

第 41/2015 號行政長官公告

中華人民共和國於一九九九年十二月十三日以照會通知聯合國秘書長，經修訂的《1974年國際海上人命安全公約》自一九九九年十二月二十日起適用於澳門特別行政區；

國際海事組織海上安全委員會於二零一二年十一月三十日透過第MSC.337(91)號決議通過了《船上噪音等級規則》，該規則自二零一四年七月一日起適用於澳門特別行政區；

基於此，行政長官根據澳門特別行政區第3/1999號法律第六條第一款的規定，命令公佈包含上指規則的第MSC.337(91)號決議的中文及英文文本。

二零一五年四月二十二日發佈。

行政長官 崔世安

Aviso do Chefe do Executivo n.º 41/2015

Considerando que a República Popular da China, por nota datada de 13 de Dezembro de 1999, notificou o Secretário-Geral das Nações Unidas sobre a aplicação da Convenção Internacional para a Salvaguarda da Vida Humana no Mar de 1974, tal como emendada, na Região Administrativa Especial de Macau a partir de 20 de Dezembro de 1999;

Considerando igualmente que, em 30 de Novembro de 2012, o Comité de Segurança Marítima da Organização Marítima Internacional, através da resolução MSC.337(91), adoptou o Código relativo aos Níveis de Ruído a Bordo dos Navios, e que tal Código é aplicável na Região Administrativa Especial de Macau desde 1 de Julho de 2014;

O Chefe do Executivo manda publicar, nos termos do n.º 1 do artigo 6.º da Lei n.º 3/1999 da Região Administrativa Especial de Macau, a resolução MSC.337(91), que contém o referido Código, nos seus textos em línguas chinesa e inglesa.

Promulgado em 22 de Abril de 2015.

O Chefe do Executivo, *Chui Sai On*.

第MSC.337 (91) 號決議

(2012年11月30日通過)

《船上噪聲等級規則》

海上安全委員會，

憶及《國際海事組織公約》關於本委員會職能的第二十八條第(二)款，

還憶及本組織大會以第A.343 (IX) 和A.468 (XII) 號決議分別通過的《守聽位置噪聲等級測量方法建議案》及《船上噪聲等級規則》，

認識到，慮及自通過第A.468 (XII) 號決議以來就噪聲控制和允許暴露等級所獲得的經驗，有必要為船上的機器處所、控制室、工作間、居住處所和其他處所制定強制性噪聲等級限值，

注意到以第MSC.338 (91) 號決議通過的經修正的《1974年國際海上人命安全公約》(《安全公約》)(以下稱“公約”)有關噪聲防護的第II-1/3-12條，

還注意到上述第II-1/3-12條規定，船舶建造須遵循《船上噪聲等級規則》(以下稱“本規則”)以降低船上噪聲及實施人員噪聲防護，

在其第91屆會議上審議了船舶設計和設備分委會第56次會議提出的建議案，

1. 通過《船上噪聲等級規則》，其文本載於本決議附件中；

2. **提請**公約各締約國政府注意，本規則將於2014年7月1日在公約第II-1/3-12條生效時生效；
3. **要求**秘書長將本決議及其附件中本規則文本的核證無誤副本分發給所有公約締約國政府；
4. **還要求**秘書長將本決議及其附件的副本分發給所有非公約締約國的本組織會員。

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前言

1 《船上噪聲等級規則》（以下簡稱“本規則”）的制定，係為經修正的《1974國際海上人命安全公約》（《安全公約》）第II-1/3-12條所規定的噪聲防護提供國際標準。雖然本規則根據《安全公約》在法律上被視為強制性文件，但其中的某些規定仍為建議性或資料性的（見1.1.3）。

2 這些規定、建議和意見，旨在向各國主管機關提供促進船上“聽力保存”環境的工具。然而，這是處理相互交集的人與技術環境的動態主題。隨着各種技術和安全管理實踐的發展，規範和建議案必將根據具體情況而發展。因此，鼓勵各國主管機關傳授得自經認可組織、船舶經營人和設備設計者的經驗和信息，以完善本規則。

3 本規則針對常規客船和貨船制定。儘管本規則將某些類型和尺度的船舶排除於其適用範圍之外，但應認識到，對於在設計或作業上與常規船舶有顯著不同的船舶，在全面應用本規則時，需要具體考慮。

4 本規則無意取代本組織通過的《守聽位置噪聲等級測量方法建議案》（第A.343（IX）號決議）。該建議案相對於船舶噪聲對正確接收外部聲響航行信號的干擾，雖然根據該建議案和根據本規則測量噪聲等級的方法有所不同，但是由於本規則主要關注噪聲對健康和舒適的影響，這兩個文件應視為是相互兼容的。需注意確保一般要求與航行信號可聽度要求之間的兼容性。

第 1 章 – 總則

1.1 範圍

1.1.1 本規則旨在為防止船上出現具有潛在危險的噪聲等級提供標準，並為海員可接受的環境提供標準。這些標準係針對客船和貨船制定的。鑑於對某些尺度和營運類型的船舶免除這些要求，應認識到，對於與常規船舶顯著不同的船舶，在全面應用本規則時，將需要特殊考慮。本規則旨在為設計標準提供依據，符合標準的依據是滿意完成導致簽發“噪聲測量報告”的海上試驗。根據對船員進行的個人保護原理的培訓和降噪措施的保持，預測持續符合作業要求。這些將按照《安全公約》第IX章所規定的適當動態過程和實踐加以執行。

1.1.2 為以下所列提出了要求和建議：

- .1 對噪聲等級和噪聲暴露的測量；
- .2 在目前還不能把噪聲限制到無潛在傷害聲等級的各種情況下，防範海員因噪聲導致聽力損失的風險；
- .3 船員通常進入的所有處所的可接受的最大噪聲等級限值；和
- .4 對居住處所之間隔聲的驗證。

1.1.3 雖然本規則根據《安全公約》在法律上被視為強制性文件，但是本規則的下列規定仍為建議性、遵守的選項、或資料性的：

1.3.2和1.3.3段

3.4.2和3.4.3段

第5章

6.3節

7.3節

附錄2

附錄3

附錄4

1.2 目的

本規則的目的是限制噪聲等級和減少船員對噪聲的暴露，以便：

- .1 考慮到通話和聽到聲響警報的需要，及在控制站、駕駛和無線電設備處所與有人值班機器處所中能作出清醒決定的環境，為安全工作條件作出規定；
- .2 保護船員不暴露於可能造成噪聲導致的聽力損失的過大噪聲等級；和
- .3 為船員在休息、娛樂和其他處所提供一種可接受的舒適度，也為暴露於高噪聲等級而受到影響提供恢復條件。

1.3 適用

1.3.1 本規則適用於1,600總噸及以上的新船。

1.3.2 本規則中有關具有潛在危險的噪聲等級、降噪和個人保護設備的具體規定，在合理和可行的範圍內，可適用於1,600總噸及以上的現有船舶，並使主管機關滿意。

1.3.3 在合理和可行的範圍內，本規則可適用於小於1,600總噸的新船，並使主管機關滿意。

1.3.4 本規則不適用於：

- .1 動力支承船；
- .2 高速船；
- .3 漁船；
- .4 鋪管駁船；
- .5 起重駁；
- .6 海上移動式鑽井平台；
- .7 非商用遊艇；
- .8 軍艦和軍用運輸船；
- .9 非機械推進船舶；
- .10 打樁船；
- .11 挖泥船。

1.3.5 本規則適用於船上有船員的港內或海上船舶。

1.3.6 如果有文件證明，即使採用相關和合理的技術性降噪措施將仍不可能符合規定，主管機關可以在特殊情況下准予免除某些要求。除以外例情況為準外，此種免除不包括客艙。如果准予免除，須確保達到本規則的目標，並須結合第5章考慮噪聲暴露限值。

1.3.7 對設計成並用於短程航行的船舶，或涉及船舶短期運作且使主管機關滿意的其他營運的船舶，本規則第4.2.3和4.2.4段可僅適用船舶的港內工況，但在這種工況下應具有足夠的時間供船員休息和娛樂。

1.3.8 本規則擬不適用於乘客艙室和其他乘客處所，除非它們是本規則規定所涵蓋的工作處所。

1.3.9 對於現有船舶的重大修理、改裝和更改，及與之相關的舾裝，在主管機關認為合理和可行的範圍內，須確保發生變化的區域符合本規則對新船的要求。

1.3.10 本規則僅涵蓋與船舶相關的噪聲源，如機械和推進裝置，但並不包含風/浪/冰的噪聲、警報和公共廣播系統等。

1.4 定義

就本規則而言，下列定義適用。附加定義在本規則其他處給出。

1.4.1 居住處所：客艙、辦公室（處理船舶業務的）、醫務室、餐廳、娛樂室（例如休息室、吸煙室、電影廳、健身房、圖書室、興趣室和遊戲室）以及海員使用的露天娛樂場所。

1.4.2 現場測試（apparent）計權隔聲指數 R'_w ：表示牆、門或地板就地整體提供的隔聲性能的一個單一數值，以分貝（dB）計（見經1:2006修正的ISO 717-1：1996）。

1.4.3 A-計權等效連續聲等級 $L_{Aeq}(T)$ ：連續穩定聲的A-計權聲壓級，其在1個測量間隔時間 T 內，其與所考慮的隨時間變化的聲具有相同的均方根聲壓。該聲等級以分貝A（dB（A））計，由下式得出：

$$L_{Aeq,T} = 10 \log \frac{1}{T} \int_0^T \frac{p_a(t)^2}{p_0^2} \cdot dt$$

式中： T = 測量時間；

$p_a(t)$ = A計權瞬時聲壓；

$P_0 = 20 \mu\text{Pa}$ （基準級）。

1.4.4 A-計權聲壓級或噪聲等級：聲等級計所測得的頻率響應按照A-計權曲線計權的數值（見IEC 61672-1）。

1.4.5 C-計權等效連續聲等級 $L_{Ceq}(T)$ ：連續穩定聲的C-計權聲壓級，其在1個測量間隔時間 T 內，與所考慮的隨時間變化的聲具有相同的均方根聲壓。該聲等級以分貝C (dB (C)) 計，由下式得出：

$$L_{Ceq,T} = 10 \log \frac{1}{T} \int_0^T \frac{p_c(t)^2}{P_0^2} \cdot dt$$

式中： T = 測量時間；

$p_c(t)$ = C-計權瞬時聲壓；

$P_0 = 20 \mu Pa$ (基準級)。

1.4.6 C-計權峰值聲等級 L_{Cpeak} ：C-計權最大瞬時聲壓級。該聲壓級以分貝C (dB (C)) 計，由下式得出：

$$L_{Cpeak} = 10 \log \frac{P_{peak}^2}{P_0^2}$$

式中： P_{peak} = C-計權最大瞬時聲壓；

$P_0 = 20 \mu Pa$ (基準級)。

1.4.7 C-計權聲壓級或噪聲等級：聲等級計所測得的頻率響應按照C-計權曲線計權的數值（見IEC 61672-1 (2002-05)）。

1.4.8 連續有人值班處所：在正常作業期間海員需要連續或長期在場的處所。

1.4.9 起重駁：帶有固定安裝的起重機並設計為主要用於起吊作業的

船舶。

1.4.10 日噪聲暴露級 ($L_{ex,24h}$)：表示24小時時間段內等效噪聲暴露級。

$$L_{ex,24h} = L_{Aeq,T} + 10 \log (T/T_0)$$

式中：T為船上有效持續時間；

T_0 為基準24小時持續時間。

總的等效連續A-計權聲壓級 ($L_{Aeq,T}$)，須採用不同的噪聲等級 (L_{Aeq,T_i}) 和相關時間段以下列公式計算：

$$L_{Aeq,T} = 10 \lg \left[\frac{1}{T} \sum_{i=1}^n (T_i \times 10^{0.1L_{Aeq,T_i}}) \right]$$

式中： L_{Aeq,T_i} 為等效連續A-計權聲壓級，以分貝計，按間隔時間 T_i 取平均值；

$$T = \sum_{i=1}^n T_i$$

如海員在船上的時間超過24小時， $L_{ex,24h} = L_{Aeq,24h}$ 。

1.4.11 挖泥船：帶有固定安裝的挖掘設備，從事水底沉積物挖掘作業的船舶。

1.4.12 值班站：主要航行設備、船舶無線電或應急電源所在的處所或者火災記錄或火災控制設備集中的處所，以及用作廚房、主配膳室、儲藏室（獨立的配膳室和儲物間除外）、郵件及貴重物品室、並非機器處所組成部分的工作間以及類似處所。

1.4.13 動力支承船：在水中或水上操作並具有與常規排水型船舶不同特性的船舶。在上述範疇內，係指符合下列任一特性的船：

- .1 其重量或相當大一部分重量以借助靜水力以外的作業模式加以平衡；
- .2 船能在函數 $\frac{V}{\sqrt{gL}}$ 等於或大於0.9的航速下操作，其中V是最大航速，L是水線長度，g是重力加速度，所有各項均用一致的單位。

1.4.14 現有船舶：並非新船的船舶。

1.4.15 漁船：用於商業性捕撈魚類、鯨魚、海豹、海象或其他海洋生物資源的船舶。

1.4.16 聽力損失：聽力損失係參照在ISO 389-1（1998）號標準中有常規定義的基準聽覺閾值確定。聽力損失相當於被測對象的聽覺閾值與基準聽覺閾值之差。

1.4.17 聽力保護器：為減少到達耳朵的噪聲等級而配戴的裝置。被動降噪耳機阻擋噪聲到達耳朵。主動降噪頭戴式耳機在耳機內產生抵消環境噪聲的信號。

1.4.18 積分聲等級計：設計為或適用於測量平均均方根時間A-計權和C-計權聲壓的聲等級計。

1.4.19 機器處所：設有蒸汽機或內燃機、泵、空壓機、鍋爐、燃油裝置、主要電機、加油站、推進裝置、冷藏裝置、防搖裝置、操舵裝置、通風和空調機等的任何處所以及通向這些處所的圍壁通道。

