



**GUIDE FOR**

---

**HABITABILITY OF INDUSTRIAL PERSONNEL ON  
ACCOMMODATION VESSELS**

**FEBRUARY 2017**

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

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## Foreword

ABS has produced this *Guide for Habitability of Industrial Personnel on Offshore Accommodation Vessels* in order to provide a single source for habitability criteria suitable for accommodation vessels.

This Guide may be applied to accommodation vessels providing accommodation to industrial personnel, excluding members of the crew, who are engaged in some aspect of coastal, offshore, or related employment. More specifically, this Guide may be applied to mobile offshore units (i.e., a self-elevating or column-stabilized mobile offshore units), non-self-propelled barges and offshore support vessels primarily intended for the accommodation of more than 36 persons who are industrial personnel, engaged in some aspect of coastal, offshore, or related employment, excluding members of the crew. In the case of an accommodation barge, it is intended to accommodate these persons only when the barge is moored or otherwise fixed on location. During transit, the accommodation barge will have on board only those crew members necessary for the transit operation. In the case of a self-elevating unit, during jacking or towing operations, it is intended that the unit have on board only those crew members necessary for these operations.

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

For the **HAB(ACCOM)** level, this Guide focuses on five (5) categories of habitability criteria that can affect task performance, safety and the quality of life. These categories can be controlled, measured, and assessed in personnel rest, and recreation areas of offshore accommodation vessel. These categories are: personnel accommodation area design, whole-body vibration, noise, indoor climate, and lighting.

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

To be awarded any of these notations, an offshore accommodation vessel must meet the appropriate prescriptive criteria across the various habitability categories.

In addition to the **HAB(ACCOM)** notation assignment, at the Owner's request, ABS may review the crew accommodation area design for compliance with the requirements of the applicable ABS *Guide for Crew Habitability* as related to the **HAB**, **HAB(WB)**, and **HAB(MODU)** notations as well as with the ILO MLC, 2006 Title 3 requirements, as related to the **MLC-ACCOM** notation.

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](http://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](mailto:rsd@eagle.org).*



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## SECTION 1 General

### 1 Introduction

ABS recognizes the importance that suitable habitability criteria and design practices may have on the safety, productivity, morale, and overall well-being of industrial personnel. The *ABS Guide for Habitability of Industrial Personnel on Accommodation Vessels* has been developed with the objective of improving the quality of personnel performance and comfort by improving their living environment in terms of accommodation area design and ambient environmental qualities. These habitability criteria have been chosen to provide a means to reduce personnel fatigue, improve performance and safety, and to enhance personnel recruiting and retention.

### 2 Application

This Guide is applicable to new and existing accommodation vessels for which an optional Habitability (**HAB(ACCOM)**), Habitability Plus (**HAB+(ACCOM)**), or Habitability Plus Plus (**HAB++(ACCOM)**) notation has been requested. The habitability criteria are a measure of the acceptability of industrial personnel accommodation areas for living.

In addition to the **HAB(ACCOM)** notation assignment, at the Owner's request, ABS may review the crew accommodation area design for compliance with the requirements of the applicable *ABS Guide for Crew Habitability* as related to the **HAB**, **HAB(WB)**, and **HAB(MODU)** notations as well as with the ILO MLC, 2006 Title 3 requirements, as related to the **MLC-ACCOM** notation.

ABS has produced this *Guide for Industrial Personnel Habitability on Accommodation Vessels* in order to provide a single source for habitability criteria suitable for the industrial personnel areas of accommodation vessels. This Guide may be applied to vessels providing accommodation to industrial personnel who are engaged in some aspect of coastal, offshore, or related employment, excluding members of the vessel's crew.

### 3 Scope

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

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

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

- i) Whole-body Vibration
- 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 personnel performance and providing a base level of habitability and elements of safety related to habitability.

While producing this Guide, ABS took a pragmatic 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/unit or shipyard for the purposes of meeting any of the ABS Habitability (**HAB(ACCOM)**, **HAB+(ACCOM)**, **HAB++(ACCOM)**) notation requirements. Approval of the Testing Specialist for accommodation vessels may also allow for testing and measurement services for other ABS Habitability, Comfort, and MLC notations.

*Accommodation Vessel:* Within the application of this Guide, an *Accommodation Vessel* is a mobile offshore unit (i.e., a self-elevating or column-stabilized mobile offshore unit), a non-self-propelled barge, or an offshore support vessel, primarily intended for the accommodation of more than 36 persons who are industrial personnel, engaged in some aspect of coastal, offshore, or related employment, excluding members of the crew. In the case of an accommodation barge, it is intended to accommodate these persons only when the barge is moored or otherwise fixed on location. During transit, the accommodation barge will have on board only those crew members necessary for the transit operation. In the case of a self-elevating unit, during jacking or towing operations, it is intended that the unit have on board only those crew members necessary for these operations.

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

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

*Crew:* All persons carried on board the accommodation vessel to provide maintenance and operation of the vessel, its machinery, systems and arrangements or to provide services (e.g., catering, laundry, medical, etc.) for other persons onboard the vessel.

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

*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.

*Industrial Personnel:* Individuals from the offshore or similar industry who are temporarily housed on the accommodation vessel. These persons do not include members of the crew of the accommodation vessel itself, but may include crew members or industrial personnel from other vessels, drilling units, offshore installations, etc.

*Industrial Personnel Accommodation Areas/Block:* For the purpose of this Guide, are those areas used for cabins and sanitary spaces (private and public), food service areas, recreation spaces, medical areas, access/egress areas, office and administration spaces, and service spaces.

*Recreation Spaces:* Those portions of the industrial personnel accommodation areas that are used for recreation such as a lounge, library, quiet room, internet room, TV room, movie theater, exercise room, gymnasium, shop/kiosk, or similar permanently enclosed spaces.

*Service Spaces:* Those portions of the industrial personnel accommodation areas that are used for changing rooms, self-service laundry spaces, and similar permanently enclosed spaces.

*Office and Administration Spaces:* Those portions of the industrial personnel accommodation areas that are used for offices areas, reception spaces (e.g., helicopter arrival and departure areas), conference rooms and training rooms, and similar permanently enclosed spaces.

*Food Service Areas:* Those portions of the industrial personnel accommodation areas that are used for dining areas, snack areas and pantries containing no cooking appliances.

*Test Plan:* Document containing the requisite information regarding vessel design and layout, test personnel, test conditions, measurement locations, data acquisition, instruments, data analysis, and test schedule necessary for verifying the measurements for the ambient environmental aspects of habitability. This document is to be primarily prepared by the ABS Recognized Ambient Environment Testing Specialist with additional input provided by the designer/builder. Submission of the document for approval can be by either the Testing Specialist or the designer/builder.

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

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

## 5 Associated Documentation

See Appendix 2, “Procedural Requirements for ABS Recognized Ambient Environmental Testing Specialists” for more information.

## 6 Notation

At the request of the Owner, operator, or builder, an accommodation vessel complying with the minimum criteria for personnel 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(ACCOM)**.

An accommodation vessel complying with the **HAB(ACCOM)** criteria and the more stringent criteria with respect to personnel accommodation areas, whole-body vibration, noise and indoor climate may be distinguished in the *Record* by the notation **HAB+(ACCOM)**.

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

	<b>HAB(ACCOM)</b>	<b>HAB+(ACCOM)</b>	<b>HAB++(ACCOM)</b>
Industrial Personnel Accommodation Areas	<b>HAB(ACCOM)</b> requirements for Accommodation Areas	<b>HAB(ACCOM)</b> and <b>HAB+(ACCOM)</b> requirements for Accommodation Areas (no difference between <b>HAB+(ACCOM)</b> and <b>HAB++(ACCOM)</b> )	
Whole-body Vibration	Level of vibration – reducing discomfort	Lower level of vibration – increased comfort	Lowest level of vibration – increased comfort
Noise	IMO Code on Noise with modifications	<b>HAB(ACCOM)</b> with additional requirements	<b>HAB+(ACCOM)</b> with additional requirements
Indoor Climate	No provision for individual temperature adjustment		Aimed at enhancing industrial personnel comfort by making provisions for individual adjustments for 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 accommodation vessel are to be submitted:

- i) Outboard and inboard profiles that show the elevations of all major decks.
- ii) Plans of each deck showing the watertight and non-tight bulkhead locations, structural and non-structural bulkhead locations, layout of major machinery, etc.

## 7.2 Industrial Personnel Accommodation Areas

At a minimum, scaled arrangement drawings of the various accommodation spaces (elevation and plan views) are to be submitted to ABS Engineering. Details of the accommodation area data requirements are provided in Section 2/5, “Industrial Personnel Accommodation Area Documentation”.

## 7.3 Ambient Environment

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

### 7.3.1 Test Plans

Test Plans 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

Test Plans require approval by ABS Engineering before any measurements are made. ABS Engineering is to notify the Owner, operator, or builder whether the Test Plans have been approved or require alteration. An ABS approved copy of the Test Plan is to become part of the accommodation vessel’s official documentation.

### 7.3.2 Test Reports

Upon completion of the ambient environmental testing, Test Reports are to be submitted to the ABS Surveyor. In addition, a copy of the Test Reports is to become part of the accommodation 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:

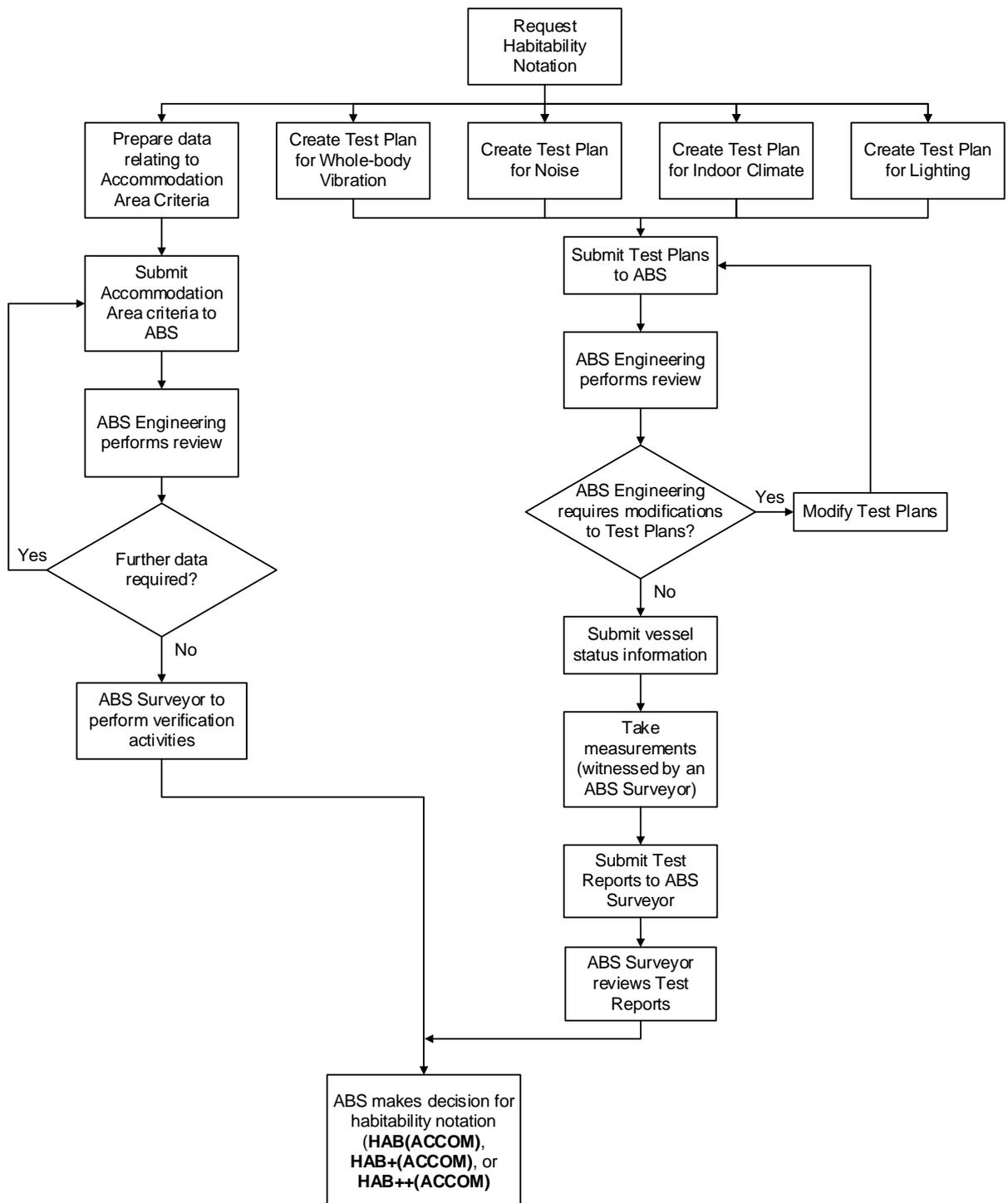
<i>Environmental Aspect</i>	<i>Test Report Details</i>
Whole-body Vibration	Subsection 3/8
Noise	Subsection 4/8
Indoor Climate	Subsection 5/8
Lighting	Subsection 6/8

## 8 Process for Obtaining a Notation

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

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

**FIGURE 1**  
**Process for Obtaining a Habitability Notation**



### 8.1 Industrial Personnel Accommodation Areas

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

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

The results of the ABS Engineering review and actual ABS Surveyor verification are to 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 are to be individually prepared and submitted to ABS Engineering. These Test Plans are to serve as a primary means for verifying the measurement locations and measurement process, as well as specifying the Testing Specialist who will perform the ambient environmental testing.

Testing, inspections, and data collection are to be performed by Testing Specialists and witnessed by an ABS Surveyor. Test Reports for ambient environmental testing are to be prepared by Testing Specialists and submitted to the ABS Surveyor for review.

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

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

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

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

**TABLE 1**  
**Threshold for Measurements to be Considered**  
**Close to Non-Compliance**

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

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

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

### 8.3 Results

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

## 9 Initial Requirements

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

## 10 Surveys after Construction

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

- i) Maintenance and Operations logs since the previous Initial, Annual, or Special Periodical Survey, if any
- ii) Fire, repair, and damage reports since the previous Initial, Annual, or Special Periodical Survey, if any
- iii) A list of all structural or mechanical modifications to the accommodation vessel since the previous Initial, Annual, or Special Periodical Survey, if any
- iv) Verification that equipment and facilities continue to be fit for purpose and are operating in accordance with the 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 Habitability notation. As a result, the accommodation vessel may be subject to the review, ambient environmental testing, and inspection requirements of this Guide.

### 10.2 Special Periodical Surveys

In order to maintain the **HAB(ACCOM)**, **HAB+(ACCOM)**, or **HAB++(ACCOM)** notation, a Special Periodical Survey is to be completed within five years after the date of build or after the crediting date of the previous Special Periodical Survey. The interval between Special Periodical Surveys may be reduced by ABS. If a Special Periodical Survey is not completed at one time, it will be credited as of the completion date of the survey, but not later than five years from date of build or from the date recorded for the previous Special Periodical Survey. If the Special Periodical Survey is completed prematurely but within three months prior to the due date, the Special Periodical Survey will be credited to agree with the effective due date.

### 10.2.1 Survey Requirements

The Survey is to comprise ABS Engineering reviews, ABS Surveyor accommodation verifications, and witnessing of ambient environmental testing. The Survey will cover all applicable habitability aspects.

