant with the required test conditions.

8.2.3 Test Personnel

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 experience in performing noise testing onboard marine vessels.
- iii)* have adequate knowledge of vessel structures and equipment.

8.2.4 Equipment

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.

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".

8.3 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

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)* be a Certified Industrial Hygienist (CIH) with experience in this ambient environmental aspect or
- iii)* have a documented history of at least two (2) years supervising ambient environmental testing onboard marine vessels.

The supervisor shall have sufficient knowledge of vessel structures, measuring equipment, ANSI/ASHRAE **15 and 55a as well as** ISO 7726, to **verify** that test procedures are compliant with the required test conditions.

8.3.3 Test Personnel

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 experience in performing ambient environmental testing onboard marine vessels.
- iii)* have adequate knowledge of vessel structures and equipment.

8.3.4 Equipment

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.

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".

8.4 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

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)* be a Certified Industrial Hygienist (CIH) with experience in this ambient environmental aspect or
- iii)* have a documented history of at least two (2) years supervising ambient environmental testing onboard marine vessels.

The supervisor shall have sufficient knowledge of vessel structures, measuring equipment, and IESNA RP-12, to **verify** that test procedures are compliant with the required test conditions.

8.4.3 Test Personnel

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 experience in performing ambient environmental testing onboard marine vessels.
- iii)* have adequate knowledge of vessel structures and equipment.

8.4.4 Equipment

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.

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".



APPENDIX 3 Accommodation Area Criteria

(1 September 2013) The accommodation area criteria are contained in Appendix 3, “Accommodation Area Criteria”. The ILO MLC, 2006 quantitative accommodation area requirements have been included in this Guide and are denoted by a “#” symbol in the tables of Appendix 3 “Accommodation Area Criteria”.

To use the tables in Appendix 3, first determine which notation is being requested **HAB**, **HAB+**, or **HAB++**.

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

For example, Criteria #14 below provides three degrees for angles of inclination for stairways, one for **HAB**, **HAB+**, and **HAB++**. If seeking a **HAB++** notation, the 40 degrees criteria would need to be fulfilled. By fulfilling the criteria for the **HAB++** requirements, the criteria for **HAB+** and **HAB** are met.

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

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

Accommodation Area Criteria				
General				
Requirement		Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
# = Related ILO MLC 2006, Title 3 Requirement				
#	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.)		
	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 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 workstations 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** notation, the unshaded boxes under “Meets **HAB** Requirements” must be met. For a **HAB+** notation, the unshaded boxes under “Meets **HAB+** Requirements” need to be met as well as **HAB** requirements. For a **HAB++** notation, the unshaded boxes under “Meets **HAB++** Requirements” need to be met as well as **HAB** requirements and **HAB+** Requirements.

Accommodation Area Criteria				
Access/Egress				
Requirement		Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
# = Related ILO MLC 2006, Title 3 Requirement				
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 staterooms), 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	Horizontal doors that are self-closing must close in a time period of not less than 5 seconds or more than 10 seconds and be capable of closing against a 3.5-degree list.			
7	Vertical 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				
8	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. 			
9	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:			
	<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: Temporary rails can be used around unprotected openings into which a person may slip, trip or fall.</i>			