1.4.20 海上移動式鑽井平台：能為勘探或開發海床下資源，如液態或氣態碳氫化合物、硫磺和鹽而從事鑽探作業的船舶。

1.4.21 駕駛室兩翼：船舶駕駛室延伸到船舶兩舷的部分。

1.4.22 新船：係指按照《安全公約》第II-1/3-12.1條規定適用於本規則的船舶。

1.4.23 噪聲：就本規則而言，能導致聽力損害或能對健康產生危害或具有其他危險性或破壞性的所有聲音。

1.4.24 噪聲導致的聽力損失：源於耳蝸之內神經細胞受損，係因聲音作用而引起的聽力損失。

1.4.25 噪聲等級：見A-計權聲壓級（1.4.4）。

1.4.26 偶爾暴露：通常每周一次或頻次更少的暴露。

1.4.27 打樁船：從事海底打樁作業的船舶。

1.4.28 鋪管駁船：專為海底管道鋪設相關作業建造或配合這些作業使用的船舶。

1.4.29 港內工況：僅推進所需的所有機器均停止的工況。

1.4.30 具有潛在危險的噪聲等級：人員在沒有保護的情況下暴露會有承受聽力損失風險的聲等級和更高聲等級。

1.4.31 重大修理、改裝和更改：係指對船舶做出改建，實質性地改變船舶的尺度、裝載量或發動機功率，改變船舶的類型，或以其他方式改變船舶，使其若為新船，則應遵守相關規定。

1.4.32 聲音：由空氣或其他物質中的壓力波所傳遞，並是產生聽覺的客觀原因的能量。

1.4.33 聲壓級 L_p 或 SPL ：聲音或噪聲的聲壓級，以分貝（dB）計，由下式得出：

$$L_p = 10 \log \frac{P^2}{P_0^2}$$

式中：P = 聲壓，以帕斯卡計；

$$P_0 = 20 \mu\text{Pa} \text{ (基準級) 。}$$

1.4.34 短程航行：在航行中，船舶的行進時間一般不致長到船員需要睡眠，或較長的非當班時間的航行。

1.4.35 計權隔聲指數 R_w ：表示牆、門或地板（在實驗室內）整體隔聲性能的一個單一數值，以分貝（dB）計（見經1：2006修正的ISO 717-1：1997）。

第2章－測量設備

2.1 設備規格

2.1.1 聲等級計

聲壓級的測量須按本章要求採用精密積分聲等級計進行。這種聲等級計須酌情按照IEC 61672-1（2002-05）1類型/級標準，或按照主管機關接受的等效標準製造。

2.1.2 倍頻程濾波器

當頻程濾波器的情況單獨使用或與聲等級計結合使用時，須符合IEC 61260（1995）或主管機關接受的等效標準。

2.2 設備的使用

2.2.1 校準

聲音校準儀須符合IEC 60942（2003-01）標準，並須經所用聲等級計的製造商認可。

2.2.2 測量儀器和校準儀的校驗

校準儀和聲等級計須至少每2年由國家標準實驗室或按照經（Cor 1：2006）更正的ISO 17025（2005）認證的適任實驗室驗證一次。

2.2.3 傳聲器風罩

在室外諸如在駕駛室兩翼或甲板上，和有任何顯著空氣流動的甲板下的處所採集讀數時，須使用傳聲器風罩。風罩對測量級的影響與在“無風”工況下相似噪聲相比須不大於0.5 dB（A）。

第3章—測量

3.1 通則

3.1.1 船舶建造完工後，或在其後儘可能早的實際可行時，須在3.3和3.4所規定的作業工況下，對第4章規定的所有處所進行噪聲等級測量，並按4.3的要求予以適當記錄。

3.1.2 為確保符合第4章，須進行A-計權等效連續聲等級 $L_{Aeq}(T)$ 測量。

3.1.3 為按照HML-方法確定適當的聽力保護，須在 $L_{Aeq}(T)$ 超過85 dB(A)的處所，進行C-計權等效連續聲等級 $L_{Ceq}(T)$ 和C-計權峰值聲等級 L_{Cpeak} 的測量，見第7章和附錄2。

3.2 測量人員要求

3.2.1 為確保可以接受並具有可比性的測量結果和報告的質量，測量機構或專家須證明其勝任噪聲測量的能力。

3.2.2 進行測量的人員須：

- .1 具有噪聲、聲音測量和所使用設備處理方面的知識；
- .2 受過有關本規則所規定的程序的培訓。

3.3 海上試驗操作工況

3.3.1 測量應在船舶滿載或壓載工況下進行。船舶的航線須儘可能保持平直。測量時的實際條件須記錄在測量報告中。

3.3.2 噪聲測量須在正常營運航速下並且除下文另有規定外，在不小於80%最大額定持續功率(MCR)下進行。可調螺距和垂直翼螺旋槳(如有)須處於正常的航行位置。對於特殊船型及帶有特殊推進裝置和動力配置的船舶，如柴油－電氣系統，主管機關可以與船廠和船東合作，在應用3.3.1和3.3.2時，對實際的船舶設計或操作參數給與適當考慮。

3.3.3 正常航行狀態和水平下通常使用的所有機械、航行儀器、無線電和雷達裝置等，包括噪聲控制，在整個測量期間內均須工作。但是，在進行這些測量時，不得有通電霧信號和直升機作業。

3.3.4 在設有通常僅在應急或試驗時運行的柴油機驅動的應急發電機、消防泵或其他應急設備的處所內測量時，這些設備須在工作。測量的目的並不在於確定符合最大噪聲等級限值，而是作為船員在這些處所中進行維護、修理和測試活動時的個人保護的參考。

3.3.5 機械通風、加熱和空調設備須在正常工作，其功率須符合設計條件。

3.3.6 門和窗一般應予關閉。

3.3.7 處所內所有必要的設備應安裝完畢。可以在沒有家具的情況下進行測量，但不能由於沒有家具而有所寬鬆。可對包括家具的情況再次進行檢查或採集後續讀數。

3.3.8 裝有首推進器、防搖裝置等的船舶，在此類機械裝置工作時會經受高噪聲等級。對於首推進器，測量須在40%推進功率時進行，並且船舶的航速須適合於首推進器的工作。測量須在此類機械裝置工作時於其周圍，並在相鄰居住處所和值班室站的位置進行。如果此類設備擬用於連續工作，例如防搖裝置，須為確保符合第4章進行測量。如果此類系統僅擬短暫使用，如港內操縱期間，測量僅與確保符合關於噪聲暴露量的第5章相關。

3.3.9 如果船舶安裝擬用於正常工作狀況的動力定位裝置（DP），附加的DP模式下噪聲測量須在控制站、值班站和居住區域內進行，以確保不超過這些處所的最大噪聲等級限值。主管機關、船級社、船廠和DP設計方須酌情商定一種模擬DP推進器系統的工作模式，其工作條件要大致相當於按船舶營運的設計環境條件以推進器最大功率的40%或以上進行定位。

3.4 港內操作工況

3.4.1 3.4.2、3.4.3和3.4.4中規定的測量針對船舶港內工況。

3.4.2 當船舶貨物裝卸設備的噪聲可能導致受其作業影響的值班站和居住處所的噪聲高於最大噪聲等級，應進行測量。船舶以外的聲源所產生的噪聲應按第3.5.3所述扣除。

3.4.3 如船舶是車輛運輸船且裝卸期間的噪聲源於車輛，貨物處所內的噪聲等級和暴露時間應結合第5章考慮。船廠和船東可與主管機關合作，對此種源於車輛的噪聲等級進行理論上的評估。

3.4.4 如果在維護、檢修或類似港內工況期間將遵守5.3.5關於聽力保護的規定而非4.2.1的規定，則須在機械正在港內工況下工作的機器處所內進行測量。

3.5 環境條件

3.5.1 如果水深小於5倍的吃水或在船舶附近有大塊反射表面，則會影響到所獲取的讀數。因此須在噪聲測量報告中記下這些條件。

3.5.2 氣象條件，例如風雨和海況應不致影響測量。風力應不超過4級，波高應不超過1米。如果無法達到，則須報告實際條件。

3.5.3 須注意使外部聲源，例如人、娛樂、建造和修理工作所產生的噪聲，不致影響到測量位置處的船上噪聲等級。如有必要，實測值可根據能量總和原理按穩態背景噪聲予以修正。

3.6 測量程序

3.6.1 測量噪聲等級時，測量處所內須只有操作船舶所需的海員和測量人員在場。

3.6.2 聲壓級讀數須採用A-計權（dB（A））和C-計權（dB（C））濾波器以分貝讀取，如有必要，並須在31.5和8,000 Hz之間的倍頻帶上讀取。

3.6.3 噪聲等級測量須採用積分聲等級計以空間平均值方式進行（如3.13.1所述），並維持一段時間直到獲得穩定讀數或至少15s，以代表因不規則操作或聲場變化所造成變化的平均值。讀數須僅取最近的分貝。如dB讀數的第1個小數為5或更高，讀數應取最近的較高整數。

3.7 噪聲暴露的確定

除連續聲等級測量外，還應根據ISO 9612：2009確定海員的噪聲暴露程度（見第5章）。一種基於ISO 9612的簡化程序和與工作位置相關的噪聲暴露在附錄4中給出。

3.8 校準

在測量進行之前和之後，須用2.2.1所述校準儀校準聲等級計。

3.9 測量的不確定度

船上測量的不確定度視幾種因素而定，例如測量技術和環境條件。按本規則進行的測量除極少例外，其等效連續A-計權聲壓級的可重複標準偏差，等於或小於1.5dB。

3.10 測量點

3.10.1 測量位置

除非另有說明，測量時傳聲器須位於甲板以上1.2m（坐着的人員）和1.6m（站着的人員）之間的高度。兩個測量點之間的距離至少應為2m，在無機器的大處所內，應按不大於10m的測點間距（包括最

大噪聲等級位置在內)對整個處所進行測量。無論如何，均不得在距處所邊界小於0.5m處進行測量。傳聲器的位置須如3.10.3和3.11至3.14的規定。測量須在人員工作的位置，包括通信站，進行。

3.10.2 值班室

對所有進行工作的地點均須進行噪聲測量。如果認為值班室附近的噪聲等級有差異，則須在設有值班室的處所內作補充測量。

3.10.3 進氣口和排氣口

在測量噪聲等級時，如有可能，傳聲器不應位於氣流方向夾角的30°度之內，且距發動機、通風、空調和冷卻系統的進氣口或排氣口邊緣的距離不小於1米，並儘可能遠離反射表面。

3.11 機器處所的測量

3.11.1 須在機器處所內海員的各個主要工作或控制站及相鄰控制室(如設有)進行測量，並特別注意電話所在處和語音交流及聲響信號具有重要性的位置。

3.11.2 通常不應在距運轉中的機器或距甲板、艙壁或其他大的表面或空氣進口等小於1米處進行測量。如這不可能，須在機器和相鄰反射表面之間的中點處進行測量。

3.11.3 對形成聲源的機器，應在距此機器1米之處進行測量。測量應在甲板、平台或走道以上1.2米至1.6米處如下進行：

- .1 距各聲源1米，在聲源周圍以不大於3米的間距測量所有聲源，諸如：

- 在每一層的主渦輪機或柴油機；

- 主齒輪箱；
- 渦輪鼓風機；
- 濾清器；
- 交流發電機和發電機組；
- 鍋爐生火平台；
- 強力鼓風機和/或抽風機；
- 壓縮機；
- 貨泵（包括其驅動電機或渦輪機）。

對於大型發動機和機器處所，在按上述間距測得的聲壓級 dB (A) 變化不顯著的情況下，為避免不必要地進行大量不切實際的測量和記錄，不必在每個位置都進行記錄。但是，對具有代表性的位置和最大噪聲等級的位置須進行全面測量，在各級須至少記錄4次測量結果；

- .2 在本地控制站，例如主機和機械控制室的主操縱台或應急操縱台；
- .3 .1和.2未予規定而在進行例行檢查、調整和維護保養時通常停留的所有其他位置；
- .4 在通常使用的通道上的各點（上文已規定的位置所包括者除外），測量間距不大於10m；和
- .5 機器處所內的各房間，如工作間。為限制測量和記錄的次數，記錄的次數可按.1所述減少，但對機器處所直至上甲板各層均有總數不少於4次的測量記錄（包括本段所規定的測量）。

3.12 駕駛處所的測量

測量須在駕駛室兩翼進行，但應在所測的一翼處於船舶背風面時進行測量。

3.13 居住處所的測量

3.13.1 須在處所的中央進行一次測量。傳聲器應緩慢地在水平方向和/或垂直方向上移動超過1米(±0.5米，計及3.10.1中所述的測量衡準)。如果室內的噪聲等級，特別是在靠近坐着或躺着人員頭部位置處有顯著差異，即大於10dB(A)時，則應在其他測點進行補充測量。

3.13.2 測量居住艙室的數目不得少於40%總艙數。在任何情況下，必須考慮明顯受到噪聲影響的居住艙室，即與機器或機艙棚相鄰的居住艙室。

3.13.3 對於具有大量船員艙室的船舶，如客船/遊船，可以接受減少測量位置數。在選擇受試艙室時，應選擇較為靠近噪聲源的艙室而使其對受試艙室組具有代表性，並使主管機關滿意。

3.13.4 在露天甲板上，須在供娛樂活動用的任何區域內進行測量。

3.14 通常無人處所的測量

3.14.1 在3.10至3.13所述的處所以外，須對噪聲等級特別高且船員可能暴露(即使是比較短時間的暴露)的所有地點和斷續使用的機械處所進行測量。

3.14.2 為限制測量和記錄的次數，對於通常無人的處所、貨艙、甲板區域和其他遠離噪聲的處所，不必測量噪聲等級。

3.14.3 在貨艙內可能有人員作業的區域須使用至少3個傳聲器位置點。

第4章—可接受的最大聲壓級

4.1 通則

4.1.1 本節所規定的限值須被視為最大聲等級，而非理想聲等級。如合理可行，噪聲等級應低於所規定的最大聲等級。

4.1.2 船舶投入營運之前，對4.2所規定的限值須通過所涉處所的等效連續聲等級測量進行評估。對於具有很多測量位置的大型艙室，各位置均須與限值作對比。

4.1.3 應要求進入額定噪聲等級大於85dB(A)處所的人員，在這些處所中停留時配戴聽力保護器（見第5章）。4.2.1給出的110dB(A)的限值，所假設的是，配戴了符合第7章聽力保護器要求的聽力保護器。

4.1.4 限值按A-計權聲壓級予以規定（見1.4.4和1.4.24）。

4.2 噪聲等級限值

不同處所的噪聲等級限值（dB(A)）規定如下：

艙室和處所的名稱	船舶尺度	
	1,600 至 10,000 總噸	≥10,000 總噸
4.2.1 工作處所（見 5.1）		
機器處所	110	110
機器控制室	75	75