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

- i) Fire, repair, or damage reports since previous Annual Survey, if any
- ii) A list of all structural or mechanical modifications to the accommodation vessel since previous Annual Survey, if any
- iii) Drawings/arrangements of industrial personnel spaces, HVAC, electrical, etc., affected by alterations, if any
- iv) Copies of the approved Initial Test Plans and Test Reports
- v) Copies of Test Plans and Test Reports resulting from Annual Surveys, if any
- vi) Previous Special Periodical Survey Test Plans and Reports
- 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 personnel spaces against any alterations to the accommodation vessel related to the criteria in Appendix 3 of this Guide 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 by ABS Engineering. The third is to allow scheduling of measurement verifications and ambient environmental testing by ABS Surveyor.

A Special Periodical Survey Test Plan for each ambient environmental aspect of Habitability is to be submitted in accordance with the criteria stated below. The approved Initial Test Plans are to 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 Section 3 through 6 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 are to be followed:

- i) Measurements are to be taken in all areas affected by alterations, if any. 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 all ambient environmental aspects, measurements are to 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)].
- iii) For all ambient environmental aspects, measurements are to be taken in twenty-five (25) percent of industrial personnel cabins identified in the initial Test Plans. Any worst case locations can be considered part of the representative sample for personnel cabins, if applicable.
- iv) For all ambient environmental aspects, measurements are to be taken where a single instance of one (1) type of an industrial personnel accommodation space exists within the accommodation vessel (e.g., mess room, gymnasium, library, etc.). The worst case locations can be considered part of the single instance representative sample, if applicable.

- v) Where multiple instances of the same type space exist, a representative sample of at least twenty-five (25) percent of each type is to 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 are to be conducted in accordance with 7.4.2 of the appropriate Section of this Guide.

### 10.3 Requirements for Accommodation Vessel Alterations

No alterations, including the installation of portable accommodation modules, which affect or may affect the Habitability notation awarded, including alterations to the structure, machinery, electrical systems, piping, furnishings or lighting systems, are to be made to the accommodation vessel unless plans of the proposed alterations are submitted to and approved by ABS before the work of alteration/installation is commenced. If ABS determines that the alteration will affect the Habitability notation, the altered accommodation 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 satisfy the criteria directly cited or referred to in this Guide. The demonstration of an alternative's acceptability can be made through either the presentation of satisfactory service experience or systematic analysis based on valid engineering principles.

### 11.2 National Regulations

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

### 11.3 Departures from Criteria

The criteria contained in this Guide are envisioned to apply to accommodation 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 Mobile Offshore Drilling Units*
- *ABS Rules for Building and Classing Steel Barges*
- *ABS Rules for Building and Classing Offshore Support Vessels*
- *ABS Guide for Building and Classing Mobile Offshore Units*
- *ABS Guide for Building and Classing Accommodation Barges*
- *ABS Guide for Portable Accommodation Modules*

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

When a departure from criteria is identified, during either the notation's initial issuance or reconfirmation process, it is to be reviewed by ABS in consultation with the shipyard or the Owner. When the design of the accommodation areas or ambient environmental test results contains 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 Industrial Personnel Accommodation Areas

### 1 Background

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

Conversely, inappropriate accommodation areas can adversely impact the industrial personnel'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 industrial personnel alertness and well-being is to be of concern to accommodation vessel Owners and operators.

### 2 Scope

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

The criteria are applicable only to the areas of the accommodation block allocated to the industrial personnel and do not include crew accommodation and vessel operational spaces in the accommodation block.

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

### 3 Associated Documentation

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

### 4 Criteria

The accommodation area criteria are contained in Appendix 3, "Accommodation Area Criteria". Meeting the baseline **HAB(ACCOM)** criteria in Appendix 3 fulfills the physical quantitative accommodation area arrangement requirements contained in ILO MLC 2006, Title 3, denoted by a "#" symbol in the tables.

The **HAB+(ACCOM)** and the **HAB++(ACCOM)** notations have more stringent criteria than the **HAB(ACCOM)** notation with the objective of providing enhanced living conditions to improve industrial personnel safety and comfort. This includes enhanced criteria for access/egress, industrial personnel cabins, food service areas, and recreation/leisure.

## 5 Industrial Personnel Accommodation Area Documentation

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

### 5.1 Data Requirements

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

#### 5.1.1 New Construction

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

#### 5.1.2 Existing Accommodation Vessels

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

## 6 Submittal Review and Verification

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

ABS Engineering will review the submitted accommodation area documentation. ABS Engineering will report any deviation from criteria to the Owner, operator or builder for resolution and will also identify any criteria that the ABS Surveyors must field verify.

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

## 7 Results

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



## SECTION 3 Whole-body Vibration

### 1 Background

Living onboard accommodation vessels imposes a series of generally low-frequency mechanical vibrations, as well as single-impulse shock loads on the human body.

Low-frequency vibrations are also imposed by vessel motions, which are produced by the various sea states in conjunction with vessel speed when in transit. 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 accommodation vessels. The criteria were selected to limit potential vibration-related discomfort of industrial personnel.

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 personnel will be exposed.

The criteria in this Section are applicable only to industrial personnel accommodation areas, as defined in Section 1, and do not include vessel crew accommodation spaces.

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

### 3 Terminology

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

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

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

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

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

- In human response to vibration, various frequency weightings have been defined in order to reflect known or hypothesized relationships between vibration frequency and human response.
- The frequency weighting used to evaluate whole-body vibration in this Guide is  $W_m$  (whole-body) for all three axes (x, y, and z), in accordance with ISO 20283-5:2016.

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

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

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

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

*Reference Calibration:* Calibration of a measuring instrument and of a portable calibrator conducted at least every two (2) years (or more frequently if specified by the manufacturer) by an accredited Testing and Calibration Laboratory accredited according to ISO 17025:2005, as amended, with traceability to a national or international standard.

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

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

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

*Water Depth:* The expected distance from the water's surface to the seabed on location.

*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. It 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 20283-5:2016, Mechanical Vibration – Measurement of Vibration on Ships – Part 5: Guidelines for Measurement, Evaluation and Reporting of Vibration with Regard to Habitability on Passenger and Merchant Ships
- ISO 2631-2:2003, 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
- ISO 20283-2:2008, Mechanical Vibration – Measurement of Vibration on Ships – Part 2: Measurement of Structural Vibration

- ISO 17025:2005, General requirements for the competence of testing and calibration laboratories.
- World Meteorological Organization (WMO) Manual on Codes, No. 306, Part A, Alphanumerical Codes (2011 Edition, Updated in 2014)

## 5 Criteria

The whole-body vibration criteria for the Habitability notations (**HAB(ACCOM)**, **HAB+(ACCOM)**, or **HAB++(ACCOM)**) are provided in Section 3, Table 1, “Maximum Weighted Root-Mean-Square Acceleration Level”. The severity of the vibration is to be indicated by the weighted root-mean-square acceleration value ( $a_w$ ) as defined in ISO 8041:2005.

The maximum vibration levels are to be determined for the test conditions specified in 3/7.3, “Test Conditions” and are not to be exceeded. In addition, these criteria are only applicable under normal operating conditions (i.e., mooring, dynamic positioning, and/or transit) during which industrial personnel are accommodated onboard the vessel.

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

The **HAB(ACCOM)** notation’s maximum vibration level is primarily aimed at reducing discomfort. The more stringent maximum level for the **HAB+(ACCOM)** and **HAB++(ACCOM)** notations are aimed at improving comfort. In this instance, “comfort” means the ability of personnel to use a space for its intended purpose with minimal annoyance from whole-body vibration.

**TABLE 1**  
**Maximum Weighted Root-Mean-Square Acceleration Level**

Notation	Frequency Range	Acceleration Measurement	Maximum Weighted RMS Level		
			Type A Spaces	Type B Spaces	Type C Spaces
<b>HAB(ACCOM)</b>	1.0 – 80 Hz	$a_w$	125 mm/s <sup>2</sup> (3.5 mm/s)	125 mm/s <sup>2</sup> (3.5 mm/s)	143 mm/s <sup>2</sup> (4.0 mm/s)
<b>HAB+(ACCOM)</b>	1.0 – 80 Hz	$a_w$	107 mm/s <sup>2</sup> (3.0 mm/s)	107 mm/s <sup>2</sup> (3.0 mm/s)	125 mm/s <sup>2</sup> (3.5 mm/s)
<b>HAB++(ACCOM)</b>	1.0 – 80 Hz	$a_w$	71.5 mm/s <sup>2</sup> (2.0 mm/s)	89.5 mm/s <sup>2</sup> (2.5 mm/s)	107 mm/s <sup>2</sup> (3.0 mm/s)

Notes:

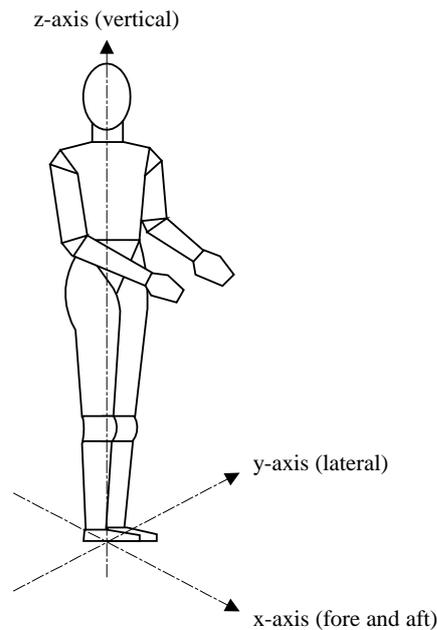
**Type A Spaces:** Cabins, Medical Spaces

**Type B Spaces:** Food Service Areas, Recreation Spaces, Public Sanitary Spaces, Service Spaces, Access/Egress Areas

**Type C Spaces:** Office, Administration Areas, Reception areas

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.

**FIGURE 1**  
**Measurement Axes**



## 6 Test Plan

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

### 6.1 Documentation

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

### 6.2 Test Personnel

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

### 6.3 Test Conditions

The Test Plan is to detail the conditions (i.e. mooring, dynamic positioning, and/or transit) under which the tests will be performed. The applicable normal operating conditions are those during which industrial personnel are accommodated onboard the vessel.

### 6.4 Measurement Locations

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

### 6.5 Data Acquisition and Instruments

The Test Plan is to provide information regarding the methods and instrumentation to be used for measurement and data collection. Instrumentation specification details are to include type of instruments to be used, accuracy, calibration, sensitivity, conformance with ISO 8041:2005, 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 is to provide information regarding the methods, software, and instrumentation to be used for data analysis.

## 6.7 Test Schedule

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

## 6.8 Data Collection Sheets

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

## 6.9 Conflict of Interest Declaration

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

# 7 Test Requirements

## 7.1 General

In general, whole-body vibration measurements are to be in accordance with the procedures described in ISO 20283-5:2016.

## 7.2 Data Acquisition and Instruments

For the **HAB(ACCOM)**, **HAB+(ACCOM)**, or **HAB++(ACCOM)** notation, a sample of data is to be recorded for each whole-body vibration measurement position. Each whole-body vibration measurement sample is to be at least sixty (60) seconds in duration. For each location measured, a data sample is to be taken for each applicable operational condition (i.e., mooring, dynamic positioning, and/or transit), in accordance with the requirements of 3/7.3, "Test Conditions".

The above measurement samples are to all be taken using the appropriate Type 1 instrumentation (ISO 8041:2005), then frequency weighted and analyzed in accordance with ISO 20283-5:2016. It is desirable to employ equipment that records and stores acceleration time histories.

## 7.3 Test Conditions

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

### 7.3.1 Power Output

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

**7.3.2 Machinery and Equipment Operation**

As appropriate for the mode of operation (i.e., mooring, dynamic positioning, and/or transit), all machinery essential for vessel operation is to operate under normal conditions throughout the measurement period. Heating, Ventilation, and Air Conditioning (HVAC) systems are to be running as for normal seagoing conditions during the measurement period.

**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 are to be taken under normal operating. The vessel, if transit condition is applicable, is to maintain a single heading and a constant speed during the test. Measurements during dynamic positioning and mooring are to be taken while the vessel is maintaining a position relative to another vessel/unit or fixed point (e.g., offshore installation).

For self-elevating units (jack-ups), the water depth and the air gap are to be within the top one-third ( $\frac{1}{3}$ ) of the unit's operating range.

For self-elevating units (jack-ups), when reporting water depth, the expected air gap is to also be defined.

**7.3.4 Rudder Conditions**

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

**7.3.5 Sea Condition**

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

**7.3.6 Loading Conditions**

The loading condition of an accommodation vessel is to be as close as possible to normal operating conditions. If this is not practicable, the loading condition is to be highlighted 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 is to be avoided. For this reason, only the personnel needed for the normal operation of the equipment in the space and those carrying out the measurements are to be present in the space being tested.

**7.4 Measurement Locations**

**7.4.1 Selection of Spaces where Measurements are to be Conducted**

The aim when selecting vibration measurement locations is to obtain a representative sample of data that reflects the actual conditions in industrial personnel accommodation areas. For practical reasons, it is important to select the locations such that an appropriate amount of data can be collected during the testing phase. The measurement locations are to 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 industrial personnel accommodation areas via the accommodation vessel's structure. Measurements are to be taken in all identified worst case locations.
- ii)* Where a single instance of one (1) type of industrial personnel accommodation space exists within the accommodation vessel (e.g., mess room, gymnasium, library, etc.), that location is to be selected for measurement.

- iii) Where multiple instances of the same type accommodation space exist that are not industrial personnel cabins, a representative sample of at least twenty (20) percent of each type is to be selected for measurement. The worst case locations are to be considered part of the representative sample, if applicable.
- iv) Select a representative sample of industrial personnel cabins throughout the accommodation vessel. For vessels with less than 50 cabins, fifty (50) percent of cabins are to be selected on each deck. For vessels with 50 to 100 cabins, thirty (30) percent of cabins (but not less than 25 cabins total on all decks) are to be selected on each deck. For vessels with greater than 100 cabins, twenty (20) percent of cabins (but not less than 33 cabins total on all decks) are to be selected on each deck. The worst case locations are to be considered part of the representative sample for personnel cabins, if applicable.

**7.4.2 Walkthrough Verification Inspection Locations**

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

**7.4.3 Transducer Placement Positions**

Vibration transducers (accelerometers) are to be located and attached properly to the floor surface to measure the vibration at the interface between the industrial personnel and the source of vibration. The mounting of accelerometers is to comply with ISO 5348:1998. When the vibration enters the human body from a non-rigid or resilient material (e.g., floor covering), secure the transducers with a suitably formed mount that does not alter the pressure distribution on the surface of the floor covering.

In cabins, the vibration transducers are to be placed on the deck in the center of the space. (*Note:* This location may not provide the maximum vibration levels for this particular space. The objective is to minimize the number of measurements yet still obtain a fair and representative sample of the exposure conditions of the person occupying the cabin).

For larger spaces (mess rooms, recreation areas, etc.) it will be necessary to place transducers at a number of locations in order to obtain a representative sample of the whole-body vibration levels for that space. Transducer locations are to be evenly distributed throughout the space. For a specific room size, the minimum number of measurement locations is to 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 20 m <sup>2</sup> (215 ft <sup>2</sup> )	1
> 20–40 m <sup>2</sup> (215–431 ft <sup>2</sup> )	2
> 40–80 m <sup>2</sup> (431–861 ft <sup>2</sup> )	3
> 80–120 m <sup>2</sup> (861–1291 ft <sup>2</sup> )	4
> 120–200 m <sup>2</sup> (1291–2150 ft <sup>2</sup> )	5
Greater than 200 m <sup>2</sup> (2150 ft <sup>2</sup> )	6

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

## 8 Test Report

As stated in 1/7.3.2, “Test Reports”, a Test Report is to be submitted to the ABS Surveyor to determine whether the vibration levels meet the whole-body vibration criteria and whether this part of the notation requirement has been met. The details listed in the following paragraphs are to be provided in the Whole-body Vibration Test Report.