Accommodation Area Criteria				
Access/Egress				
Requirement # = Related ILO MLC 2006, Title 3 Requirement		Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
10	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				
11	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.			
12	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.			
13	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.).			
14	Accommodation area stairways have a maximum angle of inclination from the horizontal of:			
	<ul style="list-style-type: none"> 50 degrees 			
	<ul style="list-style-type: none"> 45 degrees 			
	<ul style="list-style-type: none"> 40 degrees 			
15	Stair risers and treads have the following design:			
	<ul style="list-style-type: none"> the riser height is no more than 230 mm (9 in.) and the tread depth is approximately 190 mm (7.5 in.), including a 25 mm (1 in.) tread nosing 			
	<ul style="list-style-type: none"> the riser height is no more than 230 mm (9 in.) and the tread depth is approximately 230 mm (9 in.), including a 25 mm (1 in.) tread nosing 			
	<ul style="list-style-type: none"> the riser height is no more than 230 mm (9 in.) and the tread depth is approximately 275 mm (10.75 in.), including a 25 mm (1 in.) tread nosing 			
	<ul style="list-style-type: none"> stairs in a stairway or stair tower, the depth of the tread and the height of riser are consistent 			
	<ul style="list-style-type: none"> the minimum tread width on one-way (one person) stairs is at least 610 mm (24 in.) 			
	<ul style="list-style-type: none"> the minimum tread width on two-way (two person) stairs is at least 915 mm (36 in.) 			

Accommodation Area Criteria				
Access/Egress				
	Requirement # = Related ILO MLC 2006, Title 3 Requirement	Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
	<ul style="list-style-type: none"> the minimum tread width on two-way (two person) stairs is at least 1,015 mm (40 in.) 			
	<ul style="list-style-type: none"> once a minimum tread width has been established at any deck, in that stair run, it is not decreased in the direction of escape 			
	<ul style="list-style-type: none"> all nosings have a non-slip surface 			
16	Stairway or stair towers are fitted with handrails with the following design:			
	<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				
17	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.			
18	Inclined ladders are between 50° and 60° from the horizontal.			
19	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. 			
20	Ladder landings at the top and bottom of inclined ladders:			
	<ul style="list-style-type: none"> at least 760 mm (30 in.) clear in length 			
	<ul style="list-style-type: none"> at least 915 mm (36 in.) clear in length. 			
RAMPS				
21	Ramps are sloped < 15 degrees for inclined walking surfaces			
22	Ramps have a non-skid surface.			
23	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.			
24	Access to lifeboats is provided such that a person in a stretcher can be easily embarked into the survival craft (e.g., ramp)			

Accommodation Area Criteria				
Access/Egress				
Requirement # = Related ILO MLC 2006, Title 3 Requirement		Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
PASSAGEWAY/WALKWAY DESIGN				
25	The clear walkway width for one person in an unrestricted area, where two persons could pass is at least 710 mm (28 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 915 mm (36 in.).			
27	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.).			

Appendix 3 Accommodation Area Criteria

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

Accommodation Area Criteria							
Crew Cabins							
Requirement # = Related ILO MLC 2006, Title 3 Requirement					Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
NON-PASSENGER AND NON-SPECIAL PURPOSE SHIP FLOOR AREA FOR VARIOUS VESSEL SIZES							
		Under 1,000 tons	1,000 to 3,000 tons	3,000 to 10,000 tons	Over 10,000 tons		
One Person Room							
#	1	4.5 m ² (48.5 ft ²)	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)	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)	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							
#	2	7.0 m ² (75 ft 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)	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)	8.0 m ² (86 ft ²)	9.0 m ² (97 ft ²)	9.0 m ² (97 ft ²)		
Junior Officer and Senior Officer							
#	3	7.5 m ² (80.5 ft ²)	7.5 m ² (80.5 ft ²)	8.5 m ² (91.5 ft ²)	10 m ² (107.5 ft ²)		
PASSENGER AND SPECIAL PURPOSE SHIP FLOOR AREA FOR VARIOUS VESSEL SIZES							
		Under 1,000 tons	1,000 to 3,000 tons	3,000 to 10,000 tons	Over 10,000 tons		
One Person Room							
#	4	4.5 m ² (48.5 ft ²)	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)	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)	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							
#	5	7.5 m ² (80.5 ft ²)	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)	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)	9.5 m ² (102.5 ft ²)		
Three Person Room							
#	6	11.5 m ² (124 ft ²)	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)	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)	13.5 m ² (145.5 ft ²)		