艙室和處所的名稱	船舶尺度	
	1,600 至 10,000 總噸	≥10,000 總噸
並非機器處所組成部分的工作間	85	85
未規定的工作處所（其他工作區域）	85	85
4.2.2 駕駛處所		
駕駛室和海圖室	65	65
瞭望位置，包括駕駛室兩翼和窗口	70	70
無線電室（無線電設備工作，但不產生聲響信號）	60	60
雷達室	65	65
4.2.3 居住處所		
居住艙室和醫務室	60	55
餐廳	65	60
娛樂室	65	60
露天娛樂區域（外部娛樂區域）	75	75
辦公室	65	60
4.2.4 服務處所		
廚房（食物加工設備不工作）	75	75
備膳室和配膳間	75	75
4.2.5 通常無人處所		
3.14 中所述處所	90	90

4.3 測量報告

4.3.1 每艘船舶均須有噪聲測量報告。報告須包括船上各處所的噪聲等級資料。報告須載明每一規定測量點的讀數。測量點須在報告所附的總佈置圖或居住艙室圖紙上標出，或用其他方法列明。

4.3.2 噪聲測量報告的格式見附錄1。

4.3.3 噪聲測量報告須一直保存在船上並方便船員取閱。

第5章—噪聲暴露限值

5.1 通則

5.1.1 第4章所述噪聲等級限值是用於在符合這些限值要求時，海員將不致暴露於超過80 dB (A) 的 $L_{ex}(24)$ ，即在每天或24小時期間內，等效連續噪聲暴露將不超過80 dB (A)。對於新船，應按照3.7所述的方法計算各類船員的預期噪聲暴露量，以海上試驗噪聲等級測量為基礎，確認是否符合這些衡準。

5.1.2 在聲壓級超過85 dB (A) 的處所內，應採用適當的聽力保護，或應用本節所述的暴露時間限值，以確保保持一個等效的保護水平。

5.1.3 適用這些規定的每艘船舶，應在其安全管理體系中包含關於公司聽力保護、暴露限值政策和就此進行培訓的一節，且培訓將記載在培訓記錄中。

5.1.4 對附錄2中所載有關這些方面的海員須知應給與考慮。船員不應無保護暴露於超過135 dB (C) 的峰值。

5.2 聽力保護和聽力保護器的使用

為符合本節的暴露量衡準，允許使用符合第7章的聽力保護器。即使在要求配戴聽力保護器以符合本規則要求時，主管機關仍可實施風險評估、聽力保護方案和其他措施。

5.3 海員暴露於高噪聲等級的限制

海員不應暴露於超過圖5.1所示和5.3.1至5.3.5段中所述的噪聲等級和時限。

5.3.1 有保護的最大暴露（A區，圖1）

任何海員，即便配戴聽力保護器，不應暴露於超過120 dB（A）的噪聲等級或超過105 dB（A）的 L_{eq} （24）。

5.3.2 偶爾暴露（B區，圖1）

在B區內，僅允許偶爾暴露，並應使用衰減為25至35 dB（A）之間的聽力保護器。

5.3.3 偶爾暴露（C區，圖1）

在C區內，僅允許偶爾暴露，並應使用衰減至少為25 dB（A）的聽力保護器。

5.3.4 日暴露（D區，圖1）

如果海員的例行工作（日暴露）在噪聲等級位於D區的處所內進行，應使用衰減至少為25 dB（A）的聽力保護器，並可考慮風險評估和聽力保護方案。

5.3.5 無保護的最大暴露（E區，圖1）

對於暴露時間少於8小時，沒有採取聽力保護措施的海員，不應暴露於超過85 dB（A）的噪聲中。如海員在高噪聲處所停留超過8小時，則不應超過80 dB（A）的 L_{eq} （24）。因此，在每24小時中至少有三分之一時間內，每個海員應處於噪聲等級不超過75 dB（A）的環境中。

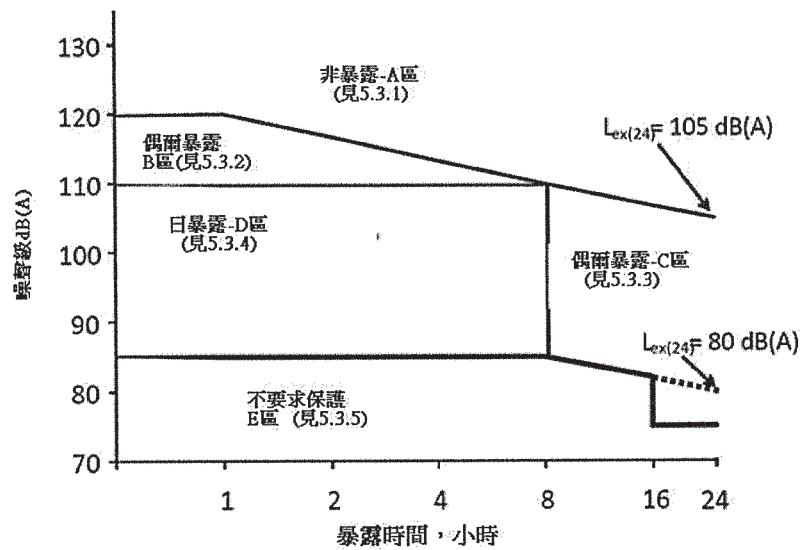


圖1：許可的每日和偶爾工作區

註：在A-D區工作時，要求聽力保護器把入耳的聲音衰減至85 dB (A) 以下。在E區工作時，不要求使用聽力保護器，但如果聲等級高於80 dB (A) 超過8小時則應配置。

5.4 24小時等效連續聲等級的限值

作為符合5.3規定（圖1）的替代方法，任何無保護的海員均不應暴露於大於80 dB (A) 的24小時等效連續聲等級。在要求使用聽力保護器的處所內，每人的日暴露時間不應超過連續4小時或總計8小時。

5.5 聽力保護方案

5.5.1 可為在 $L_{Aeq} > 85$ dB (A) 的處所內工作的海員提供聽力保護方案，以使其在關於噪聲的危害、聽力保護的使用及監控聽力敏銳度方面得到培訓。聽力保護方案的一些要素如下：

- .1 由經培訓的並具有適當資格的人員進行的初始和定期聽力測試，並使主管機關滿意。
- .2 暴露人員長時期暴露於高噪聲的危害，以及護耳器正確使用的說明（見附錄2）。
- .3 聽力測試記錄的保持。
- .4 對聽力嚴重損失的人員的記錄和聽力敏銳度的定期分析。

5.5.2 聽力保護方案的一個可選要素，是對高噪聲等級處所內工作的人員所處的24小時等效連續聲等級進行控制。此類控制要求計算24小時等效連續聲等級。如果此24小時等效連續聲等級不符合限值要求，則應控制暴露時間或在適當時間使用聽力保護器，以使人員暴露量在限值之內。

第6章 – 居住處所之間的隔聲

6.1 通則

對居住處所之間的隔聲須給與考慮，以便即使在相鄰處所內進行諸如音樂、談話、裝卸貨物等活動，仍有可能休息和娛樂。

6.2 隔聲指數

6.2.1 居住處所的艙壁和甲板的空氣隔聲特性，按照經（1：2006）修正的ISO標準717-1：1996第一部分，須至少符合下列計權降噪指數（ R_w ）：

居住艙室至居住艙室

$$R_w = 35 ;$$

餐廳、娛樂室、公共處所和娛樂區域至 居住艙室和醫療室	$R_w = 45$;
走廊至居住艙室	$R_w = 30$;
居住艙室至帶有交通門的居住艙室	$R_w = 30$ 。

6.2.2 空氣隔聲特性須按照ISO 10140-2:2010經實驗室試驗確定，並使主管機關滿意。

6.3 材料的裝設

6.3.1 應留意材料的裝設和居住處所的建造。在海上試驗期間，如果對材料的裝設存在疑義，應如6.2.1段的要求，選取具有代表性的每種類型的分隔板、地板、門，進行船上測量，並使主管機關滿意。

6.3.2 現場測試計權降噪指數 R'_w 應符合6.2.1段的要求，公差不大於3 dB。

註：應按照ISO 140-4:1998進行現場測量。當所測試材料的面積小於 10 m^2 時， R'_w 指數的計算應考慮 10 m^2 為最小值。

第7章—聽力保護和警告信息

7.1 通則

當在聲源處採用控制聲音的措施未能將任何處所的噪聲降至4.1.3段所規定的聲等級時，須向需要進入此等處所的海員提供有效的個人聽力保護。聽力保護器的提供不得視為有效噪聲控制的替代。附錄3彙總了可適用於新船的現有降噪方法。

7.2 對聽力保護器的要求

7.2.1 個人聽力保護器須選擇能消除聽力危害風險或將該風險降低至7.2.2段所述可接受聲等級者。船舶經營人須盡力確保聽力保護器的配戴，並須負責檢查所採取的符合本規則的措施的有效性。

7.2.2 聽力保護器須為可將聲壓級降至85 dB (A) 或以下（見5.1）的類型。應按照ISO 4869-2：1994中所述的HML-方法（見附錄2中的解釋和範例）選擇適當的聽力保護器。如果在無源狀態下頭戴式耳機與聽力保護器具有等效功能，則可以採用消噪技術。

7.2.2.1 消噪耳機的規格應如同經確認的製造商規格。

7.3 聽力保護器的選擇和使用

應教會海員按附錄2正確使用船上提供或使用的聽力保護器。

7.4 警告牌

如機器處所（或其他處所）中的噪聲等級大於85 dB (A)，這些處所的入口應懸掛警告牌，該警告牌由主管機關規定的以船舶工作語言描述的符號和補充標誌組成（見如下英文警告牌和標誌示例）。如果只是此類處所的小部分具有這類噪聲等級，應在眼睛高度對這個或這些特定位置或設備加以標明，並在可接近的各個方向上均可見到。

有噪聲艙室進口處的標誌	
80~85 dB (A)	高噪聲等級—使用聽力保護器
85~110 dB (A)	危險噪聲—強制使用聽力保護器
110~115 dB (A)	小心：危險噪聲—強制使用聽力保護器—僅可短暫逗留
>115dB (A)	小心：超高噪聲等級—強制使用聽力保護器—逗留時間不超過10分鐘



附錄1

噪聲測量報告的格式

1 船舶概況

- .1 船名
- .2 船籍港
- .3 船東、船舶經營人或代理的姓名和地址
- .4 船廠名稱和地址
- .5 建造地點
- .6 海事組織編號
- .7 總噸位
- .8 船舶類型
- .9 船舶尺度 – 長度
寬度
型深
最大吃水（夏季載重線）
- .10 最大吃水時的排水量
- .11 安放龍骨日期
- .12 交船日期

2 機械概況

- .1 推進機械

製造廠：

類型：

台數：

最大連續額定功率	kW
正常設計營運軸轉速:	r/min
正常營運額定功率:	kW

.2 輔助柴油機

製造廠:	類型:
輸出功率: kW	台數:

.3 主減速齒輪:

.4 螺旋槳類型 (固定螺距螺旋槳、可調螺距螺旋槳、垂直翼螺旋槳)

螺旋槳數:	葉片數:
設計螺旋槳軸轉速:	r/min

.5 其他 (如係特殊推進和動力配置)

.6 機艙通風

製造廠:	類型:
台數:	
風機直徑: m	風機轉速: r/min/可變轉速(是/否)
氣流量: m ² /h	總壓力: Pa

3 測量儀器和人員

.1 儀器 商標 類型 序號

聲等級計

傳聲器

濾波器
風罩
校準儀
其他設備

.2 聲等級計的校準日期校準開始結束

- 在檢測時由主管當局進行

.3 進行測量的人員/組織的身份

4 測量時的條件

.1 測量日期： 開始時間： 完成時間：

.2 測量時的船舶位置

.3 船舶的裝載工況

.4 測量時的狀態

- 首吃水
- 尾吃水
- 龍骨下的水深

.5 氣象條件

- 風力
- 海況

.6 航速

.7 實際螺旋槳軸轉速： r/min

- .8 螺旋槳的螺距：
- .9 推進機械轉速： r/min
- .10 推進機械功率： kW
- .11 運轉的推進機械台數：
- .12 運轉的輔助柴油機台數：
- .13 運轉的渦輪發電機台數：
- .14 機艙通風速度模式（高/低/可變）：
- .15 發動機負荷（%MCR）：
- .16 其他運轉的輔助設備：
- 運轉中的通風、加熱和空調設備

5 測量數據

噪聲限值

測得的聲壓級

dB (A)

L_{Aeq} dB (A)

L_{Ceq} dB (C)

L_{Cpeak} dB (C)

註：聲壓級 L_{Ceq} 和 L_{Cpeak} 的測量僅在超過85 dB (A) 並要求聽力保護器時進行。

工作處所

機器處所

機器控制室

工作間
非指定的工作場所

駕駛處所

駕駛室和海圖室
瞭望位置，包括駕駛室兩翼和窗口
無線電室
雷達室

居住處所

居住艙室和醫療室
餐廳
娛樂室
露天娛樂區域
辦公室

服務處所

廚房（食物加工設備不工作）
備膳室和配膳間

通常無人處所

6 主要降噪措施（列出所採取的措施）

7 備註（列出任何與本規則不同之處）

.....

姓名

地址

.....

.....