### 8.1 Test Details

The following details (when applicable) are to be recorded for each period of testing:

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

### 8.2 Transducer Placement Positions

Actual transducer placement positions (for each applicable operational condition) are to 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), are to 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, are to be provided.

### 8.4 Results

The following results per measuring location, are to be provided in table format (for each applicable operational condition):

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

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

### 8.6 Surveyor Witnessing Documentation

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

## 9 Results

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



## SECTION 4 Noise

### 1 Background

A large amount of research has been performed on the effects of noise on human performance. 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 industrial personnel performance and to facilitate communication and sleep in appropriate vessel spaces. An additional goal is to enhance personnel safety and comfort. In this instance, “comfort” means the ability of personnel to use an accommodation space for its intended purpose with minimal interference or annoyance from noise.

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

The criteria in this Section are applicable only to industrial personnel accommodation areas, as defined in Section 1, and do not include crew accommodation spaces.

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

### 3 Terminology

*Apparent Weighted Sound Reduction Index  $R'_w$* : A single number value expressed in decibels (dB) which describes the overall sound insulation performance in situ of walls, doors or floors provides.

*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 61672-1:2013 in order to account for the frequency response characteristics of the human ear. The symbol is  $L_A$ ; the unit is dB(A). The measurement  $L_{Aeq}$  is an equivalent continuous A-weighted sound pressure level, measured over a period of time.

*Calibration Checks*: Field calibration of a measuring instrument conducted before and after a field test, using a reference calibrated signal or through zero calibration. Sound calibrators are to comply with the standard IEC 60942:2003, as amended, type/class (1) standard and are to be approved by the manufacturer of the measuring instrument used.

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

*Equivalent Continuous A-weighted Sound Pressure Level*: The A-weighted sound pressure level of a noise fluctuating over a period of time  $T$ , expressed as the amount of average energy. The symbol is  $L_{Aeq}$ ; the unit is dB(A).

*Reference Calibration:* Calibration of measuring instrument and sound calibrator, conducted at least every two (2) years (or more frequently if specified by the manufacturer) by an accredited Testing and Calibration Laboratory accredited according to ISO 17025:2005, as amended, with traceability to a national or international standard.

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

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

## 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 61672-1:2013, Electroacoustics – Sound Level Meters – Part 1: Specifications
- IEC 60942:2003, Electroacoustics – Sound Calibrators
- IMO Resolution MSC.337(91) (2012), Code on Noise Levels Onboard Ships
- ISO 717-1:2013, Acoustics – Rating of Sound Insulation in Buildings and of Building Elements – Part 1: Airborne Sound Insulation
- ISO 10140-2:2010, Acoustics – Laboratory Measurement of Sound Insulation of Building Elements – Part 2: Measurements of Airborne Sound Insulation
- ISO 16283-1:2014, Acoustics – Field Measurement of Sound Insulation in Buildings and of Building Elements – Part 1: Airborne Sound Insulation
- ISO 17025:2005, General requirements for the competence of testing and calibration laboratories
- World Meteorological Organization (WMO) Manual on Codes, No. 306, Part A, Alphanumerical Codes (2011 Edition, Updated in 2014)

## 5 Criteria

### 5.1 Equivalent Continuous A-weighted Sound Pressure Level

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

Noise levels are to be determined for the test conditions specified in 4/7.3, “Test Conditions” and are not to be exceeded. The maximum acceptable noise levels given in Section 4, Table 1, “Noise Criteria” are  $L_{Aeq}$  values, determined as appropriate to the character of the noise (see 4/7.5, “Measurement Procedures and Recorded Results”). Noise measurements are only to be taken in industrial personnel accommodation spaces. Specific locations are referred to in 4/7.4, “Measurement Locations”.

The noise criteria are only applicable under normal operating conditions (i.e., mooring, dynamic positioning, and/or transit) during which industrial personnel are accommodated onboard the vessel.

### 5.2 Acoustic Insulation

The airborne sound insulation properties for bulkheads and decks within the accommodation are to comply at least with the weighted sound reduction index ( $R_w$ ) according to ISO 717-1:2013, provided in Section 4, Table 2, “Airborne Sound Insulation Criteria”. The airborne sound insulation properties are to be determined by laboratory tests in accordance with ISO 10140-2:2010 as identified in IMO Code on Noise. The manufacturer of the acoustic insulation is to provide the weighted sound reduction index ( $R_w$ ) value and evidence of the laboratory test.

Alternatively, in lieu of laboratory tests, the weighted apparent sound reduction index ( $R'_w$ ) for bulkheads and decks within the accommodation, based on field measurements according to ISO 16283-1:2014, are to comply at least with the requirements provided in Section 4, Table 2, “Airborne Sound Insulation Criteria” with tolerance of up to 3 dB.

The means by which the  $R_w$  values will be determined (i.e., laboratory test or field measurement) will be at the discretion of the owner in collaboration with the builder and clearly identified in the Noise Test Plan.

**TABLE 1  
Noise Criteria**

<i>Space</i>	<i>Maximum Acceptable Noise <math>L_{Aeq}</math> Level dB(A)</i>		
	<b>HAB (ACCOM)</b>	<b>HAB+ (ACCOM)</b>	<b>HAB++ (ACCOM)</b>
<b>Cabins, Medical and Sanitary Spaces</b>			
Cabins	55	55	50
Medical and First Aid Center	55	55	50
Sanitary Spaces (Public)	65	60	55
<b>Food Service Spaces</b>			
Mess Rooms, Dining Areas	60	55	55
Pantries, Snack Areas	60	55	55
<b>Recreation Spaces</b>			
Indoor Recreation Spaces (e.g., Lounge, Coffee Bars, Internet Room, Smoking Room, Gymnasium, etc.)	60	55	55
Cinema, Entertainment Spaces	65	60	55
Quiet Rooms, Library and Hobby Rooms	60	55	55
Shop/Kiosk	60	60	55
Open Deck Recreation Areas	75	70	70
Coffee Shop Outside the Accommodation Block	75	70	70
<b>Access and Egress Spaces</b>			
Passageways in Cabin Areas	65	65	60
Passageways in Public Areas	70	70	65
<b>Office and Administration Spaces</b>			
Offices and Conference Rooms	60	55	55
Reception Areas/Helicopter Lobby	60	60	55
Offices Rooms Outside the Accommodation Block	60	60	55
<b>Service Spaces</b>			
Changing Rooms	75	70	65
Laundry Areas (self-service)	90	85	80

**TABLE 2  
Airborne Sound Insulation Criteria**

<i>Space</i>	<i>Minimum Acceptable Sound Insulation index <math>R_w</math> dB(A)</i>		
	<b>HAB (ACCOM)</b>	<b>HAB+ (ACCOM)</b>	<b>HAB++ (ACCOM)</b>
Cabin to cabin or hospital	35	38	41
Corridor or stairway to cabin	30	33	36
Mess rooms, recreation rooms, public spaces and entertainment spaces to cabins and hospitals	45	48	51
Offices, conference rooms and reception areas to cabin or hospital	45	48	51

## 6 Test Plan

As stated in 1/7.3.1, “Test Plans”, a Test Plan is to be developed to serve as the principal means for verifying the measurements to be performed to demonstrate or confirm compliance with noise criteria. The Test Plan is to include the following:

### 6.1 Documentation

The Test Plan is to include appropriate design information including noise specifications (if available) for the accommodation vessel. It is also to include appropriate drawings indicating the locations of all noise sources and noise generating equipment.

The Test Plan is also to include the acoustic insulation plan and relevant supporting documentation for review and approval. With the Test Plan, the acoustic insulation laboratory test results (see 4/5.2, “Acoustic Insulation”) are to be submitted for review or, alternatively, it will indicated that field testing will be performed.

### 6.2 Test Personnel

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

### 6.3 Test Conditions

The Test Plan is to detail the conditions (i.e., mooring, dynamic positioning, and/or transit) under which the tests will be performed. The applicable normal operating conditions are those during which industrial personnel are accommodated onboard the vessel.

### 6.4 Measurement Locations

The Test Plan is to document, in detail, on appropriate drawings, all spaces or areas where measurements will be taken. In addition, measurement positions are to 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 is to provide information regarding the methods and instrumentation to be used for measurement and data collection. Instrumentation specification details are to include type of instruments to be used, accuracy, calibration, and sensitivity. More details on data acquisition and instruments are provided in 4/7.2, “Data Acquisition and Instruments”.

### 6.6 Data Analysis

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

### 6.7 Test Schedule

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

### 6.8 Data Collection Sheets

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

### 6.9 Conflict of Interest Declaration

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

## 7 Test Requirements

### 7.1 General

In general, the noise measurements are to be carried out in accordance with the IMO Resolution MSC.337(91) Code on Noise Levels On-board Ships, and ISO 2923:1996. When applicable, sound insulation measurements are to be carried out in accordance with ISO 16283-1:2014.

### 7.2 Data Acquisition and Instruments

The integrating-averaging sound level meter is to meet the requirements for a Type 1 instrument specified in IEC 61672-1:2013.

When used alone, or in conjunction with a sound level meter, as appropriate, an octave filter set is to conform to IEC 61260-1:2014, as amended, standard. A microphone wind screen is to be used when taking readings outside or on deck, and below deck where there is any substantial air movement. The wind screen is not to affect the measurement level of similar sounds by more than 0.5 dB(A) in “no wind” conditions.

For sound insulation field testing, equipment as specified in ISO 16283-1:2014 is to be used for the measurement of insulation properties (i.e., Apparent Weighted Sound Reduction Index  $R'_w$ ).

For each location measured, a data sample is to be taken for each applicable operational condition, in accordance with the requirements in 4/7.3, “Test Conditions”.

### 7.3 Test Conditions

The test conditions required for the noise measurements are to be in accordance with the following Subparagraphs, based on ISO 2923:1996. The taking of measurements for assessing noise of accommodation vessels requires that vessel being tested be in a representative state of operation.

#### 7.3.1 Power Output

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

#### 7.3.2 Machinery and Equipment Operation

As appropriate for the mode of operation (transit, dynamic positioning or moored), all machinery essential for vessel operation is to operate under normal conditions throughout the measurement period. Heating, Ventilation, and Air Conditioning (HVAC) systems are to be running as for normal seagoing conditions during the noise measurements.

#### 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 are to be taken under normal operating. The vessel, if transit condition is applicable, is to maintain a single heading and a constant speed during the test. Measurements during dynamic positioning and mooring are to be taken while the vessel is maintaining a position relative to another vessel/unit or fixed point (e.g., offshore installation).

For self-elevating units (jack-ups), the water depth and the air gap are to be within the top one-third ( $1/3$ ) of the unit’s operating range.

For self-elevating units (jack-ups), when reporting water depth, the expected air gap is also to be defined.

**7.3.4 Rudder Conditions**

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

**7.3.5 Sea Conditions**

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

**7.3.6 Loading Conditions**

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

**7.3.7 Test Interference**

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

Doors and windows are to be closed, except where they are normally left open. Any open doors or windows are to be noted in the Noise Test Report. Spaces are to be furnished with all usual equipment and furnishings normally found in the space. Equipment is to be configured to operate in its normal operating mode.

**7.3.8 Airborne Sound Insulation Measurements**

In the case that field airborne sound insulation measurements are taken, these are to be performed in port with no or very low (as far as practicable) ambient noise to avoid interference with the measurements.

**7.4 Measurement Locations****7.4.1 Selection of Spaces where Measurements are to be Conducted**

The aim when selecting noise and sound insulation measurement locations is to obtain a representative sample of data that reflects the actual conditions in industrial personnel accommodation areas. 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 are to be selected in accordance with the following criteria:

Noise measurement location selection 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 industrial personnel accommodation areas via the accommodation vessel's structure. Measurements are to be taken in all identified worst case locations.
- ii)* Where a single instance of one (1) type of industrial personnel accommodation space exists within the accommodation vessel (e.g., mess room, gymnasium, library, etc.), that location is to be selected for measurement.
- iii)* Where multiple instances of the same type accommodation space exist that are not industrial personnel cabins, a representative sample of at least twenty (20) percent of each type is to be selected for measurement. The worst case locations are to be considered part of the representative sample, if applicable.
- iv)* A representative sample of industrial personnel cabins throughout the accommodation vessel is to be selected. For vessels with less than 50 cabins, fifty (50) percent of cabins are to be selected on each deck. For vessels with 50 to 100 cabins, thirty (30) percent of cabins (but not less than 25 cabins total on all decks) are to be selected on each deck. For vessels with greater than 100 cabins, twenty (20) percent of cabins (but not less than 33 cabins total on all decks) are to be selected on each deck. The worst case locations are to be considered part of the representative sample for personnel cabins, if applicable.

Field sound insulation measurement location selection criteria:

- i) When applicable, the selection of insulation measuring locations is to be representative of the different types of sound insulation provided. As a minimum two (2) measurements of each type is required on each deck.

#### 7.4.2 Walkthrough Verification Inspection Locations

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

#### 7.4.3 Measurement Positions

The measurement positions described below are taken or adapted from ISO 2923:1996 and IMO Resolution MSC.337(91).

In industrial personnel accommodation spaces, measurement is to be taken in the middle of the space.

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

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

If practicable, measurements are not to be closer than 1000 mm (39.5 in.) from air inlets, or from decks, bulkheads or other large surfaces.

Sound insulation measurements, when applicable, are to be carried out in accordance with ISO 16283-1:2014.

### 7.5 Measurement Procedures and Recorded Results

#### 7.5.1 Persons Present During Measurements

When Testing Specialist personnel are conducting noise and sound insulation level measurements in any space, only personnel necessary for the operation of equipment in that space are to be present.

#### 7.5.2 Sampling Duration

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

Field measurements of sound insulation index, when applicable, are to be carried out in accordance with ISO 16283-1:2014. When the area of the tested partition is less than 10 m<sup>2</sup> (108 ft<sup>2</sup>), a minimum value of 10 m<sup>2</sup> (108 ft<sup>2</sup>) is to be considered for the calculation of index  $R'_w$ .

#### 7.5.3 Cyclic Noise

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

#### 7.5.4 Intermittent Noise

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

#### 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 is to be made approximately 300 mm (12 in.) from the vent, measured in line with the direction of airflow, and recorded in the Noise Test Report.

## 8 Test Report

As stated in 1/7.3.2, “Test Reports”, a Test Report is to be submitted to the ABS Surveyor to determine whether the noise levels are at or below the limits, whether the field measured cabin sound insulation meets the appropriate criteria, and whether this part of the notation requirement has been met. The details listed in the following paragraphs are to be provided in the Noise Test Report.

### 8.1 Noise Test Details

The following details (when applicable) are to be recorded for each period of noise testing and for each applicable operational condition:

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

### 8.2 Noise Measurement Positions

Actual measurement positions (for each applicable operational condition) are to be indicated on appropriate drawings.

### 8.3 Noise Measurement Equipment Details

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

### 8.4 Noise Results

The following results, per measurement location, per operational condition, are to be provided in table format:

- i)* Measurement position
- ii)* Number of people present in the space at time of measurement
- iii)* Measurement period if different from requirement
- iv)* Equivalent continuous A-weighted sound pressure level ( $L_{Aeq}$ )
- v)* Note any open doors and windows
- vi)* Note equipment operating in proximity to the measurement position
- vii)* Note observed direct sources of noise (such as ventilation devices) and any additional measurement data collected
- viii)* Indication of Pass/Fail

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

- i)* Name and number of space
- ii)* Walkthrough inspection observations
- iii)* Measurement results if necessary

### **8.5 Apparent Sound Insulation Index Results**

The section of the Test Report relating to the apparent sound insulation measurements, when applicable, is to be in accordance with the format for recording results indicated in ISO 16283-1:2014.