Accommodation Area Criteria								
Crew Cabins								
Four Person Room								
#	7	14.5 m ² (156 ft ²)	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)	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)	16.5 m ² (177.5 ft ²)			
Junior Officer								
#	8	7.5 m ² (80.5 ft ²)	7.5 m ² (80.5 ft ²)	7.5 m ² (80.5 ft ²)	7.5 m ² (80.5 ft ²)			
Senior Officer								
#	9	8.5 m ² (91.5 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)			
OCCUPANCY LEVEL								
#	10	Individual berths are provided for each crew member.						
#	11	Sleeping rooms in non-passenger vessels are not occupied by more than two persons						
	12	Individual sleeping rooms are provided (as appropriate) for:						
		<ul style="list-style-type: none"> officers in charge of a department 						
		<ul style="list-style-type: none"> navigating officers 						
		<ul style="list-style-type: none"> engineering officers in charge of a watch 						
		<ul style="list-style-type: none"> senior radio officers. 						
#		<ul style="list-style-type: none"> each seafarer, exemption may be granted by the competent authority for ships less than 3000 gross tonnage or special purpose ships 						
#	13	Separate sleeping rooms shall be provided for men and for women						
#	14	Crew members sharing rooms are in same occupation group and day persons do not share a room with watch-keepers.						
	15	Maximum number of persons to be accommodated in any sleeping room is marked indelibly and legibly in some conveniently seen place:						
		<ul style="list-style-type: none"> in the room 						
		<ul style="list-style-type: none"> outside the room. 						
CREW CABIN LOCATION								
	16	Location, means of access, structure and arrangement in relation to other spaces of crew accommodation areas is to:						
		<ul style="list-style-type: none"> provide adequate security 						
		<ul style="list-style-type: none"> protect against weather and sea 						
		<ul style="list-style-type: none"> insulate from heat and cold 						
		<ul style="list-style-type: none"> insulate from undue noise and effluvia (odors) from other spaces. 						
#	17	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.						
	18	Crew quarters are not located:						
		<ul style="list-style-type: none"> 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 						
#		<ul style="list-style-type: none"> immediately beneath working alleyways 						
#		<ul style="list-style-type: none"> below load line amidships or aft, unless satisfactory arrangements are made for lighting and ventilation and approved by the flag Administration 						
#		<ul style="list-style-type: none"> forward of the collision bulkhead. 						

Accommodation Area Criteria				
Crew Cabins				
19		Main steam and exhaust pipes for winches, electric cableways, ducting and similar gear/equipment do not pass through alleyways leading to crew accommodation areas or through the crew accommodation areas.		
ROOM DESIGN				
General				
#	20	Internal bulkheads are of approved material that is not likely to harbor vermin.		
	21	Wall surfaces are not constructed from tongued and grooved boarding or any other form of construction likely to harbor vermin.		
#	22	Where practicable a sitting or day room, adjoining the sleeping room is provided for the Master and Chief Mate		
	23	Pipes, ventilation ducts, or other installations do not obstruct berths.		
	24	Sleeping rooms are ventilated and heated.		
	25	HVAC vents shall not be directed at the heads of berths.		
	26	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				
	27	Berths are not side by side so that access to one berth can only be obtained over another.		
	28	Berths are generally oriented fore and aft		
	29	Berths contain individually operated privacy curtains		
	30	Berths contain individually operated fans/blowers.		
#	31	Crew cabin arrangements are either single tier or double tiered.		
#	32	Berths with portlights above them are only in a single tier arrangement.		
Emergency				
	33	An emergency alerting system (e.g., an audible alarm) is present for all crew cabin spaces.		
Outfitting				
#	34	Sleeping rooms with portlights, have curtains that completely block out light.		
#	35	Sleeping rooms are lighted with natural light and are provided with artificial light (subject to special arrangements as may be permitted in passenger vessels).		
	36	Grab bars and stepping surfaces are provided for access to upper berths.		
#	37	An electric reading light is provided at the head of each berth.		
#	38	The top berth in a tier has a dust-proof bottom of wood, canvas, or other suitable material.		
	39	In sleeping rooms with more than one occupant, furniture (beds, lockers, drawers, etc.) are labeled identifying which furniture is dedicated to which berth.		
	40	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.		
#	41	Furniture is of smooth, hard material not liable to warp or corrode.		
#	42	In vessels regularly trading to mosquito-infested ports, suitable screens are fitted to side scuttles, ventilators and doors to the open deck.		