地點	日期	簽名
----	----	----

附件

頻率分析附頁

對某些區域進行的頻率分析可以產生更為準確和精確的噪聲等級預測，並將有助於查明超過第4章中所規定限值的特定頻帶。進一步指導可見ISO 1996-2：2007。

附錄2

關於安全管理體系納入噪聲問題的導則

1 海員須知

1.1 應向海員說明長時間暴露於高噪聲的危害以及噪聲引起聽力損失的風險。對所有海員應在初始僱傭時說明須知事項，並在之後定期對那些經常在噪聲超過85 dB（A）的處所內工作的海員說明須知事項。對本規則各項規定的須知應包括：

- .1 噪聲暴露限值和警告牌的使用；
- .2 （首次使用時）所提供的聽力保護器的類型，其大致降噪值及其正確使用、安裝以及對正常交流的影響；
- .3 有關聽力保護的公司政策和程序，及適用時，任何在懸掛警告牌的處所內工作的海員可享用的監控計劃；和
- .4 關於聽力損失的可能跡象的指南，如耳鳴、失聽或耳堵塞，及當這些跡象出現時採取的減緩技術。

1.2 相關海員應接受必要的正確使用和維護機械和消聲器或降噪器的指導，以避免產生不必要的噪聲。

2 船舶經營人的職責

2.1 船舶經營人應負責確保執行和維護有關減少和控制噪聲的措施，使本規則的要求得到滿足。

2.2 如果任何處所內的噪聲等級超過85 dB（A）的限值，船東應確保：

- .1 標明該處所並遵守本規則相關規定；
- .2 船長和船舶高級船員應知曉控制進入該處所的重要性，以及使用適當的聽力保護器的重要性；
- .3 提供足夠數量的適當的聽力保護器，以供發放給所有的相關船員每人一套；
- .4 船長、高級船員和船上的任何安全員，均知曉船上提供相關培訓和資料的必要性。

2.3 如果手工工具、廚房和其他便攜設備，在正常工況下產生大於85 dB (A) 的噪聲等級，船東應確保提供警告信息。

3 海員的職責

應使海員意識到有必要確保：

- .1 採用所有的噪聲控制措施；
- .2 向船舶安全管理體系規定的負責人報告任何有缺陷的噪聲控制設備；
- .3 當進入警告牌要求使用聽力保護器的處所時，始終配戴適當的聽力保護器，並即使逗留很短的時間也不應摘下聽力保護器；
- .4 不應損壞或誤用所提供使用的聽力保護器，並保持清潔。

4 聽力保護器的選擇

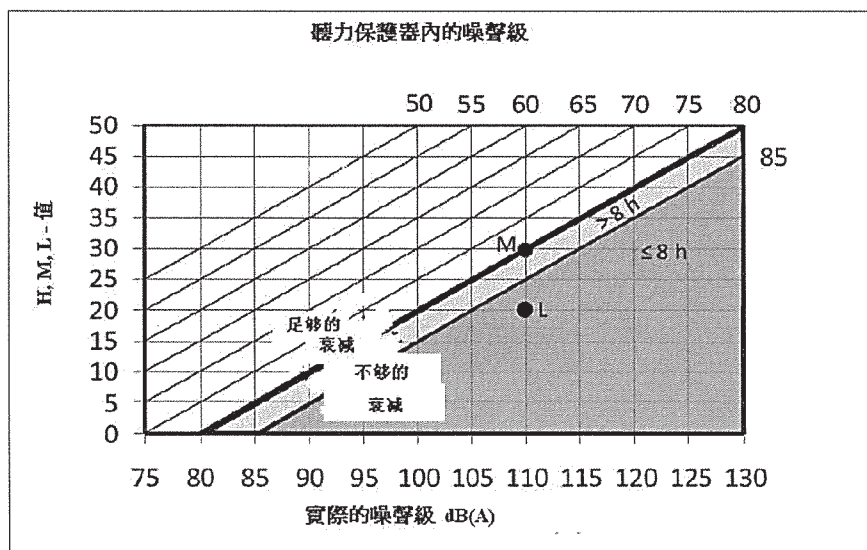
4.1 應按照ISO 4869-2:1994中所述的HML-方法選擇適當的聽力保護器。為向船舶經營人和海員選擇合適的聽力保護提供指導，對HML-方法及其使用簡述如下。

4.2 HML-方法是按照ISO 4869-2:1994 “配戴聽力保護器時有效A-計權聲壓級的估算” 計算的評定等級。使用H、M和L評定等級，需要噪聲的A-計權 (L_{Aeq}) 和C-計權 (L_{Ceq}) 聲壓級以及相關聽力保護器的HML值，這些將由製造廠提供。

4.2.1 聽力保護器的HML值與其提供的高、中和低頻率噪聲的降噪相關。這些H和M值用於暴露噪聲等級保護的計算，該噪聲在中、高頻率具有主要能量。如果測得的 L_{Ceq} 級和 L_{Aeq} 級相差2 dB或更少，即視為此種情況。

4.2.2 聽力保護器的M和L值用於暴露噪聲等級保護的計算，該噪聲具有明顯的低頻率成分，且在聽力保護器擬使用的處所內所測得的 L_{Ceq} 級和 L_{Aeq} 級相差大於2 dB。

4.3 HML-方法簡易應用實例：



在某一給定的船舶上，機艙內測得的聲等級為110 dB (A)、115 dB (C)。據製造廠稱，所選擇的聽力保護器具有下列降噪性能：H = 35 dB，M = 30 dB，L = 20 dB。

- .1 自實際噪聲等級（110 dB（A））開始的垂線上標註聽力保護器的L和M值。
- .2 確定噪聲是否具有低或高/中頻率。如果 $L_{Ceq}-L_{Aeq}$ 之間的差值大於2 dB，則噪聲具有低頻率（L），如果 $L_{Ceq}-L_{Aeq}$ 之間的差值小於2 dB，則噪聲具有高或中頻率（M）。
- .3 如果聲音為高/中頻率（ $L_{Ceq}-L_{Aeq}\leq 2$ ），沿M-值的對角線讀取聽力保護器內的噪聲等級。在此情況下，聽力保護器內的噪聲等級為80 dB（A），表明聽力保護器的降噪性能足以供每日工作超過8小時之用。
- .4 如果聲音為低頻率（ $L_{Ceq}-L_{Aeq}>2$ ），沿L-值的對角線讀取聽力保護器內的噪聲值。在此情況下，聽力保護器內的噪聲等級 >85 dB（A），表明聽力保護器的性能不夠好，甚至不足以供8小時工作日之用。選用1個L-值大於25 dB的聽力保護器作為替代。

4.4 採用HML-方法的計算—原理和實例

特定噪聲環境下某一具體保護器的可取性確定也可計算。H、M和L值可用於對特定噪聲情況下某一具體保護器的L'A（耳部總A-計權噪聲等級）進行估算。

- .1 計算 $L_{Ceq}-L_{Aeq}$ （這要求對 L_{Aeq} 和 L_{Ceq} 進行測量。所有的1級聲等級計均可採用A-計權或C-計權。）
- .2 如果 $L_{Ceq}-L_{Aeq}\leq 2$ dB，預測降噪聲等級（PNR）採用下列公式計算：

$$PNR = M - \left(\frac{H - M}{4} * (LC_{eq} - LA_{eq} - 2) \right)$$

如果 $LC_{eq} - LA_{eq} > 2$ dB，PNR採用下式計算：

$$PNR = M - \left(\frac{M - L}{8} * (LC_{eq} - LA_{eq} - 2) \right)$$

- .3 然後從總A-計權噪聲等級中扣除PNR以給出保護器L'A的耳部有效A-計權聲等級：

$$L'A = LA_{eq} - PNR$$

實例： 聽力保護器 $H = 35$ dB， $M = 25$ dB， $L = 20$ dB

機艙中的噪聲等級：

$$LA_{eq} = 108.7 \text{ dB (A)}$$

$$LC_{eq} = 109.0 \text{ dB (C)}$$

$$LC_{eq} - LA_{eq} = 0.3 \text{ dB}$$

$$PNR = 25 - \left((35 - 25) / 4 \right) * (0.3 - 2) = 29.3 \text{ dB}$$

$$L'A = 108.7 - 29.3 = 79.4 \text{ dB (A)} .$$

在這種情況下，聽力保護器內的噪聲等級在80 dB (A) 以下，表明聽力保護器的降噪性能足以供每日工作超過8小時之用。

附錄3

建議降噪方法

1 通則

1.1 為減少船上的噪聲，以符合本規則第4章和第5章中所規定的限值，應仔細考慮這類減少噪聲的措施。本附錄旨在為船舶設計提供這方面的資料。

1.2 噪聲控制措施的設計和構造，應由精通噪聲控制技術的人員進行監督。

1.3 能夠用於控制噪聲等級或減少海員對於潛在有害噪聲暴露的一些措施，示於本附錄第2至第10節中。要強調的是，沒有必要對所有的船舶實施本附錄所建議的全部或任何措施。本規則沒有提供結構上有效控制噪聲措施所需的，或在特定環境下決定何種措施為適當所需的詳細技術資料。

1.4 採用噪聲控制措施時，應注意確保不違背有關船舶結構、居住處所和其他安全事項的規範和規則，降噪材料的使用不應引起火災、安全或健康方面的危險，而且這些材料也不應由於構造或附件的不結實而引發可能妨礙從處所撤離或疏水的危險。

1.5 設計階段中，在決定何種發動機和機械的安裝設計、機械的安裝方法和相對於其他處所的位置、以及居住處所的降噪措施和位置時，應對噪聲控制給與考慮。

1.6 由於一般的船舶建造方法，源於機器和螺旋槳並傳到居住處所和機器處所以外的其他處所的噪聲，極有可能是結構傳導噪聲。

1.7 當為控制現有船上機械裝置噪聲而設計有效和經濟的措施時，以A-計權聲等級計進行的聲音測量，可能需要以某些形式的頻率分析作為補充。

2 噪聲源的隔離

2.1 如實際可行，產生超過本規則4.2所規定噪聲等級的任何發動機或機械，應安裝在不需連續照管的艙室內（另見本附錄6.1段）。

2.2 居住艙室無論在垂直方向還是水平方向的位置均應儘實際可能遠離諸如螺旋槳和推進機械等噪聲源。

2.3 如實際可行，機艙棚應佈置在設有居住處所的上層建築和甲板室之外。如這不可行，在機艙棚和居住處所之間應佈置通道（如可行）。

2.4 如實際可行，應考慮將居住處所佈置在甲板室內，而不是佈置在延至船舷的上層建築內。

2.5 適用時，也可考慮採用無人處所、衛生間和洗滌室將居住處所與機器處所隔開。

2.6 可能需要採用適當的分隔板、艙壁、甲板等防止聲音的傳播。其相對於聲源與所隔聲音的頻率而具有正確的結構和位置，是很重要的。

2.7 如一個處所，諸如機器處所，被分隔為噪聲大（不連續有人值班）和較低噪聲（能夠連續有人值班）的處所，最好具有完全的分隔。

2.8 在某些處所可能宜採用吸聲材料，以防止由於分隔板、艙壁、甲板等的反射而提高噪聲等級。

3 排氣和進氣的消音

3.1 內燃機的排氣系統、機器處所、居住處所和其他處所的進氣系統，其佈置應使進氣口或排氣口遠離海員常去的位置。

3.2 當需要時，應安裝消聲器、消噪設備或降噪器。

3.3 為將居住處所的噪聲降至最小，通常需要將排氣系統及某些管路和管道與艙棚、艙壁等隔絕，以減少結構傳導的噪聲。

4 機械的屏蔽

4.1 在連續有人值班處所或可合理預期海員會長時間進行維護保養或檢修工作的處所，且本附錄第2節所詳述的分隔實際上不可行時，應考慮給所產生聲壓級超過本規則4.2規定限值的發動機和機械，安裝隔聲屏蔽或部分屏蔽。

4.2 當安裝於上述4.1所指處所內的發動機或機器所產生的噪聲等級在本規則5.3.1的衡準範圍和圖5.1中的A區之內時，提供降噪措施是十分必要的。

4.3 安裝隔聲屏蔽時，重要的是將噪聲源完全屏蔽。

5 減少尾部噪聲

為減少船艙噪聲的影響，特別是對居住處所的噪聲影響，應在與尾部、螺旋槳等相關的設計程序中考慮噪聲輻射問題。

6 操作人員的圍蔽

6.1 在大多數機器處所內，採用降噪控制室或其他類似處所（見本附錄的2.1）保護操作或值班海員是理想及可取的。

6.2 在噪聲等級超過85 dB(A)的小船和現有船舶的連續有人值班的機器處所內，在預期值班人員可能花費大部分時間值守的控制室或操作平台內，最好提供一個噪聲庇護所。

7 居住處所內噪聲加重的控制

7.1 為減小居住處所內的噪聲等級，可能需要考慮通過彈性基座將包括此類處所的甲板室與船舶的其他結構隔絕。

7.2 還可考慮在居住處所內設置與艙壁、襯板和天花板的柔性連接以及安裝浮築地板。

7.3 在居住處所內，為舷窗和窗戶配備窗簾及使用地毯，有助於吸聲。

8 機械的選擇

8.1 在設計階段，應考慮到所安裝的每台機械所產生的聲音。通過選用產生較小的空氣噪聲、液體噪聲或結構噪聲的機器控制噪聲是有可能的。

8.2 應要求製造商提供其機械所產生噪聲的資料，並提供建議安裝方法以將噪聲降至最小。

9 檢查和維修

各台機械、設備和相關工作處所的有關任何噪聲控制/降低特徵的所有項目，應作為船上安全管理系統的一個部分定期檢查。如果這種檢查發現噪聲控制措施方面的缺陷或導致噪聲過大的其他缺陷，應實際可行地儘快糾正。

10 振動隔離

10.1 如有必要，機器應以仔細挑選的彈性基座為支撐。為確保隔離的有效性，彈性基座應安裝在具有足夠剛度的基礎上。

10.2 如輔助機械、空壓機、液壓裝置、發電機組、風機、排氣管和消聲器等的結構傳導噪聲在居住處所或駕駛室產生不能接受的噪聲等級，應考慮使用彈性基座。

10.3 安裝隔聲罩裝置時，可考慮為機器安裝彈性基座，及機器與所有管道、圍井和電纜之間均採用柔性連接。

11 噪聲預測

11.1 在新船設計階段，設計方/船廠可以通過計算、評估或類似方法，對船舶區域內可能產生超過第4章中可接受等級的噪聲等級進行預測。

11.2 在設計階段，應採用11.1所述的噪聲預測，查明船舶內為遵守本規則4.2節規定的噪聲等級限值必須對降噪措施給與特別考慮的可能區域。

11.3 設計階段中所計劃的噪聲預測和任何降噪措施應文件化，特別是在根據噪聲預測，儘管有合理的技術舉措，仍須預期符合本規則4.2節的任何噪聲等級限值將難以實現的情況下。

12 消噪設備

12.1 消噪，也稱為抗噪，是通過引入一個抗噪信號抵抵消諸如由發動機和回轉機械所產生的大多為低頻（低於500 Hz）的重複噪聲，該信號與噪聲相等但與噪聲形成180度異相。通過與相關區域的噪聲相匹配的方法，將這種抗噪聲引入到環境中。然後兩種信號相互抵消，有效地消除環境中相當部分的噪聲能量。