### **8.6 Deviations**

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

### **8.7 Surveyor Witnessing Documentation**

The equipment field calibration and data collection process of the noise level and apparent sound insulation index tests are to be witnessed by an ABS Surveyor. The ABS Surveyor is to sign or initial each page of the test data sheets included in the Test Report and is to prepare a witnessing document stating whether all steps of the noise level testing were completed to their satisfaction. A copy of the witnessing document is to be given to the person conducting the testing, for insertion into the final Noise Test Report. The original is to be retained for ABS' files.

## **9 Results**

The Noise Test Report is to be reviewed by the ABS Surveyor against the appropriate **HAB(ACCOM)**, **HAB+(ACCOM)**, or **HAB++(ACCOM)** 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 an accommodation vessel are to 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 accommodation vessels. The criteria are based on currently available standards and were selected to provide an index of personnel 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 personnel cabin area horizontal gradient temperature differential between the temperature of inside bulkhead surfaces adjacent to 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.

The criteria in this Section are applicable only to industrial personnel accommodation areas, as defined in Section 1, and do not include crew accommodation spaces.

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

### 3 Terminology

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

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

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

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

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

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

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

*Reference Calibration:* Calibration of a measuring instrument, conducted at least every two (2) years (or more frequently if specified by the manufacturer) by an accredited Testing and Calibration Laboratory accredited according to ISO 17025:2005, as amended, with traceability to a national or international standard.

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

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

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

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

#### 4 Associated Documentation

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

- ANSI/ASHRAE 55-2013, Thermal Environmental Conditions for Human Occupancy
- ISO 7726:1998, Ergonomics of the Thermal Environment – Instruments for Measuring Physical Quantities
- ISO 7547:2002, Ships and Marine Technology – Air-Conditioning and Ventilation of Accommodation Spaces – Design Conditions and Basis of Calculations
- NEBB:2005, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
- ISO 17025:2005, General requirements for the competence of testing and calibration laboratories.

#### 5 Criteria

The indoor climate criteria for the Habitability notations (**HAB(ACCOM)**, **HAB+(ACCOM)**, and **HAB++(ACCOM)**) are provided in Section 5, Table 1, “Summary of Indoor Climate Requirements”.

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

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

The **HAB(ACCOM)** and **HAB+(ACCOM)** notation criteria provide for a range of air temperatures maintained by a temperature controller for each zone and are primarily aimed at HVAC systems that do not make provision for individual adjustment to suit personal preferences and activities within a specific space. The **HAB++(ACCOM)** notations are aimed at enhancing personnel comfort by making provisions for personnel 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(ACCOM)** or a **HAB+(ACCOM)** Notation

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

### 5.1.2 For a **HAB++(ACCOM)**

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

## 5.2 Relative Humidity

The HVAC system is to 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 is to be maintained within 3°C (6°F).

## 5.4 Air Velocity

Air velocities are not to 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 Personnel Cabin Area Horizontal Gradient

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

## 5.6 Air Supply Quantity

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

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

## 6 Test Plan

As stated in 1/7.3.1, “Test Plans”, a Test Plan is to be developed to serve as the principal means for verifying the measurements to be performed to verify compliance with indoor climate criteria. The Test Plan is to include the following:

### 6.1 Documentation

The Test Plan is to include the following documentation and data:

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

### 6.2 Test Personnel

The Test Plan is to provide information about the Testing Specialist who will be conducting the testing 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 is to 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 is to document, in detail, on appropriate drawings, all spaces or areas where measurements will be taken. Details on selecting measurement locations and determining transducer placement positions are provided in 5/7.4, “Measurement Locations”.

### 6.5 Data Acquisition and Instruments

The Test Plan is to provide information regarding the methods and instrumentation to be used for measurement and data collection. Instrumentation specification details are to include type of instruments to be used, accuracy, 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 is to provide information regarding the methods, software, and instrumentation to be used for data analysis.

## 6.7 Test Schedule

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

## 6.8 Data Collection Sheets

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

## 6.9 Conflict of Interest Declaration

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

# 7 Test Requirements

## 7.1 General

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

## 7.2 Data Acquisition and Instruments

The thermal measurement instrumentation is to meet or exceed the minimum characteristics of instruments for measuring physical quantities characterizing an environment specified in ISO 7726:1998.

The following quantities are to 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 personnel cabin spaces only)

The air temperature and humidity measurements are to 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 are to be reported for each space measured. For the **HAB+(ACCOM)** and **HAB++(ACCOM)** notation, the air temperature measurements are to be made at least every five (5) minutes for a minimum period of one (1) hour if the system has the capacity to reach within that hour the **HAB+(ACCOM)** and **HAB++(ACCOM)** requirements for lower and upper temperatures. If not, the air temperature measurements are to be made at least every ten (10) minutes for a minimum period of two (2) hours.

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

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

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

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

### **7.3 Test Conditions**

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

#### **7.3.1 Testing**

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

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

#### **7.3.2 Machinery and Equipment Operation**

Heating, Ventilation and Air-conditioning (HVAC) systems are to be running during the vibration measurements.

All machinery essential for operation (fluid, turbo generators, and additional machinery) is to operate under normal conditions throughout the measurement period. A written confirmation issued by the builder confirming that the HVAC system has been tested, adjusted and balanced is to be provided to the ABS Surveyor before any measurement commences. The total system Testing, Adjusting, and Balancing (TAB) is to be conducted in accordance with the National Environmental Balancing Bureau (NEBB) standard “*NEBB Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems*” or other similar certification standard.

#### **7.3.3 Doors and Windows**

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

#### **7.3.4 Equipment and Furnishings**

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

#### **7.3.5 Weather and Climatic Conditions**

When thermal conditions in the industrial personnel accommodation spaces have a high sensitivity to time of day and weather conditions (e.g., spaces adjacent to exterior bulkheads), the measurement is to 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 are to 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 is to be avoided. For this reason, only the personnel needed for the normal operation of the equipment in the space and those carrying out the measurements are to be present in the space being tested.

## 7.4 Measurement Locations

### 7.4.1 Selection of Spaces where Measurements are to be conducted

The aim when selecting indoor climate measurement locations is to obtain a representative sample of data that reflects the actual conditions in industrial personnel accommodation 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 are to 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 accommodation 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 areas at the ends of HVAC ductwork or piping runs (for heating or cooling) are to be selected as potential problem locations. Measurements are to 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 industrial personnel accommodation areas which may be outboard or adjacent to the accommodation vessel's hull. Measurements are to be taken in all identified problem areas.
- iii)* Where a single instance of one (1) type of space exists within the accommodation vessel (e.g., mess room, gymnasium, library, etc.), the location is to be selected for measurement.
- iv)* Where multiple instances of one (1) type of space exist (e.g., cabins, or recreation areas), a representative sample of at least twenty-five (25) percent of each type (e.g., one-man room, two-man room, etc.) is to 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 industrial personnel accommodation spaces are to be subject to a walkthrough inspection by the ABS Surveyor. The number and locations of the walkthrough inspections will be determined by the ABS Surveyor. The purpose of the walkthrough verification is to subjectively assess the indoor climate qualities. At the discretion of the ABS Surveyor, additional measurements may be required.

### 7.4.3 Transducer Placement Positions

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

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

### 8.1 Test Details

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

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

### 8.2 Transducer Placement Positions

Actual measurement locations and transducer placement positions are to 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) are to 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, are to be provided.

### 8.4 Results

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

- i)* Measurement position
- ii)* Number of people present in the space at time of measurement
- iii)* Measurement period if different from requirement
- iv)* Air temperature (minimum, maximum, and average) at 100 mm (4 in.) above deck
- v)* Air temperature (minimum, maximum, and average) at 1100 mm (43 in.) above deck
- vi)* Air temperature (minimum, maximum, and average) at 1700 mm (67 in.) above deck
- vii)* Relative humidity (minimum, maximum, and average) at 1700 mm (67 in.) above deck
- viii)* Air velocity at 100, 1100, and 1700 mm (4, 43, and 67 in.) above deck at measurement positions
- ix)* Vertical gradient (Average air temperature at 1700 mm (67 in.) minus average air temperature at 100 mm (4 in.) above deck)
- x)* Horizontal gradient (Side wall surface temperature in personnel cabin and medical spaces minus average air temperature at 1100 mm (43 in.) above deck)
- xi)* Indication of Pass/Fail

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

- i)* Name and number of space
- ii)* Walkthrough inspection observations
- iii)* Measurement results if necessary

### 8.5 Deviations

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

### 8.6 Surveyor Witnessing Documentation

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

## 9 Results

The Indoor Climate Test Report is to be reviewed by the ABS Surveyor against the appropriate **HAB(ACCOM)**, **HAB+(ACCOM)**, or **HAB++(ACCOM)** criteria for notation confirmation.



## SECTION 6 Lighting

### 1 Background

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

The selection of appropriate illuminance levels for specific tasks and personnel 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 an accommodation vessel are generally similar to tasks encountered ashore, requirements for illuminance on accommodation vessels generally correspond to those tasks performed in living and recreation areas on shore.

### 2 Scope

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

The criteria in this Section are applicable only to industrial personnel accommodation areas, as defined in Section 1, as well as to exterior passageways, corridors, stairways and muster/embarkation areas related to industrial personnel movement onboard and do not include crew accommodation spaces.

Lighting criteria are based on currently available objective standards and research data. Compliance with this Section is a prerequisite for the Habitability (**HAB(ACCOM)**), Habitability Plus (**HAB+(ACCOM)**), or Habitability Plus Plus (**HAB++(ACCOM)**) 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 is to 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 ( $\text{lm}/\text{m}^2$ ) or foot-candles ( $\text{fc}$ ;  $\text{lm}/\text{ft}^2$ ). 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 ( $\text{cd}/\text{m}^2$ ).

*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*.

*Reference Calibration:* Calibration of a measuring instrument, conducted at least every two (2) years (or more frequently if specified by the manufacturer) by an accredited Testing and Calibration Laboratory accredited according to ISO 17025:2005, as amended, with traceability to a national or international standard.

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

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

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

## 4 Associated Documentation

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

- ISO 8995-1:2002, Lighting of Work Places – Part 1: Indoor
- DIN EN 12464-1:2011, Light and Lighting – Lighting of Work Places – Part 1: Indoor Work Places
- DIN 5032-7:1985, Photometry; Classification of Illuminance Meters and Luminance Meters
- CIE S 023/E:2013 (ISO/CIE 19476:2014), Characterization of the Performance of Illuminance Meters and Luminance Meters
- BS 667:2005, Illuminance meters. Requirements and test methods
- ISO 17025:2005, General requirements for the competence of testing and calibration laboratories
- IEC 61892-2, Mobile and Fixed Offshore Units – Electrical Installations

## 5 Criteria

The lighting criteria for the Habitability notations are provided in Section 6, Table 1, “Lighting Criteria”.

For lighting, the criteria for **HAB(ACCOM)**, **HAB+(ACCOM)**, and **HAB++(ACCOM)** are the same. In this Section, general lighting and task lighting requirements are provided for personnel tasks and spaces normally encountered on accommodation vessels. The lighting levels provided in the table are for new lamps. It is recommended that lighting fixtures are uniformly spaced to minimize shadows. Emergency lighting is covered in SOLAS and IMO Resolutions and was not considered in the selection of the lighting levels provided in this Guide.

### 5.1 General and Task Lighting

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

**TABLE 1**  
**Lighting Criteria**

<i>Space</i>	<i>Type of Lighting</i>	<i>Illuminance Level in Lux</i>
<b>Cabins and Sanitary Spaces</b>		
Cabin	General	150
Cabin – Reading & Writing (Desk)	Task	500
Cabin – Reading & Writing (Bunk Light)	Task	150
Cabin – Light during Sleep Periods	General	<30
Sanitary Spaces – Lavatory/Toilet (Private and Public)	General	200
Sanitary Spaces – Bath/Shower (Private and Public)	General	150
<b>Food service Areas</b>		
Mess Room, Dining Area	General	300
Pantries, Snack Areas	General	150
<b>Recreation Spaces</b>		
Recreation Room/Lounge/Coffee Room/Smoking Room	General	200
Library/Quiet Room	General	150
Library/Quiet Room – Reading Area	Task	500
Multimedia Room (e.g., Internet Room)	General	200
TV Room/Movie Theater	General	150
Bulletin Boards/Display Areas	Task	150
Exercise Room, Gymnasium	General	300
All other Recreation Spaces (e.g., Game Room, Shop/Kiosk, etc.)	General	200
<b>Medical, Dental &amp; First Aid Areas</b>		
Hospital/Medical Waiting Area	General	150
Hospital – Reading & Writing (Desk)	Task	500
Medical and Dental Treatment/Examination Room	Task	500
Dispensary	General	150
Dispensary - On dispensary table	Task	500
Laboratories	Task	500
Ward	General	300
<b>Access, Egress &amp; Evacuation</b>		
Interior Passageways, Corridors, Stairways and Elevators	General	100
Exterior Passageways, Corridors and Stairways	General	100
Muster/Embarkation Area	General	200
<b>Office and Administration Spaces</b>		
Office and Reception Areas	General	300
Office and Reception Areas – Reading & Writing (Desk)	Task	500
Meeting, Training Rooms	General	500
<b>Service Spaces</b>		
Changing Rooms	General	200
Laundry (Self-service)	General	200

## 6 Test Plan

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

### 6.1 Documentation

The Test Plan is to 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 are to be to a scale and sized to permit the scaling of measurement points (required by 6/7.4, “Measurement Locations”) and lighting equipment and the recording of luminance and other relevant data.

### 6.2 Test Personnel

The Test Plan is to 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 is to 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 is to document, in detail, on appropriate drawings, all spaces or areas where measurements will be taken. In addition, measurement positions within these areas are to be indicated. Details on selecting measurement locations are provided in 6/7.4, “Measurement Locations”.

### 6.5 Data Acquisition and Instruments

The Test Plan is to provide information regarding the methods and instrumentation to be used for measurement and data collection. Instrumentation specification details are to include type of instruments to be used, accuracy, calibration, 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 is to provide information regarding the methods used for data analysis.

### 6.7 Test Schedule

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

### 6.8 Data Collection Sheets

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

### 6.9 Conflict of Interest Declaration

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

## 7 Test Requirements

### 7.1 General

Visual tasks encountered on accommodation vessels vary and the lighting provided can influence the ability to see and perform those tasks. Some vision and lighting considerations include task duration, visual fatigue, task criticality, veiling reflections, shadows, and abilities of the observer. The presence of glare is a concern and is often difficult to identify, measure, and assess. Glare is often transient (based on factors such as the direction of the sun to illuminated components or from the placement of lighting fixtures) and therefore difficult to anticipate. As part of lighting data collection, glare is to be subjectively evaluated jointly by the Testing Specialist and the ABS Surveyor witnessing the collection of lighting data. These assessments are to be made as a part of the activities discussed in 6/7.4.2, "Walkthrough Verification Inspection Locations".

Illuminance measurements are to be carried out as described below.

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

### 7.2 Data Acquisition and Instruments

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

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

### 7.3 Test Conditions

The test conditions required for lighting measurements are to 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 accommodation vessel operation. If testing is done in port, the vessel's power and not shore power is to be used.

#### 7.3.2 Spaces with Windows/Portlights

In spaces with windows or portlights where the minimum lighting level is intended to be provided by artificial light sources only, lighting measurements are to 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) is to 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, are to be obtained. These readings are to 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 are to be taken in cabins with all cabin 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 are to be avoided. For this reason, only the personnel needed to operate any equipment during testing and those carrying out the measurements are to be present in the space.

Doors and windows are to be closed, except where they are normally left open. Any open doors or windows are to be noted in the Lighting Test Report. Spaces are to be furnished with all usual equipment and furnishings normally found in the space.