Accommodation Area Criteria			
Crew Cabins			
DIMENSIONAL ASPECTS			
Aisles			
#	43	Aisle widths in sleeping areas are:	
		<ul style="list-style-type: none"> at least 610 mm (24 in.), between a single berth and the nearest obstruction 	
		<ul style="list-style-type: none"> at least 915 mm (36 in.), between facing berths 	
Berths			
#	44	The lower berth in a tier is at least 300 mm (12 in.) above the deck.	
#	45	The upper berth is placed approximately midway between the bottom of the lower berth and the lower side of the deck head beams.	
	46	Head clearance above each berth is:	
		<ul style="list-style-type: none"> at least 610 mm (24 in.) 	
		<ul style="list-style-type: none"> at least 810 mm (32 in.) 	
	47	Berth inside dimensions are:	
#		<ul style="list-style-type: none"> at least 1980 mm (78 in.) by 800 mm (31.5 in.) 	
		<ul style="list-style-type: none"> at least 2030 mm (80 in.) by 965 mm (38 in.) 	
#	48	The framework and leeboard of a berth is of approved material, hard, smooth and not likely to corrode or to harbor vermin.	
#	49	Berths constructed from tubular frames are completely sealed and without perforations which would give access to vermin.	
Storage Space			
	50	Sleeping rooms provide storage space for each occupant:	
		<ul style="list-style-type: none"> the clothes locker is fitted with a shelf and hasp 	
#		<ul style="list-style-type: none"> the clothes locker is at least 0.475 m³ (16.75 ft³) 	
#		<ul style="list-style-type: none"> 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. 	
	51	Accommodation areas for the hanging of oilskins (wet weather gear) are:	
		<ul style="list-style-type: none"> sufficient 	
		<ul style="list-style-type: none"> adequately ventilated 	
		<ul style="list-style-type: none"> provided outside but convenient to the sleeping rooms. 	

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

Accommodation Area Criteria				
Sanitary Spaces				
Requirement		Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
# = Related ILO MLC 2006, Title 3 Requirement				
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 if it is not conveniently located near the navigation bridge.			
#	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				
Note: tons = gross registered tons				
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.			

Accommodation Area Criteria				
Sanitary Spaces				
	Requirement # = Related ILO MLC 2006, Title 3 Requirement	Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
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:			
#	<ul style="list-style-type: none"> outside but within easy access of the machinery space and navigating bridge 			
#	<ul style="list-style-type: none"> fitted with individual lockers 			
#	<ul style="list-style-type: none"> 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.			
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 non-passenger 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 ratings) 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.			
CLEANING/MAINTENANCE				
23	Clearance is provided around and behind sanitary fixtures to easily adjust, service, or repair them			
24	Fixtures are bulkhead mounted for ease of cleaning.			
TOILETS				
25	Where there is more than one toilet in a space, they are sufficiently screened to provide privacy.			
26	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. 			
27	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 			
#	<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.)			