12.2 此種技術有幾種應用方式，包括：

- .1 主動消聲器——已由其他運輸方式表明可減少內燃機、壓縮機和真空泵的排氣噪聲，而不因背壓而造成低效率。
- .2 主動安裝——能遏制回轉機械的振動以改善舒適度，降低運動部件的磨損以及減少振動引起的二次噪聲。
- .3 消噪安靜區域——目前各種運輸方式均有靜音座椅和（汽車）車廂靜噪系統。有可能在其他處所中為海員提供舒適和恢復體能的主動靜噪型鋪位。
- .4 消噪耳機——能包括低頻率，提供優於被動耳罩的聽力保護。主動型耳機也可允許通過正常對話進行交流，並改善工作場所的安全。

12.3 建議向本組織提供這些主動降噪系統的相關經驗，以對其性能參數更好地加以評估。

13 噪聲疲勞恢復區域

13.1 設立噪聲疲勞恢復區域，可作為建造1,600總噸以下的船舶或破

冰船的可選設計方案。對超出正常例行海上操作的有噪聲作業（例如長時間空中/直升機作業或動力定位設備的惡劣天氣作業），也可考慮針對船舶具體應用設立噪聲疲勞恢復區域。這些處所的使用，應納入《安全管理規則》之下的船舶安全作業方針。

13.2 若無其他切實可行的技術或組織方案減少噪聲源所產生的過大噪聲，則應提供噪聲疲勞恢復區域。

附錄4

確定噪聲暴露的簡化程序

1 通則

1.1 為確保海員不暴露於超過80 dB (A) 的 L_{ex} (24)，本附錄提供了確定相關噪聲暴露量的簡化程序。

1.2 通常應根據ISO 9612:2009確定噪聲暴露量。

1.3 對基於海上試驗/港內停留期間噪聲測量以及船員的崗位要求的簡化方法闡述如下：

2 工作分析/崗位要求和非當班時間

2.1 借助船員名單，對各類崗位（組別）進行界定。

實例：

- 船長；
- 輪機長；
- 電工；
- 廚師；
- 等。

2.2 對於各類崗位，須分別界定崗位要求。崗位要求與船上的工作處所相關。

實例：

- 駕駛室；
- 船舶辦公室；
- 機械控制室；
- 工作間；
- 機艙；
- 廚房；
- 等。

2.3 對於各類崗位，工作班次應分為相關於工作處所的幾個組成部分（i）。對非當班時間，應進行類似的評估（所區分的一部分基於船東/船舶經營人/僱員的評估）。

實例：

電工的一整天可以分為下列幾個部分：

i = 1	工作間	=	T _i = 5h
i = 2	機械控制室	=	T _i = 2h
i = 3	船舶辦公室	=	T _i = 2h
i = 4	機艙	=	T _i = 1h
i = 5	非當班	=	T _i = 14h
	總計	=	T _{total} = 24h

3 預計噪聲暴露級的確定

3.1 根據噪聲報告以及為各類崗位預估的工作時間和非當班時間，可以計算出噪聲暴露級。假設不會超過本規則規定的居住艙室和娛樂處所的噪聲限值。根據本規則，使用精選的聽力保護器是建議性的。假設配戴聽力保護器工人的最大噪聲等級不超過 85 dB (A)。

3.2 各處所的噪聲貢獻計算如下：

$$L_{ex,24h,i} = L_{Aeq,i} + 10 \log (T_i/T_0)$$

式中： T_i 係船上每個處所的有效持續時間；

T_0 係基準時間24小時；

$L_{Aeq,i}$ 係每個處所的A-計權等效連續聲等級

3.3 A-計權噪聲暴露級按每個處所的貢獻噪聲計算如下：

$$L_{ex,24h} = 10 \log \left(\sum_{i=1}^n 10^{\frac{L_{ex,24h,i}}{10}} \right)$$

實例：結果表

崗位類型	電工	地點/處所						
		駕駛室	船舶 辦公室	機械 控制室	工作間	機艙	廚房	非當班
測得的 A-計權 等效連續聲等級 $L_{Aeq,i}$ [dB (A)]		64	63	75	84	85	72	60
持續時間/逗留 T_i [h]		0	2	2	5	1	0	14
貢獻噪聲 $L_{ex,24h,i}$ [dB]		0	52.2	64.2	77.2	71.2	0	57.7
A-計權 噪聲暴露級 $L_{ex,24h}$ [dB]	78.3							

RESOLUTION MSC.337(91)
(adopted on 30 November 2012)

CODE ON NOISE LEVELS ON BOARD SHIPS

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

RECALLING ALSO resolutions A.343(IX) and A.468(XII) by which the Assembly of the Organization adopted the Recommendation on methods of measuring noise levels at listening posts and the Code on noise levels on board ships, respectively,

RECOGNIZING the need to establish mandatory noise level limits for machinery spaces, control rooms, workshops, accommodation and other spaces on board ships, taking into account experience gained with regard to noise control and allowable exposure levels since the adoption of resolution A.468(XII),

NOTING regulation II-1/3-12 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended (hereinafter referred to as "the Convention"), adopted by resolution MSC.338(91), concerning protection against noise,

NOTING ALSO that the aforementioned regulation II-1/3-12 provides that ships shall be constructed to reduce onboard noise and to protect personnel from noise in accordance with the Code on noise levels on board ships (hereinafter referred to as "the Code"),

HAVING CONSIDERED, at its ninety-first session, the recommendation made by the Sub-Committee on Ship Design and Equipment, at its fifty-sixth session,

1. ADOPTS the Code on noise levels on board ships, the text of which is set out in the annex to the present resolution;
2. INVITES Contracting Governments to the Convention to note that the Code will take effect on 1 July 2014 upon entry into force of regulation II-1/3-12 of the Convention;
3. REQUESTS the Secretary-General to transmit certified copies of this resolution and the text of the Code, contained in the annex, to all Contracting Governments to the Convention;
4. ALSO REQUESTS the Secretary-General to transmit copies of this resolution and the annex to all Members of the Organization which are not Contracting Governments to the Convention.

ANNEX

CODE ON NOISE LEVELS ON BOARD SHIPS

PREAMBLE

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APPENDIX 1	FORMAT FOR NOISE SURVEY REPORT
APPENDIX 2	GUIDANCE ON THE INCLUSION OF NOISE ISSUES IN SAFETY MANAGEMENT SYSTEMS
APPENDIX 3	SUGGESTED METHODS OF ATTENUATING NOISE
APPENDIX 4	SIMPLIFIED PROCEDURE FOR DETERMINING NOISE EXPOSURE

PREAMBLE

1 The Code on noise levels on board ships (hereinafter referred to as "the Code") has been developed to provide international standards for protection against noise regulated by regulation II-1/3-12 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended. Although the Code is legally treated as a mandatory instrument under the SOLAS Convention, certain provisions of the Code remain recommendatory or informative (see paragraph 1.1.3).

2 These regulations, recommendations and advice are intended to provide Administrations with the tools to promote "hearing saving" environments on board ships. This is, however, a dynamic topic, dealing with the human and technical environments in which they interface. Rules and recommendations will necessarily evolve, on a case-by-case basis, as a result of various technological as well as safety management practice developments. For this reason Administrations are encouraged to pass on experience and information received from recognized organizations, ship operators and equipment designers to improve this Code.

3 The Code has been developed having regard to conventional passenger and cargo ships. While certain types and sizes of ships have been excluded from its application, it should be recognized that full application to ships which differ appreciably from the conventional types of ships regarding design or operations might need specific consideration.

4 The Organization adopted a Recommendation on methods of measuring noise levels at listening posts (resolution A.343(IX)), which this Code is not intended to supersede. That Recommendation relates to interference by shipborne noise with the proper reception of external audible navigation signals and although the methods of measuring noise levels in accordance with the Recommendation and with the Code differ, these documents are to be considered compatible inasmuch as this Code is concerned primarily with the effect of noise on health and comfort. Care will be needed to ensure that there is compatibility between the general requirements and the requirements for audibility of navigation signals.

CHAPTER 1 – GENERAL

1.1 Scope

1.1.1 The Code is intended to provide standards to prevent the occurrence of potentially hazardous noise levels on board ships and to provide standards for an acceptable environment for seafarers. These standards were developed to address passenger and cargo ships. Since some sizes and certain service types of ships have been exempted from these requirements, it should be recognized that full application of the Code to ships that differ appreciably from conventional ships will require special considerations. The Code is intended to provide the basis for a design standard, with compliance based on the satisfactory conclusion of sea trials that result in issuance of a Noise Survey Report. Ongoing operational compliance is predicated on the crew being trained in the principles of personal protection and maintenance of mitigation measures. These would be enforced under the dynamic processes and practices put in place under SOLAS chapter IX.

1.1.2 Requirements and recommendations are made for:

- .1 measurement of noise levels and exposure;
- .2 protecting the seafarer from the risk of noise-induced hearing loss under conditions where at present it is not feasible to limit the noise to a level which is not potentially harmful;
- .3 limits on acceptable maximum noise levels for all spaces to which seafarers normally have access; and
- .4 verification of acoustic insulation between accommodation spaces.

1.1.3 Although this Code is legally treated as a mandatory instrument under the SOLAS Convention, the following provisions of this Code remain recommendatory, options for compliance, or informative in nature:

Paragraphs 1.3.2 and 1.3.3
Paragraphs 3.4.2 and 3.4.3
Chapter 5
Section 6.3
Section 7.3
Appendix 2
Appendix 3
Appendix 4

1.2 Purpose

The purpose of the Code is to limit noise levels and to reduce seafarers' exposure to noise, in order to:

- .1 provide for safe working conditions by giving consideration to the need for speech communication and for hearing audible alarms, and to an environment where clear-headed decisions can be made in control stations, navigation and radio spaces and manned machinery spaces;
- .2 protect the seafarer from excessive noise levels which may give rise to a noise-induced hearing loss; and

- .3 provide the seafarer with an acceptable degree of comfort in rest, recreation and other spaces and also provide conditions for recuperation from the effects of exposure to high noise levels.

1.3 Application

1.3.1 The Code applies to new ships of a gross tonnage of 1,600 and above.

1.3.2 The specific provisions relating to potentially hazardous noise levels, mitigation and personal protective gear contained in the Code may be applied to existing ships of a gross tonnage of 1,600 and above, as far as reasonable and practical, to the satisfaction of the Administration.

1.3.3 The Code may be applied to new ships of a gross tonnage of less than 1,600 as far as reasonable and practical, to the satisfaction of the Administration.

1.3.4 The Code does not apply to:

- .1 dynamically supported craft;
- .2 high-speed craft;
- .3 fishing vessels;
- .4 pipe-laying barges;
- .5 crane barges;
- .6 mobile offshore drilling units;
- .7 pleasure yachts not engaged in trade;
- .8 ships of war and troopships;
- .9 ships not propelled by mechanical means;
- .10 pile driving vessels; and
- .11 dredgers.

1.3.5 The Code applies to ships in port or at sea with seafarers on board.

1.3.6 Dispensations from certain requirements may in special circumstances be granted by the Administration, if it is documented that compliance will not be possible despite relevant and reasonable technical noise reduction measures. Such dispensation shall not include cabins, unless exceptional circumstances prevail. If dispensation is granted, it shall be ensured that the goal of this Code is achieved, and the noise exposure limits shall be considered in conjunction with chapter 5.

1.3.7 For ships designed for and employed on voyages of short duration, or on other services involving short periods of operation of the ship, to the satisfaction of the Administration, paragraphs 4.2.3 and 4.2.4 may be applied only with the ship in the port condition, provided that the periods under such conditions are adequate for seafarers' rest and recreation.

1.3.8 The Code is not intended to apply to passenger cabins and other passenger spaces, except in so far as they are work spaces and are covered by the provisions of the Code.

1.3.9 In case of repairs, alterations and modifications of a major character and outfitting related thereto of existing ships, it shall be ensured that areas, in which changes have been made, meet the requirements of this Code for new ships, insofar as the Administration deems reasonable and practicable.

1.3.10 The Code covers only noise sources related to the ship such as machinery and propulsion but does not include wind/wave/ice noise, alarms, public address systems, etc.

1.4 Definitions

For the purpose of the Code the following definitions apply. Additional definitions are given elsewhere in the Code.

1.4.1 *Accommodation spaces*: Cabins, offices (for carrying out ship's business), hospitals, messrooms, recreation rooms (such as lounges, smoke rooms, cinemas, gymnasiums, libraries and hobbies and games rooms) and open recreation areas to be used by seafarers.

1.4.2 *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 (see ISO 717-1:1996 as amended by 1:2006).

1.4.3 *A-weighted equivalent continuous sound level $L_{Aeq}(T)$* : A-weighted sound pressure level of a continuous steady sound that, within a measurement time interval, T, has the same mean square sound pressure as a sound under consideration which varies with time. It is expressed in decibels A (dB(A)) and is given by the following equation:

$$L_{Aeq,T} = 10 \log \frac{1}{T} \int_0^T \frac{p_a(t)^2}{p_0^2} \cdot dt$$

where: T = measurement time

$p_a(t)$ = A-weighted instantaneous sound pressure

p_0 = 20 μ Pa (the reference level).

1.4.4 *A-weighted sound pressure level or noise level*: The quantity measured by a sound level meter in which the frequency response is weighted according to the A-weighting curve (see IEC 61672-1).

1.4.5 *C-weighted equivalent continuous sound level $L_{Ceq}(T)$* : C-weighted sound pressure level of a continuous steady sound that within a measurement time interval, T, has the same mean square sound pressure as a sound under consideration which varies with time. It is expressed in decibels C (dB(C)) and is given by the following equation:

$$L_{Ceq,T} = 10 \log \frac{1}{T} \int_0^T \frac{p_c(t)^2}{p_0^2} \cdot dt$$

where: T = measurement time

$p_c(t)$ = C-weighted instantaneous sound pressure

p_0 = 20 μ Pa (the reference level).

1.4.6 *C-weighted peak sound level* L_{Cpeak} : C-weighted maximum instantaneous sound pressure level. It is expressed in decibels C (dB(C)) and is given by the following equation:

$$L_{Cpeak} = 10 \log \frac{p_{peak}^2}{p_0^2}$$

where: p_{peak} = C-weighted maximum instantaneous sound pressure
 p_0 = 20 μ Pa (the reference level).

1.4.7 *C-weighted sound pressure level or noise level*: The quantity measured by a sound level meter in which the frequency response is weighted according to the C-weighting curve (see IEC 61672-1 (2002-05)).