#### 7.3.7 External (Deck) Lighting

External areas (passageways, stairways, etc.) are to be tested on dark evenings without contribution of light to the deck from shore lights. Light measurements taken for these locations are to result from lighting systems aboard (with the exception of star and moon light contributions).

### 7.4 Measurement Locations

#### 7.4.1 Selection of Spaces where Measurements are to be Conducted

The aim when selecting lighting measurement locations is to obtain a representative sample of data that represents the actual conditions in the industrial personnel accommodation spaces listed in Section 6, Table 1, "Lighting Criteria". 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 are to be selected in accordance with the following criteria:

- i)* Select problem areas based on the potential for excessive external illumination (daylight) into the space. Areas at the end of cable runs are to be selected as potential problem locations. Measurements are to 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 are to be taken in all problem areas.
- iii)* Where a single instance of one (1) type of space exists within the accommodation vessel (e.g., mess room, gymnasium, library, etc.), the location is to be selected for measurement.
- iv)* Where multiple instances of one (1) type of space exist (e.g., lounge) with the exception of cabins, a representative sample of at least twenty-five (25) percent of each type is to be selected for measurement. The problem area locations are to be considered part of the representative sample, if applicable.
- v)* Where a number of industrial personnel cabin spaces are identical in configuration in terms of lighting systems, surface treatments, geometry, furnishings and equipment layout, only two (2) of the spaces on each deck are to 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 are to be selected on each deck for measurement.
- vi)* Where external nighttime measurements are taken, spaces are to be selected according to human presence in the space, including: exterior passageways and access ways, and industrial personnel embarkation and debarkation areas.

#### 7.4.2 Walkthrough Verification Inspection Locations

All normally manned spaces are to be subject to a walkthrough inspection by the ABS Surveyor. The number and locations of the walkthrough inspections will be determined by the ABS Surveyor. The purpose of the walkthrough verification is to subjectively assess the lighting qualities.

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

### 7.4.3 General Illuminance Measurement Positions

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

For larger spaces (mess rooms, recreation areas, etc.), it is necessary to take measurements at a number of locations in order to obtain a representative sample of the illumination for that space. Measurement locations are to be evenly distributed throughout the space. For a specific room size, the minimum number of measurement locations is to be as indicated in Section 6, Table 2, "Distribution of Measurement Positions within Spaces".

**TABLE 2**  
**Distribution of Measurement Positions within Spaces**

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

The arithmetic mean of the measurement is to be used for the measure of illuminance of the general area.

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

### 7.4.4 Task Lighting Measurement Positions

For task area lighting (e.g., computer workstations, desktops and meeting tables, medical stations, etc.), a representative set of readings is to be taken over the task surface with the industrial personnel in the normal working position. Task lighting is to be measured with both general and supplementary task lighting turned on. Daylight is to be excluded during the measurements.

Measurements of task lighting are to 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 m<sup>2</sup> (5 ft<sup>2</sup>), a single measurement is to be taken at the center of the task surface. For larger task surfaces (0.5 m<sup>2</sup> (5 ft<sup>2</sup>) or larger), the illuminance is to be measured by dividing the task surface into a grids no larger than 0.5 m<sup>2</sup> (5 ft<sup>2</sup>) and averaging the measurements taken at the grid intersections.

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

## 8 Test Report

As stated in 1/7.3.2, "Test Reports", a Test Report is to 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 are to be provided in the Lighting Test Report.

### 8.1 Test Details

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

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

## **8.2 Measurement Positions**

Actual measurement locations are to be indicated on appropriate drawings.

## **8.3 Measurement Equipment Details**

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

## **8.4 Results**

The following results, per space, are to be provided in table format:

- i)* Name and number of space
- ii)* Task areas (if any) in space
- iii)* Average lighting level for general lighting
- iv)* Average lighting level for task lighting on each task surface
- v)* Corridor lighting measurements
- vi)* Lighting level in cabins with lights turned off and curtains, shutters, deadlights, etc., closed
- vii)* Presence of glare within the space and any follow-up activity requirements
- viii)* Indication of Pass/Fail

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

## **8.6 Surveyor Witnessing Documentation**

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

## **9 Results**

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



## APPENDIX 1 References

### 1 General References

- 1 American Bureau of Shipping. *Guide for Crew Habitability on Ships*. Houston, TX.
- 2 American Bureau of Shipping. *Guide for Crew Habitability on Workboats*. Houston, TX.
- 3 American Bureau of Shipping. *Guide for Crew Habitability on Mobile Offshore Drilling Units (MODUs)*. Houston, TX.
- 4 American Bureau of Shipping. *Guide for Crew Habitability on Offshore Installations*. Houston, TX.
- 5 American Bureau of Shipping. *Rules for Building and Classing Steel Vessels*. Houston, TX.
- 6 American Bureau of Shipping. *Rules for Building and Classing Facilities on Offshore Installations*. Houston, TX.
- 7 American Bureau of Shipping. *Rules for Building and Classing Mobile Offshore Drilling Units*. Houston, TX.
- 8 International Maritime Organization. (2009). *Code for the Construction and Equipment of Mobile Offshore Drilling Units, Consolidated Edition 2009*. London.

### 2 Accommodation Area References

- 1 American Society for Testing and Materials. (2013). *Standard practice for human engineering design for marine systems, equipment and facilities (ASTM F 1166)*. West Conshohocken, PA.
- 2 International Labor Office. (1949). *Accommodation of Crews Convention (Revised) (Convention C92)*. Geneva.
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- 4 International Labor Office. (1998). *Maritime labor conventions and recommendations (4<sup>th</sup> ed.)*. Geneva.
- 5 International Labor Organization. *Maritime Labour Convention, 2006*. Geneva.
- 6 International Maritime Organization. *International Convention for the Safety of Life at Sea (SOLAS), 1974: Means of escape (Chapter II-2, Regulation 13)*. London.
- 7 International Organization of Masters, Mates, & Pilots. *Contract requirements for both existing and new ship construction*. Linthicum Heights, MD.
- 8 National Fire Protection Association (NFPA). (2015). *Life safety code 101*. Quincy, MA.
- 9 Norwegian Oil Industry Association and The Federation of Norwegian Engineering Industries (NORSOK). (2015). *Living Quarters Area (C-001)*. Oslo.
- 9 Norwegian Oil Industry Association and The Federation of Norwegian Engineering Industries (NORSOK). (2006). *Architectural components & equipment (C-002)*. Oslo.
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- 12 Sailor's Union of the Pacific. (1996). *Agreement between Sailor's Union of the Pacific and American President Lines, Ltd. In the Offshore and Intercoastal Trades*. San Francisco, CA.
- 13 Seafarers International Union. *Contract requirements for unlicensed seamen*. Camp Springs, MD.
- 14 Tillman, B. and Tillman, P. (2000). Personal Correspondence with ABS.
- 15 U.S. Coast Guard, Department of Transportation. (1998). Coast Guard Regulation 32, Subpart 32.40, *Accommodation for officers and crew*, (Code of Federal Regulations, 46CFR32.40, pp. 398-400). Washington, DC: U.S. Government Printing Office.
- 16 U.S. Coast Guard, Department of Transportation. (1998). Coast Guard Regulation 92, Subparts 92.10 to 92.25, 92.10-1 to 92.25-90 *Construction and arrangement*, (Code of Federal Regulations, 46CFR92.10-92.25, pp. 51-56). Washington, DC: U.S. Government Printing Office.
- 17 U.S. Coast Guard, Department of Transportation. (2011). Coast Guard Regulation 116, Subparts D to I, 116.400-116.970 *Construction and arrangement*, (Code of Federal Regulations, 46CFR116.400-116.970, pp. 339-357). Washington, DC: U.S. Government Printing Office.
- 18 U.S. Coast Guard, Department of Transportation. (2011). Coast Guard Regulation 116, Subpart K, 116.1110-116.1160 *Construction and arrangement*, (Code of Federal Regulations, 46CFR116.1110-116.1160, p.358). Washington, DC: U.S. Government Printing Office.
- 19 U.S. Coast Guard, Department of Transportation. (2008). Coast Guard Regulation 177, Subpart I, 177.900-177.970 *Construction and arrangement*, (Code of Federal Regulations, 46CFR177.900-177.970, pp. 214-216). Washington, DC: U.S. Government Printing Office.
- 20 U.S. Coast Guard, Office of Marine Safety. (2006). *Load Line Technical Manual, Report Number USCG-M-1-90*. Washington, DC
- 21 U.S. Department of Defense. (1999). *Design criteria standard: Human engineering (MIL-STD-1472F)*. Washington, DC: U.S. Government Printing Office.
- 22 U.S. Department of Health and Human Service: Centers for Disease Control and Prevention. (2001). *Recommended shipbuilding construction guidelines for cruise vessels destined to call on U.S. Ports*. Atlanta, GA.
- 23 U.S. Department of Health, Education and Welfare: Food & Drug Administration. (1996). *Handbook on sanitation of vessel construction: Standards of sanitation and ratproofing for the construction of vessels*. Washington, DC.
- 24 U.S. Department of Labor (2000). Code of Federal Regulation, 29 CFR 1910. 23. Subpart D–*Walking-Working Surfaces – Guarding floor and wall openings and holes*. Washington, DC.
- 25 U.S. Department of Labor (2000). Code of Federal Regulation, 29 CFR 1910. 24. Subpart D–*Walking-Working Surfaces – Fixed industrial stairs*. Washington, DC.
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- 27 U.S. Navy. (2013). *Shipboard habitability design criteria and practices manual (Surface Ships) for new ship designs and modernization (T9640-AA-PRO-010/HAB)*. Arlington, VA: Naval Sea Systems Command.
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- 30 U.S. Navy. (1995). *General specifications for ships of the United States Navy (Section 640 – General Requirements for Habitability Spaces)*. Arlington, VA: Naval Sea Systems Command.

- 31 U.S. Navy. (1995). *General specifications for ships of the United States Navy* (Section 644 – Plumbing Fixtures and Fittings). Arlington, VA: Naval Sea Systems Command.
- 32 U.S. Navy. (1995). *General specifications for ships of the United States Navy* (Section 645 – Leisure and Community Facilities). Arlington, VA: Naval Sea Systems Command.
- 33 U.S. Navy. (1995). *General specifications for ships of the United States Navy* (Section 652 – Medical and Dental Spaces). Arlington, VA: Naval Sea Systems Command.
- 34 U.S. Navy. (1995). *General specifications for ships of the United States Navy* (Section 655 – Laundry & Dry Cleaning Facilities). Arlington, VA: Naval Sea Systems Command.
- 35 U.S. Navy. (1995). *Shipboard habitability design criteria manual* (T9640-AB-DDT- 010/HAB). Arlington, VA: Naval Sea Systems Command.
- 36 Woodson, W.E., Tillman, B., and Tillman, P. (1992). *Human factors design handbook: Information and guidelines for the design of systems, facilities, equipment and products for human use* (2<sup>nd</sup> ed.). New York: McGraw-Hill, Inc.

### 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 – Measurement of Vibration on Ships – Part 5: Guidelines for the Measurement, Evaluation and Reporting of Vibration with Regard to Habitability on Passenger and Merchant Ships*. (ISO 20283-5:2016). Geneva.
- 3 International Organization for Standardization. (2003). *Mechanical Vibration and Shock – Evaluation of Human Exposure to Whole Body Vibration – Part 2, Vibration in Buildings*. (ISO 2631-2:2003). Geneva.
- 4 International Organization for Standardization. (2008). *Mechanical Vibration on Ships – Part 2: Measurement of Structural Vibration* (ISO 20283-2:2008). Geneva.
- 5 International Organization for Standardization. (1998). *Mechanical mounting of accelerometers for measuring mechanical vibration and shock* (ISO 5348: 1998(E)). Geneva.
- 6 International Organization for Standardization. (2005). *Human response to vibration – Measuring instrumentation* (ISO 8041: 2005). Geneva.
- 7 World Meteorological Organization (WMO) Manual on Codes, No. 306, Part A, Alphanumerical Codes (2011 Edition, Updated in 2014).

### 4 Noise References

- 1 International Electrotechnical Commission. (2013). *Electroacoustics – Sound Level Meters – Part 1: Specifications* (International Standard IEC 61672-1:2013). Geneva: IEC Central Office.
- 2 International Maritime Organization. (2012). *Code on noise levels on-board ships* (IMO Resolution MSC.337(91) (2012). London.
- 3 International Organization for Standardization. (1996). *Acoustics – Measurement of noise on-board vessels* (ISO 2923: 1996). Geneva.
- 4 Kryter, K.D. (1994). *The handbook of hearing and the effects of noise: Physiology, psychology and public health*. San Diego: Academic Press.
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- 6 International Organization for Standardization. (2010). *Acoustics – Laboratory measurement of sound insulation of building elements – Part 2: Measurements of airborne sound insulation* (ISO 10140-2: 2010 (E)). Geneva.

- 7 International Organization for Standardization. (2013). *Acoustics – Rating of sound insulation in buildings and of building elements – Part 1: Airborne Sound Insulation (ISO 717-1: 2013 (E))*. Geneva.
- 8 International Organization for Standardization. (2014). *Acoustics – Field Measurement of Sound Insulation in Buildings and of Building Elements – Part 1: Airborne Sound Insulation (ISO 16283-1: 2014 (E))*. Geneva.

## 5 Indoor Climate References

- 1 American National Standards Institute. (2013). *Thermal Environmental Conditions for Human Occupancy (ANSI/ASHRAE 55-2013)*. Atlanta, GA.
- 2 International Organization for Standardization. (1998). *Ergonomics of the thermal environment – Instruments for measuring physical quantities (ISO 7726: 1998 (E))*. Geneva.
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- 4 National Environmental Balancing Bureau. (2005). *NEBB Procedural standards for testing, adjusting, balancing of environmental systems*. Gaithersburg, MD.
- 5 International Organization for Standardization. (2005). *Ergonomics of the thermal environment – Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria (ISO 7730: 2005 (E))*. Geneva.

## 6 Lighting References

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



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

### 1 Terminology

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

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

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

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

*Reference Calibration:* Adjustment and tuning 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)* Documented procedures for communication with the crew prior to commencing work in order to provide a safe system of work in place as necessary
- vi)* Evidence of approval/acceptance by certifying bodies, if any
- vii)* Information about other activities which may present a conflict of interest (i.e., in the case that the Testing Specialist provides, in any capacity or to any extent, input on the design of in part or whole of a vessel)
- viii)* Record of customer claims and of corrective actions requested by certification bodies for the past year
- ix)* Where relevant, list and documentation of licenses granted by equipment’s manufacturer
- x)* Example Test Plan(s) for the ambient environmental quality for which approval is requested.
- xi)* Example Test Reports

### 4.2 General Requirements

#### 4.2.1 Extent of Approval

The Testing Specialist is to 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 are also to have adequate experience and familiarity with the operation of any necessary equipment. Personnel are to have had a minimum of one year tutored on-the-job training. Where it is not possible to perform internal training, a program of external training may be considered as acceptable.

**4.2.3 Supervision**

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

**4.2.4 Personnel Records**

The Testing Specialist is to keep records of the recognized test personnel. The records are to 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 is to have the necessary equipment and facilities for the ambient environmental aspect to be tested. A record of the equipment used for ambient environmental testing is to be kept. The record is to contain information about maintenance and calibration.