Accommodation Area Criteria					
Sanitary Spaces					
	Requirement # = Related ILO MLC 2006, Title 3 Requirement	Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements	
#	28	All toilets have ventilation to the open air, independent of any other part of the space.			
	29	All toilet spaces shall be ventilated sufficiently to be reasonably free of disagreeable odors and condensation.			
	30	The following minimum number of separate toilets are provided:			
		• 3 in vessels under 800 tons			
		• 4 in vessels 800 tons or over but under 3,000 tons			
		• 6 in vessels 3,000 tons or over.			
WASHBASINS					
	31	Water heaters supplying washbasins:			
		• do not support areas that have higher water temperature requirements			
		• are provided with anti-scalding devices.			
	32	The following at a minimum are provided for each washbasin:			
		• a mirror with light			
		• toiletry shelf			
		• electrical outlets that crew members have ready access to are equipped with ground fault interrupters (GFI)			
	33	Facilities to dry hands are provided at all washbasins.			
	34	Washbasins are:			
		• constructed of approved material			
		• smooth surfaced			
		• not liable to crack, flake or corrode.			
URINALS					
	35	Urinals have privacy partitions between units and at the end of rows if not provided by sanitary space structures.			
	36	The dimension between the centerline of two urinals side-by-side is 690 mm (27 in.) or greater.			
	37	The dimension between the centerline of a urinal and bulkhead next to the urinal is 380 mm (15 in.) or greater.			
	38	The height of the front edge of a urinal is between 455 mm (18 in.) and 605 mm (24 in.) above the deck surface			

Appendix 3 Accommodation Area Criteria

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

Accommodation Area Criteria				
Office				
	Requirement # = Related ILO MLC 2006, Title 3 Requirement	Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
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. 			
OUTFITTING				
	2 The vessel's office has a toilet and washbasin in close proximity.			

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

Accommodation Area Criteria					
Food Service Areas					
Requirement # = Related ILO MLC 2006, Title 3 Requirement			Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
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	Distributive systems such as piping, wiring and HVAC ducts are minimized in food service areas.				
7	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.				
8	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					
9	Toilet room doors opening directly into food preparation or serving areas are self-closing and tight.				
FOOD SERVICE PASSAGEWAYS					
10	The passage width between storage shelves is at least 710 mm (28 in.).				
MESS ROOM					
General					
11	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. 				
# 12	Mess rooms have tables and seats sufficient for the number of persons likely to use them at any one time.				
13	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.).				
# 14	Lighting in mess rooms is provided by means of natural light and artificial light (subject to special arrangements as may be permitted in passenger vessels).				

Accommodation Area Criteria				
Food Service Areas				
	Requirement # = Related ILO MLC 2006, Title 3 Requirement	Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
15	The following is available for crew use at all times:			
#	• refrigerator			
#	• facilities for hot beverages			
#	• facilities for cool water.			
16	In vessels less than 1,000 tons, two sufficient separate mess room accommodation areas are provided for:			
	• master and officers			
	• petty officers and other ratings			
	<i>Note: Please refer to flag State requirements for applicability of separate mess rooms.</i>			
17	In vessels greater than 1,000 tons, three sufficient separate mess room accommodation areas are provided for:			
	• master and officers			
	• engine department petty officers and other ratings			
	• deck department petty officers and other ratings			
	<i>Note: Please refer to flag State requirements for applicability of separate mess rooms.</i>			
18	The tops of tables and seating are capable of being easily cleaned.			
# 19	Where available pantries are not accessible to mess rooms, adequate lockers for mess utensils and proper facilities for washing utensils are provided.			
Outfitting				
20	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.			
21	Tray slides (or rails) if provided are placed along food and beverage serving lines.			
22	Adequate lockers for mess utensils are provided.			
MESS ROOM DIMENSIONAL ASPECTS				
23	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			
24	Distance between tables with back to back seating is:			
	• at least 1195 mm (47 in.)			
	• at least 1525 mm (60 in.)			
25	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			
	• at least 1.9 m ² (20.5 ft ²) per person			
GALLEY/SCULLERY				
General				
26	Ice making facilities for at least 0.57 kg (1.25 pounds) of ice per person per day are provided.			
27	Toilet and washbasin facilities are of suitable design and provide hand washing stations so that no crew member must walk more than 7.5 m (25 ft) to a station. Slop sinks and scullery sinks are not satisfactory hand washing stations			