1.4.8 *Continuously manned spaces*: Spaces in which the continuous or prolonged presence of seafarers is necessary for normal operational periods.

1.4.9 *Crane barge*: A vessel with permanently installed cranes designed principally for lifting operations.

1.4.10 *Daily noise exposure level* ($L_{ex,24h}$) represents the equivalent noise exposure level for a period of 24 hours.

$$L_{ex,24h} = L_{Aeq,T} + 10 \log(T/T_0)$$

where: T is the effective duration on board
 T_0 is the reference duration 24 h.

The total equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$), shall be calculated by using the different noise levels (L_{Aeq,T_i}) and associated time periods with the following equation:

$$L_{Aeq,T} = 10 \lg \left[\frac{1}{T} \sum_{i=1}^n (T_i \times 10^{0,1L_{Aeq,T_i}}) \right]$$

where

L_{Aeq,T_i} is the equivalent continuous A-weighted sound pressure level, in decibels, averaged over time interval T_i ;

$$T = \sum_{i=1}^n T_i$$

$L_{ex,24h} = L_{Aeq,24h}$ when seafarers are on board over a period of 24 hours.

1.4.11 *Dredger*: A vessel undertaking operations to excavate bottom sediment, where the vessel has permanently installed excavation equipment.

1.4.12 *Duty stations*: Those spaces in which the main navigating equipment, the ship's radio or the emergency source of power are located or where the fire recording or fire control equipment is centralized and also those spaces used for galleys, main pantries, stores (except isolated pantries and lockers), mail and specie rooms, workshops other than those forming part of the machinery spaces and similar such spaces.

1.4.13 *Dynamically supported craft*: A craft which is operable on or above water and which has characteristics different from those of conventional displacement ships. Within the aforementioned generality, a craft which complies with either of the following characteristics:

- .1 the weight, or a significant part thereof, is balanced in one mode of operation by other than hydrostatic forces;
- .2 the craft is able to operate at speeds such that the function $\frac{v}{\sqrt{gL}}$ is equal to or greater than 0.9, where "v" is the maximum speed, "L" is the water-line length and "g" is the acceleration due to gravity, all in consistent units.

1.4.14 *Existing ship*: A ship which is not a new ship.

1.4.15 *Fishing vessel*: A vessel used commercially for catching fish, whales, seals, walrus or other living resources of the sea.

1.4.16 *Hearing loss*: Hearing loss is evaluated in relation to a reference auditory threshold defined conventionally in ISO Standard 389-1(1998). The hearing loss corresponds to the difference between the auditory threshold of the subject being examined and the reference auditory threshold.

1.4.17 *Hearing protector*: A device worn to reduce the level of noise reaching the ears. Passive noise-cancelling headsets block noise from reaching the ear. Active noise-cancelling headphones generate a signal that cancels out the ambient noise within the headphone.

1.4.18 *Integrating sound level meter*: A sound level meter designed or adapted to measure the level of the mean squared time averaged A-weighted and C-weighted sound pressure.

1.4.19 *Machinery spaces*: Any space which contains steam or internal-combustion machinery, pumps, air compressors, boilers, oil fuel units, major electrical machinery, oil filling stations, thrusters, refrigerating, stabilizing, steering gear, ventilation and air conditioning machinery, etc., and trunks to such spaces.

1.4.20 *Mobile offshore drilling unit*: A vessel capable of engaging in drilling operations for the exploration for, or exploitation of, resources beneath the seabed, such as liquid or gaseous hydrocarbons, sulphur or salt.

1.4.21 *Navigating bridge wings*: Those parts of the ship's navigating bridge extending towards the ship's sides.

1.4.22 *New ship*: means a ship to which this Code applies in accordance with SOLAS regulation II-1/3-12.1.

1.4.23 *Noise*: For the purpose of the Code all sound which can result in hearing impairment, or which can be harmful to health or be otherwise dangerous or disruptive.

1.4.24 *Noise induced hearing loss*: A hearing loss, originating in the nerve cells within the cochlea, attributable to the effects of sound.

1.4.25 *Noise level*: See A-weighted sound pressure level (paragraph 1.4.4).

1.4.26 *Occasional exposures*: Those exposures typically occurring once per week, or less frequently.

1.4.27 *Pile driving vessel*: A vessel undertaking operations to install pilings in the seabed.

1.4.28 *Pipe-laying barge*: A vessel specifically constructed for, or used in conjunction with, operations associated with the laying of submarine pipelines.

1.4.29 *Port condition*: The condition in which all machinery solely required for propulsion is stopped.

1.4.30 *Potentially hazardous noise levels*: Those levels at and above which persons exposed to them without protection are at risk of sustaining a noise induced hearing loss.

1.4.31 *Repairs, alterations and modifications of a major character*: means a conversion of a ship which substantially alters the dimensions, carrying capacity or engine power of the ship, which change type of the ship, which otherwise so alters the ship that, if it were a new ship, it would become subject to the relevant provisions.

1.4.32 *Sound*: Energy that is transmitted by pressure waves in air or other materials and is the objective cause of the sensation of hearing.

1.4.33 *Sound pressure level L_p or SPL*: Sound pressure level expressed in decibel (dB), of a sound or noise given by the following equation:

$$L_p = 10 \log \frac{p^2}{p_0^2}$$

where: p = sound pressure, in Pascal
 p_0 = 20 μ Pa (the reference level).

1.4.34 *Voyages of short duration*: Voyages where the ship is not generally underway for periods long enough for seafarers to require sleep, or long off-duty periods, during the voyages.

1.4.35 *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 (see ISO 717-1:1997 as amended by 1:2006).

CHAPTER 2 – MEASURING EQUIPMENT

2.1 Equipment specifications

2.1.1 Sound level meters

Measurement of sound pressure levels shall be carried out using precision integrating sound level meters subject to the requirements of this chapter. Such meters shall be manufactured to IEC 61672-1(2002-05) type/class 1 standard as applicable, or to an equivalent standard acceptable to the Administration.

2.1.2 Octave filter set

When used alone, or in conjunction with a sound level meter, as appropriate, an octave filter set shall conform to IEC 61260 (1995) or an equivalent standard acceptable to the Administration.

2.2 Use of equipment

2.2.1 Calibration

Sound calibrators shall comply with the standard IEC 60942 (2003-01) and shall be approved by the manufacturer of the sound level meter used.

2.2.2 Check of measuring instrument and calibrator

Calibrator and sound level meter shall be verified at least every two years by a national standard laboratory or a competent laboratory accredited according to ISO 17025 (2005) as corrected by (Cor 1:2006).

2.2.3 Microphone wind screen

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

CHAPTER 3 – MEASUREMENT

3.1 General

3.1.1 On completion of the construction of the ship, or as soon as practicable thereafter, measurement of noise levels in all spaces specified in chapter 4 shall take place under the operating conditions specified in sections 3.3 and 3.4 and shall be suitably recorded as required by section 4.3.

3.1.2 Measurements of the A-weighted equivalent continuous sound level, $L_{Aeq}(T)$ shall be made for the purpose of ensuring compliance with chapter 4.

3.1.3 Measurements of the C-weighted equivalent continuous sound level $L_{Ceq}(T)$ and the C-weighted peak sound level L_{Cpeak} shall be made in spaces where $L_{Aeq}(T)$ exceeds 85 dB(A) for the purpose of determining appropriate hearing protection according to the HML-method, see chapter 7 and appendix 2.

3.2 Personnel requirements

3.2.1 In order to ensure an acceptable and comparable quality of the measurement results and the reports the measuring institutes or experts shall prove their competence with view to noise measurements.

3.2.2 This person conducting measurements shall have:

- .1 knowledge in the field of noise, sound measurements and handling of used equipment;
- .2 training concerning the procedures specified in this Code.

3.3 Operating conditions at sea trials

3.3.1 Measurements should be taken with the ship in the loaded or ballast condition. The course of the ship shall be as straight as possible. The actual conditions during the measurements shall be recorded on the survey report.

3.3.2 Noise measurements shall be taken at normal service speed and, unless otherwise addressed in the provisions below, no less than 80% of the maximum continuous rating (MCR). Controllable pitch and Voith-Schneider propellers, if any, shall be in the normal seagoing position. For special ship types and for ships with special propulsion and power configurations, such as diesel-electric systems, the Administration may, in cooperation with the shipyard and shipowners, give due consideration to actual ship design or operating parameters when applying the requirements of paragraphs 3.3.1 and 3.3.2.

3.3.3 All machinery, navigation instruments, radio and radar sets, etc., normally in use at normal seagoing condition and levels, including squelch shall operate throughout the measurement period. However, neither energized fog signals nor helicopter operations shall take place during the taking of these measurements.

3.3.4 Measurements in spaces containing emergency diesel engine driven generators, fire pumps or other emergency equipment that would normally be run only in emergency, or for test purposes, shall be taken with the equipment operating. Measurements are not intended for determining compliance with maximum noise level limits, but as a reference for personal protection of seafarers carrying out maintenance, repair and test activities in such spaces.

3.3.5 Mechanical ventilation, heating and air-conditioning equipment shall be in normal operation, taking into account that the capacity shall be in accordance with the design conditions.

3.3.6 Doors and windows should in general be closed.

3.3.7 Spaces should be furnished with all necessary equipment. Measurements without soft furnishings may be taken but no allowance should be made for their absence. Rechecks or follow-up readings may be taken with soft furnishings included.

3.3.8 Ships fitted with bow thrusters, stabilizers, etc., may be subject to high noise levels when this machinery is in operation. For thrusters, measurements shall be made at 40% thruster power and the ship's speed shall be appropriate for thruster operation. Measurements shall be taken at positions around such machinery when in operation and in adjacent accommodation spaces and duty stations. If such equipment is intended for continuous operation, e.g. stabilizers, measurements shall be made for ensuring compliance with chapter 4. If such systems are intended for short temporary use only, for instance during port manoeuvres, measurements are only relevant for ensuring compliance with chapter 5 on noise exposure.

3.3.9 In case of ships with Dynamical Positioning (DP), which is intended for use in normal working condition, additional noise measurements at DP mode shall be made at control stations, duty stations, and accommodation spaces to ensure that the maximum noise level limits in these spaces are not exceeded. The Administration, classification societies, shipyard and DP designers, as appropriate, shall agree on a process to simulate the operation of the DP thruster system under conditions which would approximate station-holding at or above 40 per cent of maximum thruster power for design environmental conditions that the ship operates in.

3.4 Operating conditions in port

3.4.1 Measurements as specified in paragraphs 3.4.2, 3.4.3 and 3.4.4 relate to the ship in port condition.

3.4.2 When the noise from the ship's cargo handling equipment may lead to noise above maximum levels in duty stations and accommodation spaces affected by its operation, measurements should be taken. Noise originating from sources external to the ship should be discounted as indicated in paragraph 3.5.3.

3.4.3 Where the ship is a vehicle carrier and noise during loading and discharging originates from vehicles, the noise level in the cargo spaces and the duration of the exposure should be considered in conjunction with chapter 5. Such noise levels originating from vehicles may be estimated theoretically by the shipyard and shipowners in cooperation with the Administration.

3.4.4 Measurements shall be taken in machinery spaces with the machinery operating in the port condition if the provisions of paragraph 5.3.5 in respect of hearing protection shall be met in lieu of the provisions of paragraph 4.2.1 during maintenance, overhaul or similar port conditions.

3.5 Environmental conditions

3.5.1 The readings obtained may be affected if the water depth is less than five times the draught or if there are large reflecting surfaces in the ship's vicinity. Such conditions shall therefore be noted in the noise survey report.

3.5.2 The meteorological conditions such as wind and rain, as well as sea state, should be such that they do not influence the measurements. Wind force 4 and 1 m wave height should not be exceeded. If this cannot be achieved, the actual conditions shall be reported.

3.5.3 Care shall be taken to see that noise from extraneous sound sources, such as people, entertainment, construction and repair work, does not influence the noise level on board the ship at the positions of measurement. If necessary, measured values may be corrected for steady state background noise according to the energy summation principle.

3.6 Measurement procedures

3.6.1 During noise level measurement, only seafarers necessary for the operation of the ship and persons taking the measurements shall be present in the space concerned.

3.6.2 Sound pressure level readings shall be taken in decibels using an A-weighting (dB(A)) and C-weighting (dB(C)) filter and if necessary also in octave bands between 31.5 and 8,000 Hz.

3.6.3 The noise level measurements shall be taken with the integrating sound level meter using spatial averaging (as described in paragraph 3.13.1) and over a time period until stable readings are found or at least 15 s in order to represent the average value from variations due to irregular operation or variations in the sound field. Readings shall be made only to the nearest decibel. If first decimal of the dB reading is 5 or higher, the reading shall be made to nearest higher integer.

3.7 Determination of noise exposure

In addition to the continuous sound level measurements the noise exposure level of seafarers (see chapter 5) shall be determined based upon ISO 9612:2009. A simplified procedure based on ISO 9612 and a work place related noise exposure is given in appendix 4.

3.8 Calibration

The sound level meter shall be calibrated with the calibrator referred to in paragraph 2.2.1 before and after measurements are taken.

3.9 Measurement uncertainties

The uncertainty of measurements on board vessels depends on several factors, for example, measurement techniques and environmental conditions. Measurements made in conformity with this Code with few exceptions results in reproducibility standard deviation of the equivalent continuous A-weighted sound pressure level equal to or less than 1.5 dB.

3.10 Points of measurement

3.10.1 Measurement positions

If not otherwise stated, measurements shall be taken with the microphone at a height of between 1.2 m (seated person) and 1.6 m (standing person) from the deck. The distance between two measurement points should be at least 2 m, and in large spaces not containing machinery, measurements should be taken at intervals not greater than 10 m throughout the space including positions of maximum noise level. In no case shall measurements be taken closer than 0.5 m from the boundaries of a space. The microphone positions shall be as specified in paragraphs 3.10.3 and sections 3.11 to 3.14. Measurements shall be taken at positions where the personnel work, including at communication stations.

3.10.2 Duty stations

The noise level shall be measured at all points where the work is carried out. Additional measurements shall be performed in spaces containing duty stations if variations in noise level are thought to occur in the vicinity of the duty stations.

3.10.3 Intake and exhaust openings

When measuring noise levels, the microphone should, where possible, not be placed within a 30° angle away from the direction of the gas stream and not less than a distance of 1 m from the edge of the intake or exhaust opening of engines, ventilation, air conditioning and cooler systems, and as far as possible from reflecting surfaces.