**4.2.6 Control of Data**

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

**4.2.7 Procedures**

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

**4.2.8 Subcontractors**

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

**4.2.9 Verification**

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

**4.2.10 Reporting**

The report is to be prepared in a form acceptable to ABS as outlined within this Guide. The report is to 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 is to 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 they are 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 is to have a documented system covering at least the following:

- i)* Operating instructions for the test equipment
- ii)* Maintenance and reference calibration of equipment
- iii)* Training programs for test personnel

- iv) Supervision and verification to verify compliance with test procedures
- v) Recording and reporting of information
- vi) Quality management of subsidiaries and subcontractors
- vii) Job preparation
- viii) Periodic review of test process procedures, complaints, corrective actions, and issuance, maintenance, and control of documents.
- ix) Code of conduct for the relevant activity

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

#### **4.6 Testing Specialist Relations with the Test Equipment Manufacturer**

A company which works as a service station and conducts reference calibrations of equipment for a manufacturer (and is a Testing Specialist in this field) is to be assessed by the manufacturer(s) and nominated as their agent. The manufacturer is to 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 are to be recognized either on a case-by-case basis or as follows:

If a manufacturer of equipment (and 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 are to be based upon an evaluation of the quality assurance system implemented by the applicable company ISO 9000 or equivalent. ABS is to 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 will 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 will clearly state the type and scope of services and any limitations or restrictions imposed. The Testing Specialist will also be included in ABS' records of recognized Testing Specialists.

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

#### **5.1 Renewal**

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

### **6 Alterations**

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

## 7 Cancellation of Approval

Approval may be cancelled in the following cases:

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

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

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

## 8 Detailed Requirements by Ambient Environmental Aspect

### 8.1 Whole-body Vibration

#### 8.1.1 Extent of Engagement

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

#### 8.1.2 Supervisor

The supervisor is to:

- i)* have a documented history of at least one (1) year supervising and of at least two (2) years performing vibration testing onboard marine vessels and/or offshore units.
- ii)* have sufficient knowledge of marine vessels and/or offshore units structures and equipment, measurement, and analysis of whole-body vibration according to ISO 20283-5:2016, to verify that test procedures are compliant with the required test conditions.

#### 8.1.3 Test Personnel

The test personnel carrying out the measurements are to:

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

#### 8.1.4 Equipment

ABS is to verify that the equipment to be used is in accordance with the applicable measurement standard. It is to be demonstrated to ABS that it is fit for the intended purpose. Whole Body Vibration measurements are to be taken using an instrument manufactured to ISO 8041:2005, as amended, type/class (1) standard then frequency weighted and analyzed in accordance with ISO 20283-5:2016, as amended. It is desirable to employ equipment that records and stores acceleration time histories.

Portable calibrators are to comply with an international or national standard.

Calibration of the vibration transducer and of the portable calibrator, is to be conducted at least every two (2) years (or more frequently if specified by the manufacturer) by an accredited Testing and Calibration Laboratory accredited according to ISO 17025:2005, as amended.

#### 8.1.5 Procedures

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

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

#### 8.1.6 Reporting

The report is to be based on the instructions given in Subsection 3/8, "Test Report".

#### 8.1.7 Access to Documents

The Testing Specialist is to have access to the following documents:

- ISO 20283-5:2016, Mechanical Vibration – Guidelines for the Measurement, Evaluation and Reporting of Vibration with Regard to Habitability on Passenger and Merchant Ships
- ABS Crew Habitability Guides

### 8.2 Noise

#### 8.2.1 Extent of Engagement

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

#### 8.2.2 Supervisor

The supervisor is to:

- i)* have a documented history of at least one (1) year supervising and of at least two (2) years performing noise testing onboard marine vessels and/or offshore units
- ii)* have sufficient knowledge of marine vessels and/or offshore units structures, measuring equipment, ISO 2923:1996, IEC 61672-1:2013, and IMO Res. MSC.337(91), to verify that test procedures are compliant with the required test conditions

#### 8.2.3 Test Personnel

The test personnel carrying out the measurements are to:

- i)* have a documented history of one (1) year experience in performing noise testing onboard marine vessels and/or offshore units including participation in a minimum of 5 measurement campaigns as an assistant operator
- ii)* have knowledge in the field of noise, sound measurements and handling of measurement equipment. In addition, be able to document theoretical and practical training onboard in using a sound level meter
- iii)* have adequate knowledge of the applicable international requirements (SOLAS Regulation II-1/3-12, as amended, and IMO Code on noise levels onboard Ships, as amended)
- iv)* have training concerning the procedures specified in IMO Code on Noise Level
- v)* have adequate knowledge of marine vessels and/or offshore units structures and equipment

#### 8.2.4 Equipment

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

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

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

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

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

For sound insulation field testing, equipment as specified in ISO 16283-1:2014 is to be used for the measurement of insulation properties (i.e., Apparent Weighted Sound Reduction Index  $R'_w$ ).

#### 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 is to be based on the instructions given in Subsection 4/8, “Test Report”.

#### 8.2.7 Access to Documents

The Testing Specialist is to have access to the following documents:

- SOLAS 1974, as amended (Reg.II-1/3-12)
- Resolution A.468(XII) and IMO Resolution MSC.337(91) code on noise levels on board ships
- Resolution A.343(IX) Recommendation on methods of measuring noise levels at listening posts
- ISO 717-1:2013, Acoustics – Rating of Sound Insulation in Buildings and of Building Elements – Part 1: Airborne Sound Insulation
- ISO 16283-1:2014, Acoustics – Field Measurement of Sound Insulation in Buildings and of Building Elements – Part 1: Airborne Sound Insulation
- ABS Crew Habitability Guides

### **8.3 Indoor Climate**

#### **8.3.1 Extent of Engagement**

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

#### **8.3.2 Supervisor**

The supervisor is to:

- i)* have a documented history of at least one (1) year supervising and of at least two (2) years performing ambient environmental testing onboard marine vessels and/or offshore units
- ii)* have sufficient knowledge of marine vessels and/or offshore units structures, measuring equipment, ANSI/ASHRAE 55-2013 as well as ISO 7726:1998 and ISO 7547:2002, to verify that test procedures are compliant with the required test conditions

#### **8.3.3 Test Personnel**

The test personnel carrying out the measurements are to:

- i)* have a documented history of one (1) year experience in performing ambient environmental testing onboard marine vessels and/or offshore units
- ii)* have knowledge in the field of indoor climate, indoor climate measurements and handling of measurement equipment
- iii)* have adequate knowledge of marine vessels and/or offshore units structures and equipment

#### **8.3.4 Equipment**

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

Calibration of the measuring instrument is to be conducted at least every two (2) years (or more frequently if specified by the manufacturer) by an accredited Testing and Calibration Laboratory accredited according to ISO 17025:2005, as amended.

#### **8.3.5 Procedures**

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

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

#### **8.3.6 Reporting**

The report is to be based on the instructions given in Subsection 5/8, "Test Report".

**8.3.7 Access to Documents**

The Testing Specialist is to have access to the following documents:

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

**8.4 Lighting**

**8.4.1 Extent of Engagement**

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

**8.4.2 Supervisor**

The supervisor is to:

- i)* have a documented history of at least one (1) year supervising and of at least two (2) years performing ambient environmental testing onboard marine vessels and/or offshore units
- ii)* have sufficient knowledge of marine vessels and/or offshore units structures, measuring equipment, ISO 8995:2002 and DIN EN 12464-1:2011 to verify that test procedures are compliant with the required test conditions

**8.4.3 Test Personnel**

The test personnel carrying out the measurements are to:

- i)* have a documented history of one (1) year experience in performing ambient environmental testing onboard marine vessels and/or offshore units
- ii)* have knowledge in the field of lighting, illuminance level measurements and handling of measurement equipment
- iii)* have adequate knowledge of marine vessels and/or offshore units structures and equipment

**8.4.4 Equipment**

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

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

Calibration of the illuminance meter is to be conducted at least every two (2) years (or more frequently if specified by the manufacturer) by an accredited Testing and Calibration Laboratory accredited according to ISO 17025:2005, as amended.

**8.4.5 Procedures**

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

- i)* Test preparation
- ii)* Selection and identification of measurement locations
- iii)* Surface preparation
- iv)* Calibration checks

- v) Testing methods
- vi) Equipment handling
- vii) Report preparation and content
- viii) Method for handling previous results if subsequent calibration shows instruments to be out of tolerance

**8.4.6 Reporting**

The report is to be based on the instructions given in Subsection 6/8, “Test Report”.

**8.4.7 Access to Documents**

The Testing Specialist is to have access to the following document:

- ABS Habitability Guides



## APPENDIX 3 Accommodation Area Criteria

The accommodation area criteria are contained in Appendix 3, “Accommodation Area Criteria”. Meeting the baseline **HAB(ACCOM)** criteria in Appendix 3 fulfill the related quantitative ILO MLC 2006, Title 3 accommodation area criteria, denoted by a “#” symbol in the tables.

To use the tables in Appendix 3, first determine which notation is being requested **HAB(ACCOM)**, **HAB+(ACCOM)/HAB++(ACCOM)**.

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

For example, Criteria #13 below provides two degrees for angles of inclination for stairways, one for **HAB(ACCOM)** and one for **HAB+(ACCOM)** and **HAB++(ACCOM)**. If seeking a **HAB+(ACCOM)** notation, the 40 degrees criteria would need to be fulfilled. By fulfilling the criteria for the **HAB+(ACCOM)** requirements, the criteria for **HAB(ACCOM)** are also met.

Requirement # = Related to ILO MLC 2006, Title 3 Requirement		Meets <b>HAB(ACCOM)</b> Requirements	Meets <b>HAB+(ACCOM)/ HAB++(ACCOM)</b> Requirements
13	Accommodation area stairways (internal and external) have a maximum angle of inclination from the horizontal of:		
	• 45 degrees		
	• 40 degrees		

Accommodation Area Criteria				
General				
		Requirement # = Related to ILO MLC 2006, Title 3 Requirement	Meets HAB(ACCOM) Requirements	Meets HAB+(ACCOM)/ HAB++(ACCOM) Requirements
#	1	Accommodation areas are to 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.		
#	3	Headroom in all passageways, sleeping rooms, stairs, sanitary spaces, offices, food service areas, and recreational areas is at least 2030 mm (80.0 in.). This height is clear of any obstructions such as cableways, ducting, pipes, etc.		
	4	Non-slip type deck covering is supplied where occasional water, oil or liquid on the floors is expected.		
#	5	Painted wall surfaces and deck heads are light in color.		
	6	Interior finish materials and furnishings are designed to ease cleaning efforts and improve maintenance.		
#	7	Wall surfaces and decks are washable and impervious to damp or moisture absorption.		
#	8	Where the floorings in accommodation areas are made of composite materials, the joints with the sides are to be profiled to avoid crevices.		
#		No form of construction likely to harbor vermin is to be used.		
#		External bulkheads of sleeping rooms and mess rooms are to be adequately insulated. All machinery casings and all boundary bulkheads of galleys and other spaces in which heat is produced are to be adequately insulated where there is a possibility of resulting heat effects in adjoining accommodation or passageways. Measures are also to be taken to provide protection from heat effects of steam or hot-water service pipes or both.		
#		Sleeping rooms, mess rooms, recreation rooms and passageways in the accommodation space are to be adequately insulated to prevent condensation or overheating.		
	9	Transparent or translucent surfaces in doors, gates, walls and partitions are to be of a safety material or be adequately protected against breakage		
	10	Drawers and internal doors are designed:		
		• to prevent opening and closing due to accommodation vessel motion		
		• to be operable with one hand		

Accommodation Area Criteria			
Access/Egress			
	Requirement # = Related to ILO MLC 2006, Title 3 Requirement	Meets HAB(ACCOM) Requirements	Meets HAB+(ACCOM)/ HAB++(ACCOM) Requirements
<b>GENERAL</b>			
1	All traffic routes are to be clearly arranged with respect to orientation and safety, and provide optimal access between the various areas and levels.		
2	Escape routes are to lead directly to emergency stairs providing access to lifeboat stations and helideck.		
3	At least one internal stairway is to provide access to all levels between the highest deck giving access to the helicopter deck and the lowest deck level of the accommodation area/block.		
	<i>Note:</i> If multiple accommodation areas/blocks exist, this requirement is applicable only to the accommodation block where the helicopter deck is attached to.		
<b>DOORS</b>			
4	Doors (other than cabin toilet/bathrooms) have a clear opening width:		
	• a clear opening width of at least 700 mm (27.5 in.)		
5	Doors (other than cabin toilet/bathrooms) have a clear opening height:		
	• of at least 1980 mm (78 in.)		
6	Doors to cabin toilet/bathrooms have a clear opening width of at least 600 mm (23.5 in.)		
7	Doors used as a means of escape are capable of being operated by one person, from either side, in both light and dark conditions.		
8	Doors in accommodation spaces (with the exception of cabins), stairway, stair tower, passageway, open in the direction of escape, where practicable.		
9	Doors exposed to weather and strong winds are to be robust sliding doors. Hinged doors may be used externally, but only when recessed or shielded from weather exposure		
10	Handles for sliding doors are designed to avoid accidental crushing of fingers.		
11	Sliding doors are to have a stop or other effective means to prevent the door coming off the end of the track. They are also to have a retaining rail to prevent the door from falling should the suspension system fail or the rollers leave the track.		
<b>STAIRS</b>			
12	Accommodation area stairways (internal and external) have a maximum angle of inclination from the horizontal of:		
	• 45 degrees		
	• 40 degrees		
13	Stair risers and treads have the following design:		
	• the riser height is no more than 230 mm (9 in.) and the tread depth is approximately 230 mm (9 in.), with an additional 25 mm (1 in.) tread nosing		
	• the riser height is no more than 230 mm (9 in.) and the tread depth is approximately 275 mm (11 in.), with an additional 25 mm (1 in.) tread nosing		
14	The depth and width of the tread, and the height of riser of stairs in a stairway or stair tower are consistent		
15	The minimum tread measured clear width (i.e., clear of the handrails) is:		
	• on one-way stairs at least 700 mm (27.5 in.)		
	• on two-way stairs at least 1000 mm (39.5 in.)		
	• on two-way stairs at least 1200 mm (47 in.)		
	• all nosings have a non-slip surface.		
16	A clear landing at least as wide as the tread width and a minimum of 900 mm (35.5 in.) long is provided at the top and bottom of each stairway.		