Accommodation Area Criteria				
Food Service Areas				
Requirement		Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
# = Related ILO MLC 2006, Title 3 Requirement				
Potable Water				
28	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.			
29	If the vessel has a garbage room, hot and cold potable water is available for washing garbage cans.			
30	Potable water tanks are identified with a number and the words "POTABLE WATER" adequately sized.			
31	Potable water piping and fittings are labeled.			
Maintenance/Cleaning				
32	Drawers and bins used as food contact surfaces are readily removable and easily cleaned.			
33	Covers, insets, or receptacles for unpackaged foods or beverages are easily removable or designed for easy cleaning in place.			
34	Stove top or range sea rails are readily removable and easily cleanable and brackets for sea rails are easily cleanable.			
35	Ventilation baffles, vanes, louvers, dampers, filters, etc., are easily accessible or removable (without tools) for cleaning.			
Refrigeration/Freezer				
36	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.			
37	There is an alarm in each freezer and cold storage room to warn when the temperature is out of specification.			
Dishwashing				
38	Easy access is provided to a sink or dish washing machine.			
Galley Dimensional Aspects				
39	Tops of food dressing tables, counters and drain boards are constructed with an integral back splash			

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

Accommodation Area Criteria				
Recreation				
Requirement		Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
# = Related ILO MLC 2006, Title 3 Requirement				
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) including exercise equipment for crew members.		
#	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.		
#	3	Furnishings for recreational facilities shall as a minimum include a bookcase and facilities for reading, writing and, where practicable, games.		
EXERCISE AREAS				
#	4	Consideration has been given for a swimming or splash pool.		
RECREATIONAL AREAS				
#	5	In vessels of 8,000 tons or over, the following shall be provided:		
		• a smoking room		
		• library room in which films or television may be shown		
		• a hobby and game room.		
#	6	Consideration has been given for a recreational canteen.		
	7	Recreation rooms in the crew accommodation spaces are adequately insulated to prevent condensation or overheating.		
	8	Approximately 1.0 m ² (11 ft ²) is provided for each seat in the lounge.		
	9	Approximately 1.25 m ² (14 ft ²) is provided for each seat in the lounge.		
	10	Vessels regularly trading to or in the tropics and the Arabian Gulf, are equipped with awnings for use:		
		• over exposed decks above crew accommodation areas		
		• over exposed recreation deck space or spaces.		

Appendix 3 Accommodation Area Criteria

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

Accommodation Area Criteria				
Laundry				
Requirement		Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
# = Related ILO MLC 2006, Title 3 Requirement				
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			
	• separate from sleeping rooms and mess rooms			
	• ventilated and heated.			

Appendix 3 Accommodation Area Criteria

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

Accommodation Area Criteria				
Medical				
Requirement		Meets HAB Requirements	Meets HAB+ Requirements	Meets HAB++ Requirements
# = Related ILO MLC 2006, Title 3 Requirement				
GENERAL				
# 1	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.			
2	Medical accommodation area is not used as a storage area except for medical supplies.			
3	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.			
4	Medical accommodation area is suitably separated from other spaces and used for the care of the sick and for no other purpose.			
5	Medical accommodation area is suitably designed so that the occupant can be comfortably housed and may receive proper attention in all weather.			
6	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				
7	If the vessel does not carry a doctor, it must have an approved medicine chest with readily understandable instructions.			
# 8	Medical accommodation area has a toilet, washbasin and bathtub or shower conveniently situated for the use of patients.			
9	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.			
10	Medical accommodation area is appropriately equipped to render the necessary medical attention.			
11	Medical accommodation area is equipped with stretchers that meet the following:			
	• the ability to winch a sick person into a helicopter or vessel, and the capability of floating and righting itself in the water			
	• collapsible and suitable for use in confined spaces			
# 12	Toilet accommodation area is provided for the exclusive use of the occupants of the hospital accommodation area.			
13	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.			
14	Medical accommodation area has lockable storage for drugs, dressings and medical equipment.			
15	Medical accommodation area has an intercom or signaling system (e.g., an emergency call device) to the navigation bridge.			