3.11 Measurements in machinery spaces

3.11.1 Measurements shall be taken at the principal working and control stations of the seafarers in the machinery spaces and in the adjacent control rooms, if any, special attention being paid to telephone locations and to positions where voice communication and audible signals are important.

3.11.2 Measurements should not normally be taken closer than 1 m from operating machinery, or from decks, bulkheads or other large surfaces, or from air inlets. Where this is not possible, measurement shall be taken at a position midway between the machinery and adjacent reflecting surface.

3.11.3 Measurements from machinery which constitutes a sound source should be taken at 1 m from the machinery. Measurement should be made at a height of between 1.2 m to 1.6 m above the deck, platform or walkway as follows:

- .1 at a distance of 1 m from, and at intervals not greater than 3 m around, all sources such as:
 - main turbines or engines at each level
 - main gearing
 - turbo-blowers
 - purifiers
 - electrical alternators and generators
 - boiler firing platform
 - forced and/or induced draught fans
 - compressors
 - cargo pumps (including their driving motors or turbines)

In order to avoid an unnecessarily large and impractical number of measurements and recordings in the case of large engines and of machinery spaces where the measured sound pressure level in dB(A) at the intervals above does not vary significantly, it will not be necessary to record each position. Full measurement at representative positions and at the positions of maximum sound pressure level shall, however, be made and recorded, subject to at least four measurements being recorded at each level;

- .2 at local control stations, e.g. the main manoeuvring or emergency manoeuvring stand on the main engine and the machinery control rooms;
- .3 at all other locations not specified in .1 and .2 which would normally be visited during routine inspection, adjustment and maintenance;
- .4 at points on all normally used access routes, unless covered by positions already specified above, at intervals not greater than 10 m; and
- .5 in rooms within the machinery space, e.g. workshops. In order to restrict the number of measurements and recordings, the number of recordings can be reduced as in .1, subject to a total of at least four measurements (including those specified in this paragraph) being recorded at each machinery space level up to upper deck.

3.12 Measurements in navigation spaces

Measurements shall be taken on both navigating bridge wings but should only be taken when the navigating bridge wing to be measured is on the lee side of the ship.

3.13 Measurements in accommodation spaces

3.13.1 One measurement shall be taken in the middle of the space. The microphone shall be moved slowly horizontally and/or vertically over a distance of 1 m (+/- 0.5 m, taking into account the measurement criteria in paragraph 3.10.1). Additional measurements should be performed at other points if appreciable differences, i.e. greater than 10 dB(A), in the level of sound inside the room occur, especially near the head positions of a sitting or lying person.

3.13.2 The number of measurement cabins shall be not less than 40 per cent of total number of cabins. Cabins which are obviously affected by noise, i.e. cabins adjacent to machinery or casings, must be considered in any case.

3.13.3 For ships with a large number of crew cabins, such as passenger/cruise ships, it will be acceptable to reduce the number of measurement positions. The selection of cabins to be tested shall be representative for the group of cabins being tested by selecting those cabins in closer proximity to noise sources, to the satisfaction of the Administration.

3.13.4 On open deck, measurements shall be taken in any areas provided for the purpose of recreation.

3.14 Measurements in normally unoccupied spaces

3.14.1 In addition to the spaces referred to in sections 3.10 to 3.13, measurements shall be taken in all locations with unusually high noise levels where seafarers may be exposed, even for relatively short periods, and at intermittently used machinery locations.

3.14.2 In order to restrict the number of measurements and recordings, noise levels need not be measured for normally unoccupied spaces, holds, deck areas and other spaces which are remote from sources of noise.

3.14.3 In cargo holds, at least three microphone positions in parts of holds where personnel are likely to carry out work shall be used.

CHAPTER 4 – MAXIMUM ACCEPTABLE SOUND PRESSURE LEVELS

4.1 General

4.1.1 The limits specified in this section shall be regarded as maximum levels and not as desirable levels. Where reasonably practicable, it is desirable for the noise level to be lower than the maximum levels specified.

4.1.2 Before the ship is put in service, the limits specified in section 4.2 shall be assessed by the equivalent continuous sound level measurement for that space. In large rooms with many measurement positions the individual positions shall be compared to the limits.

4.1.3 Personnel entering spaces with nominal noise levels greater than 85 dB(A) should be required to wear hearing protectors while in those spaces (see chapter 5). The limit of 110 dB(A) given in paragraph 4.2.1 assumes that hearing protectors giving protection meeting the requirements for hearing protectors in chapter 7 are worn.

4.1.4 Limits are specified in terms of A-weighted sound pressure levels (see paragraphs 1.4.4 and 1.4.24).

4.2 Noise level limits

Limits for noise levels (dB(A)) are specified for various spaces as follows:

Designation of rooms and spaces	Ship size	
	1,600 up to 10,000 GT	≥10,000 GT
4.2.1 Work spaces (see 5.1)		
Machinery spaces	110	110
Machinery control rooms	75	75
Workshops other than those forming part of machinery spaces	85	85
Non-specified work spaces (other work areas)	85	85
4.2.2 Navigation spaces		
Navigating bridge and chartrooms	65	65
Look-out posts, incl. navigating bridge wings and windows	70	70
Radio rooms (with radio equipment operating but not producing audio signals)	60	60
Radar rooms	65	65
4.2.3 Accommodation spaces		
Cabin and hospitals	60	55
Messrooms	65	60
Recreation rooms	65	60
Open recreation areas (external recreation areas)	75	75
Offices	65	60
4.2.4 Service spaces		
Galleys, without food processing equipment operating	75	75
Serveries and pantries	75	75
4.2.5 Normally unoccupied spaces		
Spaces referred to in section 3.14	90	90

4.3 Survey report

4.3.1 A noise survey report shall be made for each ship. The report shall comprise information on the noise levels in the various spaces on board. The report shall show the reading at each specified measuring point. The points shall be marked on a general arrangement plan, or on accommodation drawings attached to the report, or shall otherwise be identified.

4.3.2 The format for noise survey reports is set out in appendix 1.

4.3.3 The noise survey report shall always be carried on board and be accessible for the crew.

CHAPTER 5 – NOISE EXPOSURE LIMITS

5.1 General

5.1.1 The noise level limits as set out in chapter 4 are designed so that if they are complied with seafarers will not be exposed to an $L_{ex}(24)$ exceeding 80 dB(A), i.e. within each day or 24-hour period the equivalent continuous noise exposure would not exceed 80 dB(A). For a new ship, compliance with these criteria should be verified on the basis of sea trial measurements of noise levels by calculation of the expected noise exposure of each category of crew members in accordance with the method prescribed in section 3.7.

5.1.2 In spaces with sound pressure levels exceeding 85 dB(A), suitable hearing protection should be used, or to apply time limits for exposure, as set out in this section, to ensure that an equivalent level of protection is maintained.

5.1.3 Each ship to which these regulations apply should include in their Safety Management System a section on the company's policy regarding hearing protection, exposure limits and conduct training on those matters, which will be logged in their training records.

5.1.4 Consideration should be given to the instruction of seafarers on these aspects, as recorded in appendix 2. No crew member should be exposed unprotected to peak values exceeding 135 dB(C).

5.2 Conservation of hearing and use of hearing protectors

In order to comply with the exposure criteria of this section, the use of hearing protectors complying with chapter 7 is permitted. Even when hearing protectors are required for compliance with the Code, risk assessments, a hearing conservation programme and other measures may be implemented by the Administration.

5.3 Limits of exposure of seafarers to high-noise levels

Seafarers should not be exposed to noise in excess of the levels and durations shown in figure 5.1 and described in paragraphs 5.3.1 to 5.3.5.

5.3.1 *Maximum exposure with protection (zone A, Figure 1)*

No seafarer, even when wearing hearing protectors, should be exposed to levels exceeding 120 dB(A) or to an $L_{eq}(24)$ exceeding 105 dB(A).

5.3.2 *Occasional exposure (zone B, Figure 1)*

Only occasional exposures should be allowed in zone B and hearing protectors with an attenuation between 25 and 35 dB(A) should be used.

5.3.3 *Occasional exposure (zone C, Figure 1)*

In zone C only occasional exposures should be allowed and hearing protectors with an attenuation of at least 25 dB(A) should be used.

5.3.4 *Daily exposure (zone D, Figure 1)*

If seafarers routinely work (daily exposure) in spaces with noise levels within zone D hearing protectors with an attenuation up to at least 25 dB(A) should be used and risk assessment and a hearing conservation programme may be considered.

5.3.5 Maximum exposure without protection (zone E, Figure 1)

For exposures of less than eight hours, seafarers without hearing protection should not be exposed to noise levels exceeding 85 dB(A). When seafarers remain for more than eight hours in spaces with a high noise level, an $L_{eq}(24)$ of 80 dB(A) should not be exceeded. Consequently, for at least a third of each 24 hours each seafarer should be subject to an environment with a noise level below 75 dB(A).

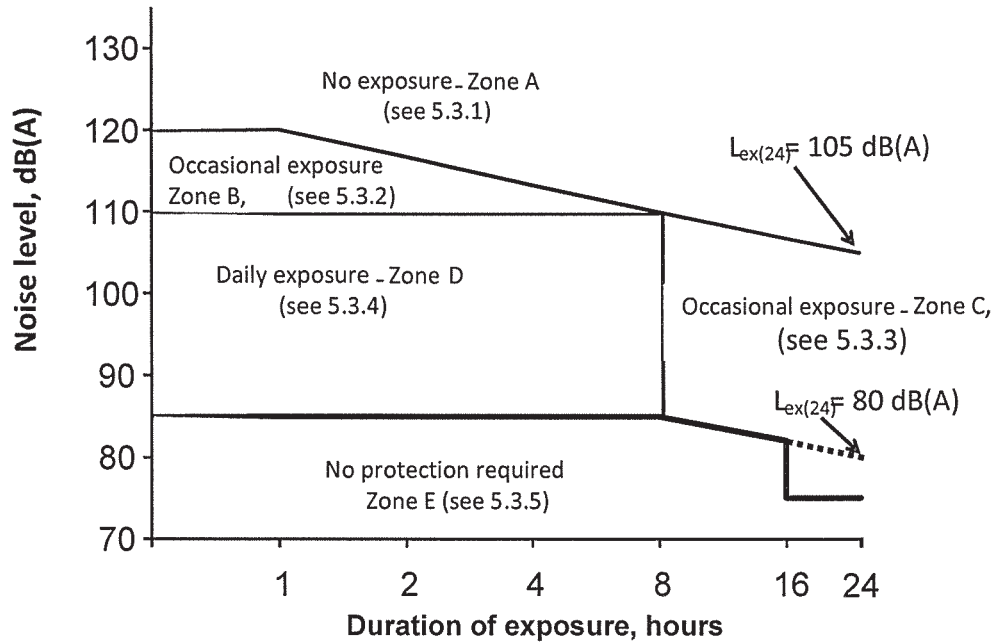


Figure 1: Allowable daily and occasionally occupational zones

Note: To work in Zone A – D hearing protectors attenuating the sound to the ear down to below 85 dB(A) are required. To work in Zone E hearing protectors are not required but should be accessible if the sound level is over 80 dB(A) for more than eight hours.

5.4 24-hour equivalent continuous sound level limit

As an alternative to compliance with the provisions of section 5.3 (figure 1), no unprotected seafarer should be exposed to a 24-hour equivalent continuous sound level greater than 80 dB(A). Each individual's daily exposure duration in spaces requiring the use of hearing protectors should not exceed four hours continuously or eight hours in total.

5.5 Hearing conservation programme

5.5.1 A hearing conservation programme may be provided for seafarers working in spaces with $L_{Aeq} > 85 \text{ dB(A)}$ in order to train them in the hazards of noise and use of hearing protection, and to monitor hearing acuity. Some elements of a hearing conservation programme are as follows:

- .1 Initial and periodic audiometric tests administered by a trained and appropriately qualified person, to the satisfaction of the Administration.
- .2 Instruction of exposed persons on the hazards of high and long duration noise exposures and on the proper use of ear protectors (see appendix 2).

- .3 Maintenance of audiometric test records.
- .4 Periodic analysis of records and hearing acuity of individuals with high-hearing loss.

5.5.2 An optional element of a hearing conservation programme is to control the 24-hour equivalent continuous sound level to which individuals working in high noise level spaces are exposed. Such control requires calculation of the 24-hour equivalent continuous sound level. If this 24-hour level does not meet the limits, the duration of exposure should be controlled or hearing protectors used at appropriate times to bring the individual's exposure within the limit.

CHAPTER 6 – ACOUSTIC INSULATION BETWEEN ACCOMMODATION SPACES

6.1 General

Consideration shall be given to the acoustic insulation between accommodation spaces in order to make rest and recreation possible even if activities are going on in adjacent spaces, e.g. music, talking, cargo handling, etc.

6.2 Sound insulation index

6.2.1 The airborne sound insulation properties for bulkheads and decks within the accommodation shall comply at least with the following weighted sound reduction index (R_w) according to ISO Standard 717-1:1996 as amended (1:2006), part 1:

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

6.2.2 The airborne sound insulation properties shall be determined by laboratory tests in accordance with ISO 10140-2:2010, to the satisfaction of the Administration.

6.3 Erection of materials

6.3.1 Care should be taken in the erection of materials and in the construction of accommodation spaces. During sea trial testing, if the erection of materials is in doubt then measurements should be taken on board ships for a representative selection of each type of partition, floors, doors as requested in paragraph 6.2.1 and to the satisfaction of the Administration.

6.3.2 The apparent weighted sound reduction index R'_w should comply with the requirements of the paragraph 6.2.1 with tolerance of up to 3 dB.

Note: Field measurements should be performed according to ISO 140-4:1998. When the area of the materials tested is $<10 \text{ m}^2$, a minimum value of 10 m^2 should be considered for the calculation of the R'_w index.

CHAPTER 7 – HEARING PROTECTION AND WARNING INFORMATION

7.1 General

When the application of means for controlling sound at source does not reduce the noise level in any space to that specified in paragraph 4.1.3, seafarers who are required to enter such spaces shall be supplied with effective hearing protection on an individual basis. The provision of hearing protectors shall not be considered to be a substitute for effective noise control. Appendix 3 summarizes current noise abatement methods which may be applied on new ships.