Accommodation Area Criteria			
Access/Egress			
	Requirement # = Related to ILO MLC 2006, Title 3 Requirement	Meets HAB(ACCOM) Requirements	Meets HAB+(ACCOM)/ HAB++(ACCOM) Requirements
17	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 900 mm (35.5 in.) long.		
18	An intermediate landing is provided at each deck level serviced by a stair, or a maximum of every 3600 mm (141.5 in.) of vertical travel for stairs with a vertical rise of 6000 mm (236 in.).		
19	Stairway or stair towers are fitted with handrails with the following design:		
	<ul style="list-style-type: none"> <li>a handrail is provided on one side of the stair</li> </ul>		
	<ul style="list-style-type: none"> <li>a handrail is provided on both sides of the stair when the clear width is 1800 mm (71 in.) or greater</li> </ul>		
	<ul style="list-style-type: none"> <li>a handrail is provided on both sides of the stair when the clear width is 1500 mm (59 in.) or greater</li> </ul>		
	<ul style="list-style-type: none"> <li>the handrails are parallel to the pitch line of the stair flight and level at landings</li> </ul>		
	<ul style="list-style-type: none"> <li>the handrail is continuous from the top to the bottom of the stairway and terminates in a safe manner at both ends</li> </ul>		
	<ul style="list-style-type: none"> <li>the vertical height above the tread at its nosing is at least 950 mm (37.5 in.) to 1000 mm (39.5 in.)</li> </ul>		
	<ul style="list-style-type: none"> <li>the distance between handrails and any obstruction is 75 mm (3 in.) or greater</li> </ul>		
	<ul style="list-style-type: none"> <li>handrails on adjacent, parallel stair flights, have a minimum of 100 mm (4 in.) clear distance between rails.</li> </ul>		
RAMPS			
20	Ramps are sloped < 15 degrees for inclined walking surfaces.		
21	Ramps have a non-skid surface.		
22	Ramps have a handrail on any open side of the ramp if the distance from the ramp to the nearest adjacent surface is 600 mm (23.5 in.) or more.		
23	Access to lifeboats is provided such that a person in a stretcher can be easily embarked into the survival craft.		
PASSAGEWAY/WALKWAY DESIGN			
24	The minimum clear passageway width (i.e., clear of the storm rails/handrails) is:		
	<ul style="list-style-type: none"> <li>on one-way passageways at least 700 mm (27.5 in.)</li> </ul>		
	<ul style="list-style-type: none"> <li>on two-way passageways at least 1000 mm (39.5 in.)</li> </ul>		
	<ul style="list-style-type: none"> <li>on two-way passageways at least 1200 mm (47 in.)</li> </ul>		
25	Dead end corridors are to have a length of:		
	<ul style="list-style-type: none"> <li>less than 7 m (23 ft)</li> </ul>		
	<ul style="list-style-type: none"> <li>less than 5 m (16.5 ft)</li> </ul>		
26	Suitable storm rails/handrails are provided as follows:		
	<ul style="list-style-type: none"> <li>storm rails/handrails are provided in all interior passageways and at all accommodations block sides where persons onboard might have normal access</li> </ul>		
	<ul style="list-style-type: none"> <li>a storm rail/handrail is provided on one side of the passageway</li> </ul>		
	<ul style="list-style-type: none"> <li>a storm rail/handrail is provided on both sides of the passageway when the clear width is 1800 mm (71 in.) or greater</li> </ul>		
	<ul style="list-style-type: none"> <li>a storm rail/handrail is provided on both sides of the passageway when the clear width is 1500 mm (59 in.) or greater</li> </ul>		
	<ul style="list-style-type: none"> <li>storm rails/handrails are 865 mm (34 in.) to 1000 mm (39.5 in.) high</li> </ul>		
	<ul style="list-style-type: none"> <li>the distance between/or behind storm rails/handrails and any obstruction is 75 mm (3 in.) or greater</li> </ul>		

Accommodation Area Criteria			
Access/Egress			
	Requirement # = Related to ILO MLC 2006, Title 3 Requirement	Meets HAB(ACCOM) Requirements	Meets HAB+(ACCOM)/ HAB++(ACCOM) Requirements
27	Deck/guard railings are provided as follows:		
	<ul style="list-style-type: none"> <li>parallel to the deck along deck edges and walkways, and around open hatches, elevators, antenna platforms, and along other boundaries</li> </ul>		
	<ul style="list-style-type: none"> <li>wherever there is danger of personnel falling to a lower level of 600 mm (23.5 in.) or more in the accommodation vessel</li> </ul>		
	<ul style="list-style-type: none"> <li>wherever there is danger of personnel becoming enmeshed with hazardous operating machinery</li> </ul>		
	<ul style="list-style-type: none"> <li>around unprotected openings with coaming height below 760 mm (30 in.)</li> </ul>		
	<ul style="list-style-type: none"> <li>the heights of rails are at least 1000 mm (39.5 in.) from the deck edge except where this height would interfere with the normal operation of the accommodation vessel</li> </ul>		
	<ul style="list-style-type: none"> <li>the heights of rails are at least 1070 mm (42 in.) from the deck edge except where this height would interfere with the normal operation of the accommodation vessel</li> </ul>		
	<ul style="list-style-type: none"> <li>toeboards are provided 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</li> </ul>		
	<ul style="list-style-type: none"> <li>vertical stanchions for railings are spaced no more than 1500 mm (59 in.) apart horizontally</li> </ul>		
	<ul style="list-style-type: none"> <li>at least every third vertical stanchion is supported by a bracket or stay</li> </ul>		
	<ul style="list-style-type: none"> <li>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 center span</li> </ul>		
	<ul style="list-style-type: none"> <li>maximum lengths of openings protected by wire or chain are 1800 mm (71 in.). A removable stanchion will constitute the start of a new opening.</li> </ul>		
	<i>Note:</i> Temporary rails can be used around unprotected openings into which a person may slip, trip or fall.		
LIFTS			
28	Lift(s) for use by the industrial personnel are to be provided if the accommodation areas extend for more than two floor levels.		
29	The lift(s) are to provide access to all accommodation area deck levels.		

Accommodation Area Criteria				
Cabins				
		Requirement # = Related to ILO MLC 2006, Title 3 Requirement	Meets HAB(ACCOM) Requirements	Meets HAB+(ACCOM)/ HAB++(ACCOM) Requirements
OCCUPANCY LEVEL				
#	1	Sleeping rooms are not occupied by more than four persons.		
#	2	Industrial personnel sharing rooms are in same occupation group and day persons do not share a room with watch-keepers.		
	3	Maximum number of persons to be accommodated in any sleeping room is marked indelibly and legibly in some conveniently-seen place:		
		• in the room		
		• outside the room		
#	4	Separate sleeping rooms are to be provided for men and for women.		
CABIN SIZE				
#	5	Cabin floor area for one-person rooms is at least 7.0 m <sup>2</sup> (75.5 ft <sup>2</sup> ).		
	6	Cabin floor area for one-person rooms is at least 8.5 m <sup>2</sup> (91.5 ft <sup>2</sup> ).		
#	7	Cabin floor area for two-person rooms is at least 8.0 m <sup>2</sup> (86 ft <sup>2</sup> ).		
	8	Cabin floor area for two-person rooms is at least 10.0 m <sup>2</sup> (107.5 ft <sup>2</sup> ).		
	9	Cabin floor area for three-person rooms is at least 11.5 m <sup>2</sup> (124 ft <sup>2</sup> ).		
	10	Cabin floor area for three-person rooms is at least 13.5 m <sup>2</sup> (145.5 ft <sup>2</sup> ).		
	11	Cabin floor area for four-person rooms is at least 14.5 m <sup>2</sup> (156 ft <sup>2</sup> ).		
	12	Cabin floor area for four-person rooms is at least 16.5 m <sup>2</sup> (177.5 ft <sup>2</sup> ).		
#		<i>Note:</i> Cabin floor area requirement is inclusive of berths, lockers, chest of drawers and seats. Small or irregularly shaped spaces which do not add effectively to the space available for free movement and cannot be used for installing furniture are to be excluded.		
CABIN LOCATION				
	13	Industrial Personnel quarters are <b>not</b> located:		
#		• immediately beneath working and/or high-traffic alleyways or other noisy areas		
#		• below load line amidships or aft, unless satisfactory arrangements are made for lighting and ventilation and approved by the flag Administration		
#		• forward of the collision bulkhead		
	14	Location, means of access, structure and arrangement in relation to other spaces of personnel accommodation areas is to:		
		• provide adequate security		
		• minimize the risk to the occupants from fire and explosion areas		
		• protect against weather and sea		
		• insulate from heat and cold		
		• insulate from undue noise and effluvia (odors) from other spaces		
#	15	There is no direct access 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 toilets.		
ROOM DESIGN				
General				
	16	There are a sufficient number of beds for the maximum number of people required to sleep on the accommodation vessels without using the same beds for successive shifts.		
	17	Pipes, ventilation ducts, or other installations do not obstruct berths.		
	18	Sleeping rooms are ventilated and heated.		

Accommodation Area Criteria				
Cabins				
		Requirement # = Related to ILO MLC 2006, Title 3 Requirement	Meets HAB(ACCOM) Requirements	Meets HAB+(ACCOM)/ HAB++(ACCOM) Requirements
	19	HVAC vents are not to be directed at the heads of berths.		
	20	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				
	21	Multi-personnel cabin berths are not side by side so that access to one berth can only be obtained over another.		
	22	Multi-personnel cabin berths contain individually operated privacy curtains.		
	23	Multi-personnel cabin berths contain individually operated fans/blowers.		
#	24	Multi-personnel cabin arrangements are either single tier or double tiered.		
#	25	Multi- personnel cabin berths with portlights above them are only allowed in a single tier arrangement.		
Emergency				
	26	An emergency alerting system (e.g., an audible alarm) is present for all personnel cabin spaces.		
Outfitting				
#	27	Sleeping rooms, with portlights or windows, have curtains that completely block out light.		
#	28	Sleeping rooms are lighted with natural light and are provided with artificial light (subject to special arrangements as may be permitted by the flag or coastal State).		
	29	Grab bars and stepping surfaces are provided for access to upper berths.		
#	30	An electric reading light is provided at the head of each berth.		
#	31	The top berth in a tier has a dust-proof bottom of wood, canvas or other suitable material.		
	32	In sleeping rooms with more than one occupant, furniture (beds, lockers, drawers, etc.) are labeled identifying which furniture is dedicated to which berth.		
	33	Each sleeping room is provided with at least the following furniture (in addition to berths and clothes lockers):		
#		• a table or desk		
#		• a chair		
#		• a mirror with a light		
#		• a small cabinet for toilet requisites for each person in the room		
#		• a book rack		
#		• coat hooks		
#	34	Furniture is of smooth, hard material, not liable to warp or corrode.		
DIMENSIONAL ASPECTS				
Aisles				
	35	Aisle widths in sleeping areas are:		
		• at least 600 mm (23.5 in.), between a single berth and the nearest obstruction (excluding bed side tables or cabin desk)		
		• at least 750 mm (29.5 in.), between a single berth and the nearest obstruction (excluding bed side tables or cabin desk)		
	36	Aisle widths in sleeping areas are at least 920 mm (36 in.), between facing berths.		
Berths				
#	37	The top of the mattress of the lower berth in a tier is:		
		• at least 300 mm (12 in.) above the deck		
		• at least 550 mm (21.5 in.) above the deck		
#	38	The upper berth is placed approximately midway between the bottom of the lower berth and the lower side of the deck head beams.		

Accommodation Area Criteria				
Cabins				
		Requirement # = Related to ILO MLC 2006, Title 3 Requirement	Meets HAB(ACCOM) Requirements	Meets HAB+(ACCOM)/ HAB++(ACCOM) Requirements
	39	Head clearance above each berth is:		
		• at least 600 mm (23.5 in.)		
		• at least 800 mm (31.5 in.)		
	40	Berth mattress dimensions are:		
#		• at least 1980 mm (78 in.) by 800 mm (31.5 in.)		
		• at least 2030 mm (80 in.) by 965 mm (38 in.)		
	41	A small clearance is to be provided between the mattress and the bed side panels to allow easy hand/finger access.		
#	42	The framework and lee-board of a berth is of approved material, hard, smooth and not likely to corrode or to harbor vermin.		
#	43	Berths constructed from tubular frames are completely sealed and without perforations which would give access to vermin.		
Storage Space				
	44	Sleeping rooms provide storage space for each occupant:		
		• the clothes locker is fitted with a shelf and hasp		
#		• the clothes locker is at least 0.475 m <sup>3</sup> (16.75 ft <sup>3</sup> )		
#		• a drawer or equivalent space of at least 56 liters (2 ft <sup>3</sup> ); if the drawer is incorporated in the clothes locker then the combined minimum volume of the clothes locker is to be 500 liters; it is to be fitted with a shelf and be able to be locked by the occupant so as to provide privacy		

Accommodation Area Criteria				
Sanitary Spaces				
		Requirement # = Related to ILO MLC 2006, Title 3 Requirement	Meets HAB(ACCOM) Requirements	Meets HAB+(ACCOM)/ HAB++(ACCOM) Requirements
<b>GENERAL</b>				
	1	Cabins are to be equipped with a private shower/bathroom, including a toilet and washbasin, so as to provide reasonable comfort for the occupants.		
#	2	An adequate number of public toilets with associated washbasins are provided which are conveniently located near the office and administration areas, recreation areas, food service areas, reception areas and changing rooms.		
		<i>Note:</i> In this context, “conveniently located near” is defined as being on the same deck or on the deck below (or above) adjacent to the stairway.		
	3	An adequate number of public shower stalls are provided within or adjacent to the changing room(s).		
#	4	Public toilets are provided for men and women and are gender identifiable without entering the space.		
#	5	All sanitary spaces are to have ventilation to the open air, independently of any other part of the accommodation areas.		
	6	Free space (space available for movement without hindrance of any objects) per person in public sanitary spaces is:		
		• at least 0.75 m <sup>2</sup> (8 ft <sup>2</sup> )		
		• at least 1.1 m <sup>2</sup> (12 ft <sup>2</sup> )		
		<i>Note:</i> In this context, per person means the number of person(s) for which the specific sanitary space is designed for in any one time (e.g., the number of toilets, urinals, showers and/or washbasins that can simultaneously be used).		
	7	Floors in sanitary spaces are:		
#		• non-slip type deck covering		
#		• easily cleaned		
#		• impervious to damp or moisture absorption		
#		• properly drained		
	8	Bulkheads in public sanitary spaces are:		
#		• steel or other approved material		
#		• watertight up to 230 mm (9 in.) above deck level		
	9	Someone standing on a wet deck in sanitary spaces cannot reach light switches or electrical outlets without ground fault interrupters (GFI).		
<b>SHOWERS/BATHS</b>				
	10	Showers are of the individual stall type and have a minimum area of:		
		• 0.55 m <sup>2</sup> (6 ft <sup>2</sup> )		
		• 0.65 m <sup>2</sup> (7 ft <sup>2</sup> )		
	11	The minimum width through the center of the shower is to be 700 mm (27.5 in.)		
	12	In sanitary spaces intended for more than one person, the shower/bath area is to be clearly separated from the rest of the sanitary space by means of hinged, glazed shower panels, curtains, or similar		
	13	Handholds are provided for shower and bath sanitary spaces.		
	14	Water heaters supplying showers:		
		• do not support areas that have higher water temperature requirements, such as food service areas		
		• are provided with anti-scalding devices		

Accommodation Area Criteria			
Sanitary Spaces			
	Requirement # = Related to ILO MLC 2006, Title 3 Requirement	Meets HAB(ACCOM) Requirements	Meets HAB+(ACCOM)/ HAB++(ACCOM) Requirements
<b>TOILETS</b>			
15	Where there is more than one toilet in a sanitary space, they are sufficiently screened to provide privacy.		
16	Multiple individual toilet stalls within a public sanitary space are to have the following dimensions:		
	• Minimum toilet stall width is 760 mm (30 in.)		
	• Minimum toilet stall width is 800 mm (31.5 in.)		
	• Minimum toilet stall length (clear of the toilet) is 760 mm (30 in.)		
	• Minimum toilet stall length (clear of the toilet) is 910 mm (36 in.)		
17	Toilet stall doors are to open outwards		
18	All toilets:		
	• have flush water available at all times		
	• are independently controllable		
<b>WASHBASINS</b>			
19	The following at a minimum are provided for each washbasin:		
	• a mirror		
	• toiletry shelf (not applicable to public washbasins)		
	• electrical outlets that personnel have ready access to are equipped with ground fault interrupters (GFI) (not applicable to public washbasins)		
	• facilities to dry hands (e.g., paper towels from a dispenser, hand driers or cabinet roller towels, etc.) are provided at all washbasins		
20	Washbasins are:		
	• constructed of approved material		
	• smooth surfaced		
	• not liable to crack, flake or corrode		
21	Washbasin are provided having hot and cold running potable water		
22	Water heaters supplying washbasins:		
	• do not support areas that have higher water temperature requirements		
	• are provided with anti-scalding devices		
<b>PUBLIC URINALS</b>			
23	Urinals have privacy partitions between units and at the end of rows if not provided by permanent structures.		
24	The dimension between the centerline of two urinals side-by-side is 690 mm (27 in.) or greater.		
25	The dimension between the centerline of a urinal and a bulkhead next to the urinal is 380 mm (15 in.) or greater.		
26	The height of the front edge of a urinal is between 455 mm (18 in.) and 605 mm (24 in.) above the deck surface.		