APPENDIX 4 Evaluation of Crew Exposure to Shock on High-Speed Craft

This Appendix provides procedures and criteria for the evaluation and assessment of vessel motions (vibration and shock) for crew health (and to a lesser degree, comfort). The results of the methods and findings below impose no requirements for acquiring a notation; rather, the results are intended to identify threats to mariner health and comfort so as to aid the Owner in identifying means to control or mitigate those threats.

1 Terminology

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

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

2 Procedure

Vibration and shock on high-speed craft should be evaluated using the vibration dose values (VDV) and assessed relative to a limiting exposure value of $9.1 \text{ m/s}^{1.75}$.

Guidance on methods of measuring whole-body vibration at a workplace with reference to health can be found in BS EN 14253.

3 Measurement

Measurements should be made using the VDV method defined in International Standard ISO 2631-1.

3.1 Location of Measurements

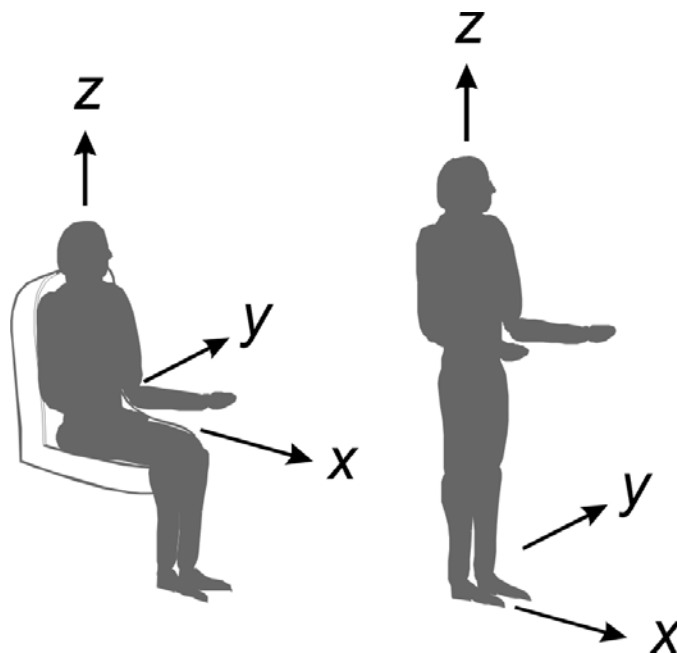
Measurements should be made at a distribution of locations representative of crew locations in the vessel as noted below. These should encompass the different types of seating installed on the vessel and locations both near to the center of the craft and closest to the forward, aft, port and starboard extremities. Vibration and shock should be measured in the three orthogonal axes on the seat (see Appendix 4, Figure 1).

For seated operations, vibration should be measured on the seat. Where suspension seats are provided, appropriate adjustments should be made for the weight of occupants.

Care should be taken to avoid artifacts due to intentional movements of a seated person (e.g., when entering, leaving or moving in the seat), which can result in inflated estimates of vibration magnitudes. Inspection of acceleration time histories can be helpful to identify these events (BS EN 14253 provides additional information and examples).

In locations where crew members stand on the deck, the vibration should be measured on the standing surface closely adjacent to the area of contact between the feet and that surface.

FIGURE 1
Whole-body Vibration Measurement Axes for Seated and Standing Workers



3.2 Duration of Measurements

Measurements should produce vibration dose values that are representative of the shock and vibration throughout the working day of a crew member. The operating conditions during the measurements should be selected to be representative of all typical conditions (e.g., loading, speed, heading, sea state) that occur during a typical watchstanding period. Measurements may be made over short periods that are representative of the different operating conditions that occur during a typical day. A predicted VDV should then be calculated from the magnitude and duration for each axis and for each condition. The partial vibration values are combined to give the overall daily VDV.