<b>Accommodation Area Criteria</b>				
<b>Office &amp; Administration Areas</b>				
		<b>Requirement</b> # = Related to ILO MLC 2006, Title 3 Requirement	Meets <b>HAB(ACCOM)</b> Requirements	Meets <b>HAB+(ACCOM)/</b> <b>HAB++(ACCOM)</b> Requirements
<b>GENERAL</b>				
1		Whenever possible, offices are to be grouped together in the administration area to promote cooperation, communication and effective use of common facilities.		
2		Offices may be arranged as a combination of single offices, large group offices and open office landscape with individual workstations.		
3		The administration area is to have necessary supporting facilities, such as conference room(s), briefing room(s), copy/printer rooms and stationery store(s).		
4		When applicable, a helicopter reception/waiting room is to be provided and is to be located as close as possible to the helideck with easy access to both the helideck and the main access/egress route(s) to the accommodation area.		
5		For work stations where personnel 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 is to be provided.		
<b>OUTFITTING</b>				
6		Offices contain a desk, chair and other requisite office furniture and equipment.		
7		Office chairs are to be height adjustable.		
8		Conference room(s) are to be equipped with projector equipment with PC connection facilities and/or teleconference equipment.		
<b>DIMENSIONAL ASPECTS</b>				
9		Individual office floor area is at least 6 m <sup>2</sup> (65 ft <sup>2</sup> )		
10		The floor area of the helicopter reception/waiting room is not to be not less than 1.5 m <sup>2</sup> (16 ft <sup>2</sup> ) per person of the planned seating capacity.		
11		The clearance between the front of a filing cabinet and a bulkhead or obstruction in front of the cabinet is at least 900 mm (35.5 in.).		

Accommodation Area Criteria				
Food Service Areas				
		Requirement # = Related to ILO MLC 2006, Title 3 Requirement	Meets HAB(ACCOM) Requirements	Meets HAB+(ACCOM)/ HAB++(ACCOM) Requirements
<b>GENERAL</b>				
	1	Dining rooms are located apart (i.e., not adjacent) from sleeping rooms		
#	2	Dining rooms have tables and seats sufficient for the number of persons likely to use them at any one time (approximately 50% of the total number of industrial personnel).		
	3	Mess lines and dining rooms are protected from weather, objectionable sights (such as garbage disposal areas) and objectionable odors (such as from engines, holds, toilets, fire room, etc.).		
	4	The following is available for industrial personnel use at all times:		
#		• refrigerator(s)		
#		• facilities for hot beverages		
#		• facilities for cool water		
	5	The tops of tables and seating are capable of being easily cleaned.		
#	6	Where available pantries are not accessible to mess rooms, adequate lockers for mess utensils and proper facilities for washing utensils are provided.		
#	7	Lighting in mess rooms is provided by means of natural light and artificial light (subject to special arrangements as may be permitted by the flag or coastal State).		
<b>OUTFITTING</b>				
	8	Tray slides (or rails) are provided along food and beverage serving lines.		
	9	A transparent sanitation shield is installed to completely shield the entire length of the food serving lines above the tray rail.		
	10	Adequate lockers for mess utensils are provided.		
<b>DIMENSIONAL ASPECTS</b>				
	11	Deck area requirements for planned seating capacity (approximately 50% of the total number of industrial personnel) are:		
#		• at least 1.5 m <sup>2</sup> (16 ft <sup>2</sup> ) per person		
		• at least 1.7 m <sup>2</sup> (18.5 ft <sup>2</sup> ) per person		
	12	Rectangular table space for each diner is:		
		• at least 610 mm (24 in.) wide by 380 mm (15 in.) deep		
		• at least 740 mm (29 in.) wide by 430 mm (17 in.) deep		
	13	Round table diameter is:		
		• for seating 4 persons at least 1220 mm (48 in.)		
		• for seating 4 persons at least 1370 mm (54 in.)		
		• for seating 6 persons at least 1520 mm (60 in.)		
		• for seating 6 persons at least 1680 mm (66 in.)		
		• for seating 8 persons at least 1830 mm (72 in.)		
		• for seating 8 persons at least 1980 mm (78 in.)		
	14	Distance between tables with back-to-back seating is:		
		• at least 1195 mm (47 in.)		
		• at least 1525 mm (60 in.)		

Accommodation Area Criteria				
Recreation				
		Requirement # = Related to ILO MLC 2006, Title 3 Requirement	Meets HAB(ACCOM) Requirements	Meets HAB+(ACCOM)/ HAB++(ACCOM) Requirements
<b>GENERAL</b>				
1		Recreation accommodation areas, conveniently situated and appropriately furnished are provided for industrial personnel.		
		The recreational area(s) goal is to provide space for 1/3 of the industrial personnel to participate simultaneously in some form of leisure activity.		
2		Rooms provided for the various activities within the recreation area are to be arranged with movable partitions so that areas can be enlarged or reduced to accommodate particular requirements, where practicable.		
#	3	The following types of recreation rooms/areas are to be provided:		
		• Lounge(s)		
		• Quiet Room/Library		
		• Multimedia Room providing internet and video game facilities (if not part of the lounge)		
		• Exercise Room/Gymnasium		
		• Smoking room (if not part of a lounge)		
		• Movie Theater/Auditorium		
		• A Shop/Kiosk with store for the purchase of personal articles		
#	4	Consideration is to be given to include the following recreational facilities onboard, where practicable:		
		• facilities for recreational handicrafts		
		• sauna		
		• where appropriate, the provision of bars on board for industrial personnel unless these are contrary to national, religious or social customs		
5		Lighting in the lounge(s) is provided by means of natural light and artificial light (subject to special arrangements as may be permitted by the flag or coastal State).		
#	6	Accommodation vessel has an open deck space or spaces to which personnel can have access when off duty.		
<b>LOUNGE</b>				
7		One or more lounge(s) are to be provided designed to seat (combined) a minimum of 20% of the number of industrial personnel onboard.		
8		Deck area requirements for planned seating capacity are:		
		• at least 1.5 m <sup>2</sup> (16 ft <sup>2</sup> ) per person		
		• at least 1.75 m <sup>2</sup> (18.5 ft <sup>2</sup> ) per person		
9		For each seat in the lounge(s), the provided deck area is:		
		• approximately 1.0 m <sup>2</sup> (11 ft <sup>2</sup> )		
		• approximately 1.25 m <sup>2</sup> (13.5 ft <sup>2</sup> )		
10		The lounge(s) are to include, as a minimum, the following facilities:		
		• tables		
		• chairs		
		• a range of storage cabinets and shelving for books, magazines, etc.		
11		Where space permits, the main lounge is to be located adjacent to the dining room, and positioned so that a logical flow sequence is established between the recreation facilities and the dining room.		
12		When the main lounge is located adjacent to the dining room, the route between the main lounge, the stairway and the dining room is to be designed to afford easy circulation and avoid congestion.		

<b>Accommodation Area Criteria</b>				
<b>Recreation</b>				
		<b>Requirement</b> # = Related to ILO MLC 2006, Title 3 Requirement	Meets <b>HAB(ACCOM)</b> Requirements	Meets <b>HAB+(ACCOM)/</b> <b>HAB++(ACCOM)</b> Requirements
	13	A coffee bar area is to be provided as part of the main lounge.		
	14	Unless a separate TV-room/area is provided, a section of the main lounge area is used for viewing of programs in a social setting.		
	15	Unless a separate game room/area is provided, a section of the main lounge area is used for games (i.e., pool, table tennis, darts, etc.)		
<b>QUIET ROOM/LIBRARY</b>				
	16	A quiet room/library is to be appropriately furnished with comfortable seating, and be used as a place for reading, writing, quiet conversations, or other low-energy activities.		
	17	It is to contain vocational and other books, the stock of which is to be adequate and changed at reasonable intervals.		
	18	It is to be located remote from high noise areas (e.g., dining room, lounge, exercise area), to avoid nuisance noise.		
<b>EXERCISE ROOM/AREA</b>				
	19	Area(s) outfitted with sport/exercise equipment are to be provided.		
	20	The exercise area(s) is to be located remote from quiet areas to avoid nuisance noise.		
	21	Consideration is to be given to provide facilities for swimming.		
<b>SMOKING ROOM/AREA</b>				
	22	Access into the rooms is to be provided via an entrance lobby to prevent smoke drifting into other areas.		

Accommodation Area Criteria			
Service Spaces			
	Requirement # = Related to ILO MLC 2006, Title 3 Requirement	Meets HAB(ACCOM) Requirements	Meets HAB+(ACCOM)/ HAB++(ACCOM) Requirements
LAUNDRY FACILITIES – GENERAL			
<b>Note:</b>	Laundry activities onboard accommodation vessel and associated laundry facilities can fall under one of the following categories: 1. Self-service: The industrial personnel are responsible for laundering their clothes, linen, towels, and coveralls. 2. Hotel-service: Dedicated crew onboard the accommodation vessel is responsible for the pick-up, laundering and delivery of clothing, linen, towels, and coveralls to the industrial personnel. Under the hotel service category, some types of items may be laundered onboard or onshore.		
1	Facilities exist for washing and drying clothes on a scale appropriate to the number of industrial personnel.		
2	Laundry facilities are located within easy access of industrial personnel accommodation areas.		
3	Laundry facilities are to be sufficient to allow the industrial personnel to be provided with clean and dry underwear once per day and clean and dry outerwear and bedding once per five (5) days.		
SELF-SERVICE LAUNDRY FACILITIES			
4	Coamings and/or deck drains are provided around washing machines, water heaters, etc.		
5	Washer and dryer capacities are matched to assure a smooth workflow.		
6	Washers and dryers are placed relative to each other to facilitate the transfer of clothing from the washer to the dryer.		
7	Tumble dryers are exhausted directly into the weather, not into the accommodation vessel.		
8	Tumble dryers are equipped with lint filters.		
9	The laundry facilities include at a minimum:		
#	• clothes washing machines		
#	• clothes drying machines		
#	• irons and ironing boards (or their equivalent)		
HOTEL-SERVICE LAUNDRY FACILITIES			
10	The laundry is to be arranged in areas for receiving, washing/drying and storing of laundry items and trolleys		
11	The laundry is to be located with good access to lift(s)		
CHANGING/LOCKER ROOMS			
12	A locker room is provided for personnel to change from and store their working clothes, boots and helmets before entering the clean area of the accommodation block.		
13	The locker room is located so as to act as a natural transit between the working and crew living spaces with separate but direct access between these spaces.		
14	Toilet and washing facilities are located adjacent to the locker room and available to personnel before changing.		
15	The locker room accommodates lockers for 110% of the total number of industrial personnel beds.		
16	Lockers are arranged in banks, with adequate space between banks for personnel to change. Island bench seats and/or seat adjacent to the lockers are provided.		

Accommodation Area Criteria				
Medical				
		Requirement # = Related to ILO MLC 2006, Title 3 Requirement	Meets HAB(ACCOM) Requirements	Meets HAB+(ACCOM)/ HAB++(ACCOM) Requirements
GENERAL				
#	1	The industrial personnel accommodation area contains a dedicated medical facility.		
	2	The medical facility will normally consist of:		
		• consultation/examination room		
		• medical store		
		• dedicated sanitary facilities		
		• ward		
	3	The medical accommodation area is suitably located to allow for safe and efficient:		
		• access for sick or injured personnel		
		• stretcher transportation from accommodation areas or work areas		
	4	The medical accommodation area is suitably separated from other spaces and used for the care of the sick and for no other purpose.		
	5	The medical accommodation area is suitably designed so that the occupants may 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 to facilitate the treatment of personnel.		
OUTFITTING				
	7	Sufficient beds are to be provided in the hospital ward on a ratio of one bed per 50 (or fraction of) industrial personnel up to a maximum number of 4 beds.		
	8	Medical accommodation area is appropriately equipped to render the necessary medical attention including means of sterilizing medical instruments.		
	9	The medical accommodation area has the necessary suitable equipment such as a clothes locker, a table and a seat based on the number of possible patients.		
	10	If the accommodation vessel does not carry a doctor, it must have an approved medicine chest with readily understandable instructions.		
#	11	The dedicated sanitary facilities consist of a toilet, washbasin, and bathtub or shower conveniently situated for the use exclusively by the patients.		
	12	The door to the toilet and washbasin opens outwards and any door latch is capable of being opened from the outside.		
	13	The medical accommodation area is equipped with stretchers that meet the following:		
		• the ability to winch a sick or injured person into a helicopter or vessel. Such a stretcher is to have the capability of floating and righting itself in the water		
		• collapsible and suitable for use in confined spaces		
	14	Hospital and medical/first aid accommodation area is situated and arranged so that a stretcher can be easily carried into it and placed alongside an examination table or bed.		
	15	The medical accommodation area has lockable storage for drugs, dressings, and medical equipment.		
	16	The medical accommodation area has an intercom or signaling system (e.g., an emergency call device) to the operations control room.		



## APPENDIX 4 Acronyms and Abbreviations

°C	Degrees Celsius
°F	Degrees Fahrenheit
ABS	American Bureau of Shipping
ANSI	American National Standards Institute
ASNT	American Society of Nondestructive Testing
ASTM	American Society of Testing and Materials
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
Avg	Average
$a_w$	Multi-axis acceleration value
$a_{xw}$	The weighted root mean square acceleration values measured along the x-axis
$a_{yw}$	The weighted root mean square acceleration values measured along the y-axis
$a_{zw}$	The weighted root mean square acceleration values measured along the z-axis
cd/m <sup>2</sup>	Candela-per-square meter
CIH	Certified Industrial Hygienist
dB(A)	Decibels measured using the A-weighted scale
DP	Dynamic Positioning
ed.	Edition
EN	European Norms
ft/s	Feet-per-second
fc	Foot-candle
ft	Feet
ft <sup>2</sup>	Square feet
GFI	Ground Fault Interrupter
<b>HAB(ACCOM)</b>	Accommodation Vessel Habitability notation
<b>HAB+(ACCOM)</b>	Accommodation Vessel Habitability Plus notation
<b>HAB++(ACCOM)</b>	Accommodation Vessel 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 <sup>2</sup>	Lumens-per-square meter
lm/ft <sup>2</sup>	Lumens-per-square foot

#### Appendix 4 Acronyms and Abbreviations

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m	Meter
m <sup>2</sup>	Square meter
m/s	Meters-per-second
m/s <sup>2</sup>	Meters-per-second squared
Max	Maximum
MCR	Maximum Continuous Rating
Min	Minimum
MLC	Maritime Labour Convention
mm	Millimeter
NDT	Nondestructive Testing
NEBB	National Environmental Balancing Bureau
NORSOK	Norwegian Engineering Industries
OSV	Offshore Service Vessel
psi	Pounds-per-square inch
RH	Relative humidity
RMS	Root-mean square
RP	Recommended Practice
$R'_w$	Apparent Weighted Sound Reduction Index
SI	International System of Units
SOLAS	Safety Of Life At Sea
TAB	Testing, Adjusting and Balancing
USA	United States of America
$W_m$	Frequency weighting used to evaluate x, y, and z-axis vibration with respect to comfort



## APPENDIX 5 Associated Documentation

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

ANSI/ASHRAE	<a href="http://www.ansi.org">www.ansi.org</a>
BS	<a href="http://www.bsigroup.com">www.bsigroup.com</a>
DIN	<a href="http://www.din.de">www.din.de</a>
IEC	<a href="http://www.iec.org">www.iec.org</a>
IESNA	<a href="http://www.iesna.org">www.iesna.org</a>
ILO	<a href="http://www.ilo.org">www.ilo.org</a>
IMO	<a href="http://www.imo.org">www.imo.org</a>
ISO	<a href="http://www.iso.org">www.iso.org</a>
NEBB	<a href="http://www.NEBB.org">www.NEBB.org</a>