3.3 Measurement Instrumentation

Whole-body vibration measuring equipment should comply with ISO 8041, “Human response to vibration – measuring instrumentation,” and be in current calibration traceable to national or international standards.

The accelerometers should have a flat frequency response between 0.25 Hz and 160 Hz, and the accelerometers and measuring instrument should have a sufficient dynamic range to encompass the range of accelerations that could occur at the measurement location. High peak accelerations can occur on high-speed craft and could result in an overload unsuitable for transducers or an instrument with an inappropriate range setting. Vibration should be measured in three axes using either a tri-axial accelerometer or three single-axis accelerometers orientated in orthogonal directions.

Calibration checks should be performed before and after measurements.

In locations where crew members are seated, measurements should be made in three axes on seat surfaces using accelerometers molded into a flexible disc that complies with ISO 10326-1. The center of this disc should be positioned under the sitting bones of the seated person.

In locations where the crew stands on the deck, the vibration should be measured directly on the supporting surface. The accelerometers may be mounted in the middle of a rigid plate in an area where the supporting surface is not rigid, with a person standing on the plate (see BS EN 14253).

4 Evaluation and Assessment of Vibration

The vibration dose value (VDV_j) for axis j (where $j = x, y$ or z) is computed from:

$$VDV_j = \left(\int_0^T a_{wj}^4(t) dt \right)^{\frac{1}{4}}$$

Here, $a_{wj}^4(t)$ is the frequency-weighted acceleration in axis j as a function of time t , and T is the duration of the exposure.

When considering the risks to health from whole-body vibration and shock, ISO 2631-1 applies a weighting factor to the vibration dose values. For the x - and y -axes, the acceleration values are multiplied by 1.4. For the z -axis, the multiplying factor is 1.0.

The vibration dose value to be used for the assessment of risk is the greatest of the frequency-weighted $VDVs$ in any of the three orthogonal axes after multiplication by the appropriate weighting factor:

$$VDV = \max[1.4VDV_x, 1.4VDV_y, VDV_z]$$

Mariner's daily VDV can be compared to exposure limits in the table below:

Value of vibration/repetitive shock above which controlling the whole-body vibration exposure to humans is recommended.	9.1 m/s ^{-1.75}
Value of vibration/repetitive shock above which humans should not be exposed.	21 m/s ^{-1.75}

Where exposures are found to be above these values, means to implement measures to control the risks of whole-body vibration to workers should be considered.

5 References

British Standards Institution (1987) Measurement and evaluation of human exposure to whole-body mechanical vibration and repeated shock. BS 6841:1987.

Griffin M J (1990) Handbook on Human Vibration. Academic Press Ltd., London.

International Organization for Standardization (2004) Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Part 5: Method for evaluation of vibration containing multiple shocks. ISO 2631-5:2004(E).

International Organization for Standardization (2007). Mechanical Vibration – Laboratory Method for Evaluating Vehicle Seat Vibration – Part 1: Basic Requirements. ISO 10326-1:2007

International Organization for Standardization (2010) Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Part 1: General Requirements. ISO 2631-1:2010.

APPENDIX 5 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
ed.	Edition
EN	European Norms
ft/s	Feet-per-second
fc	Foot-candle
ft	Feet
ft ²	Square feet
GFI	Ground Fault Interrupter
HAB	Ship Habitability notation
HAB+	Ship Habitability Plus notation
HAB++	Ship 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

Appendix 5 Acronyms and Abbreviations

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
VDV	Vibration Dose Value
W_m	Frequency weighting used to evaluate x, y, and z-axis vibration with respect to comfort.
WMO	World Meteorological Organization



APPENDIX 6 Associated Documentation

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

ANSI/ASHRAE	www.ansi.org
IEC	www.iec.org
IESNA	www.iesna.org
ILO	www.ilo.org
IMO	www.imo.org
ISO	www.iso.org
NEBB	www.NEBB.org