7.2 Requirements for hearing protectors

7.2.1 The individual hearing protectors shall be so selected as to eliminate the risk to hearing or to reduce the risk to an acceptable level as specified in paragraph 7.2.2. The ship operator shall make every effort to ensure the wearing of hearing protectors and shall be responsible for checking the effectiveness of measures taken in compliance of this Code.

7.2.2 Hearing protectors shall be of a type such that they can reduce sound pressure levels to 85 dB(A) or less (see section 5.1). Selection of suitable hearing protectors should be in accordance with the HML-method described in ISO 4869-2:1994 (see explanation and example in appendix 2). Noise-cancelling technology may be used if the headset(s) have equivalent performance to hearing protectors in their unpowered condition.

7.2.2.1 Noise-cancelling headsets specifications should be as per confirmed manufacturer specifications.

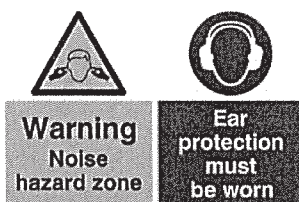
7.3 Selection and use of hearing protectors

Seafarers should be instructed in the proper use of hearing protectors as provided or used on board in accordance with appendix 2.

7.4 Warning notices

Where the noise level in machinery spaces (or other spaces) is greater than 85 dB(A), entrances to such spaces shall carry a warning notice comprising symbol and supplementary sign in the working language of the ship as prescribed by the Administration (see below an example of the warning notice and signs in English). If only a minor portion of the space has such noise levels the particular location(s) or equipment shall be identified at eye level, visible from each direction of access.

Signs at the entrance to noisy rooms (example in English)	
80-85 dB(A)	HIGH-NOISE LEVEL – USE HEARING PROTECTORS
85-110 dB(A)	DANGEROUS NOISE – USE OF HEARING PROTECTORS MANDATORY
110-115 dB(A)	CAUTION: DANGEROUS NOISE – USE OF HEARING PROTECTORS MANDATORY – SHORT STAY ONLY
>115 dB(A)	CAUTION: EXCESSIVELY HIGH-NOISE LEVEL – USE OF HEARING PROTECTORS MANDATORY – NO STAY LONGER THAN 10 MINUTES



Appendix 1

FORMAT FOR NOISE SURVEY REPORT

1 Ship particulars

- .1 Name of ship
- .2 Port of registry
- .3 Name and address of shipowner, managing owner or agent
- .4 Name and address of shipbuilder
- .5 Place of build
- .6 IMO number
- .7 Gross tonnage
- .8 Type of ship
- .9 Ship's dimensions – length
breadth
depth
maximum draught (summer load line)
- .10 Displacement at maximum draught
- .11 Date of keel laying
- .12 Date of delivery

2 Machinery particulars

- .1 Propulsion machinery

Manufacturer:	Type:	Number of units:
Maximum cont. rating – power		kW
Normal designed service shaft speed:		rpm
Normal service rating – power:		kW

- .2 Auxiliary diesel engines

Manufacturer:		Type:
Output:	kW	Number of units:

- .3 Main reduction gear:

- .4 Type of propeller (fixed propeller, controllable pitch propeller, Voith-Schneider propeller)

Number of propellers:	Number of blades:
Designed propeller shaft speed:	rpm

- .5 Other (in case of special propulsion and power configurations)

- .6 Engine room ventilation

Manufacturer:		Type:
Number of units:		
Fan diameter:	m	Fan speed:
Airflow capacity:	m ³ /h	rpm /variable speed (Y/N)
		Total pressure:
		Pa

3 Measuring instrumentation and personnel

.1	Instrumentation	Make	Type	Serial No.
	Sound level meter			
	Microphone			
	Filter			
	Windscreen			
	Calibrator			
	Other equipment			
.2	Calibration of sound level meter	Date Calibration	Start	Finish
	-	at survey by competent authority		
.3	Identification of persons/organizations carrying out measurements			

4 Conditions during measurement

.1	Date of measurement:	Starting time:	Completion time:
.2	Ship's position during measurement		
.3	Loading condition of the ship		
.4	Conditions during measurement		
	- Draught forward		
	- Draught aft		
	- Depth of water under keel		
.5	Weather conditions		
	- Wind force		
	- Sea state		
.6	Ship speed		
.7	Actual propeller shaft speed:	rpm	
.8	Propeller pitch:		
.9	Propulsion machinery speed:	rpm	
.10	Propulsion machinery power:	kW	
.11	Number of propulsion machinery units operating:		
.12	Number of diesel auxiliary engines operating:		
.13	Number of turbogenerators operating:		
.14	Engine room ventilation speed mode (high/low/variable)		
.15	Engine load (%MCR)		
.16	Other auxiliary equipment operating:		
	Ventilation, heating and air conditioning equipment in operation		

5 Measuring data

Noise limits	Measured sound pressure levels
dB(A)	L_{Aeq} dB(A)
	L_{Ceq} dB(C)
	L_{Cpeak} dB(C)

Note: Measurement of sound pressure level L_{Ceq} and L_{Cpeak} should be done only in the case of exceeding 85dB(A) and hearing protectors are required.

Work spaces

- Machinery spaces
- Machinery control rooms
- Workshops
- Non-specified workspaces

Navigation spaces

- Navigating bridge and chartrooms
- Look-out posts, including navigating bridge wings and windows
- Radio rooms
- Radar rooms

Accommodation spaces

- Cabins and hospitals
- Messrooms
- Recreation rooms
- Open recreation areas
- Offices

Service spaces

- Galleys, without food processing equipment operating
- Serveries and pantries

Normally unoccupied spaces

6 Main noise abatement measures (list measures taken)

7 Remarks (list any exceptions to the Code)

.....

Name

Address

.....

.....
Place Date Signature

ATTACHMENT

PAGES OF FREQUENCY ANALYSIS

Frequency analysis for certain areas may result in more accurate and precise noise level predictions and will aide in the detection of specific frequency bands which exceed the established limits in chapter 4. Further guidance may be found in ISO 1996-2:2007.

Appendix 2

GUIDANCE ON THE INCLUSION OF NOISE ISSUES IN SAFETY MANAGEMENT SYSTEMS

1 Instruction to seafarers

1.1 Seafarers should be instructed in the hazards of high and long duration noise exposures and the risk of noise-induced hearing loss. Instruction should be given to all seafarers on initial employment and periodically thereafter to those regularly working in spaces with noise levels in excess of 85 dB(A). Instruction in the provisions of the Code should include:

- .1 noise exposure limits and the use of warning notices;
- .2 the types of hearing protectors provided, their approximate attenuation and their proper use, fitting, and the effects on normal communications when first wearing such protection;
- .3 company policies and procedures related to hearing protection and where appropriate any monitoring programme which may be available for seafarers working in spaces covered by warning notices; and
- .4 guidance on the possible signs of hearing loss such as ringing in the ear, dead ear, or fullness in the ear and mitigating techniques to be effected when those signs occur.

1.2 Appropriate seafarers should receive such instruction as is necessary in the correct use and maintenance of machinery and silencers or attenuators in order to avoid the production of unnecessary noise.

2 Responsibility of ship operators

2.1 The ship operator should be responsible for ensuring that means for noise reduction and control are applied and maintained such that the requirements of the Code are met.

2.2 Where noise levels in any space exceed the limit of 85 dB(A), shipowners should ensure that:

- .1 the space is identified and relevant provisions of the Code are complied with;
- .2 the master and senior officers of the ship are aware of the importance of controlling entry into the space and the importance of the use of suitable hearing protection;
- .3 suitable and sufficient hearing protection is provided for distribution on an individual basis to all relevant crew members; and
- .4 the master, senior officers and any safety officer on board a ship are aware of the need for the relevant training and information to be provided on board.

2.3 Where hand tools, galley and other portable equipment produce noise levels above 85 dB(A) in normal working conditions, shipowners should ensure that warning information should be provided.

3 Responsibility of seafarers

Seafarers should be made aware of the need to ensure that:

- .1 all measures adopted for noise control are utilized;
- .2 any defective noise control equipment is reported to responsible persons under the ship's safety management system;
- .3 suitable hearing protectors are always worn when entering areas in which their use is required by warning notices and that those protectors are not removed in those spaces, even for short periods; and
- .4 the hearing protectors provided for their use are not damaged or misused and are maintained in a sanitary condition.

4 Selection of hearing protectors

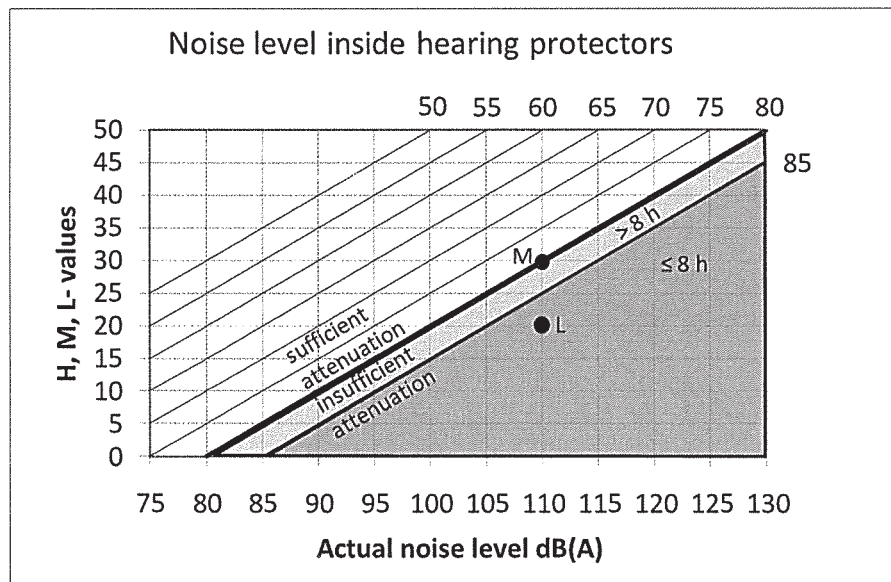
4.1 Selection of suitable hearing protectors should be carried out according to the HML-method described in ISO 4869-2:1994. In order to give guidance to ship operators and seafarers in choosing proper hearing protection, a short description of the HML-method and its use is given below.

4.2 The HML-method is a rating which is calculated in accordance with ISO 4869-2:1994, "Estimation of effective A-weighted sound pressure levels when hearing protectors are worn". Using the H, M, and L ratings requires both A-weighted (L_{Aeq}) and C-weighted (L_{Ceq}) sound pressure levels of the noise and the HML values for the hearing protector in question, which will be provided by the manufacturer.

4.2.1 The HML values for a hearing protector are related to the attenuation that the protector offers in noise of high, medium and low frequencies. These H and M values are used in the calculation of the protected exposure level for noises which have primary energy in the middle and high frequencies. This is considered the case if the measured L_{Ceq} and L_{Aeq} levels differ by 2 dB or less.

4.2.2 The M and L values for the hearing protector are used in the calculation of the protected exposure level for noises which have appreciable low-frequency components and for which the measured L_{Ceq} and L_{Aeq} levels differ by more than 2 dB in those spaces where the protector is intended to be used.

4.3 An example of simple use of the HML method:



On a given ship, the measured sound level in the machinery room is 110 dB(A), 115 dB(C). The chosen hearing protectors have the following attenuation according to the manufacturer: H= 35 dB, M=30 dB, L=20 dB.

- .1 Mark the hearing protectors' L and M values on the vertical line starting at the actual noise level (110 dB(A)).
- .2 Settle if the noise has low or high/medium frequency. If the difference $L_{Ceq} - L_{Aeq}$ is more than 2 dB the noise has low frequency (L) and if $L_{Ceq} - L_{Aeq}$ is less than 2 dB the noise has high or medium frequency (M).
- .3 If the sound is of high/medium frequency ($L_{Ceq} - L_{Aeq} \leq 2$), follow the diagonal line from the M-value and take a reading of the noise level inside the hearing protectors. In this case the noise level inside the hearing protectors is 80 dB(A) which means that the attenuation of the hearing protectors are sufficient for work over 8 hours a day.
- .4 If the sound has low frequency ($L_{Ceq} - L_{Aeq} > 2$), follow the diagonal lines from the L-value and take a reading of the noise level inside the hearing protectors. In this case, the noise level inside the hearing protectors is >85 dB(A) which means that the hearing protectors are not good enough even for a working day of 8 hours. Choose a hearing protector that has an L-value above 25 dB instead.

4.4 Calculation by the HML-method – Principle and example

Determination of feasibility of a particular protector in a specific noise environment can also be calculated. The values H, M and L may be used to estimate L'A (total A-weighted noise level at the ear) for a particular protector in specific noise situation.

- .1 Calculate $L_{Ceq} - L_{Aeq}$ (This requires measurements of L_{Aeq} and L_{Ceq} . All class 1 sound level meter can apply A-weighted or C-weighted.)

- .2 If $L_{Ceq} - L_{Aeq}$ is ≤ 2 dB, the Predicted Noise Reduction level (PNR) is calculated using the equation:

$$PNR = M - \left(\frac{H - M}{4} * (L_{Ceq} - L_{Aeq} - 2) \right)$$

If $L_{Ceq} - L_{Aeq}$ is > 2 dB, PNR is calculated using the equation:

$$PNR = M - \left(\frac{M - L}{8} * (L_{Ceq} - L_{Aeq} - 2) \right)$$

- .3 The PNR is then subtracted from the total A-weighted noise level to give the effective A-weighted level at the ear under the protector L'A:

$$L'A = L_{Aeq} - PNR$$

Example: Hearing protector H = 35 dB, M = 25 dB, L = 20 dB

Noise level in engine-room:

$$L_{Aeq} = 108.7 \text{ dB(A)}$$

$$L_{Ceq} = 109.0 \text{ dB(C)}$$

$$L_{Ceq} - L_{Aeq} = 0.3 \text{ dB}$$

$$PNR = 25 - ((35-25)/4)*(0.3-2) = 29.3 \text{ dB}$$

$$L'A = 108.7 - 29.3 = 79.4 \text{ dB(A)}.$$

In this case, the noise level inside the hearing protectors is below 80 dB(A) which means that the attenuation of the hearing protectors is sufficient for work over eight hours a day.

Appendix 3

SUGGESTED METHODS OF ATTENUATING NOISE

1 General

1.1 In order to obtain a noise reduction on board ships to comply with the limits given in chapters 4 and 5 of the Code, careful consideration should be given to means of such reduction. This appendix is intended to provide information for the design of a ship in this respect.

1.2 Design and construction of noise control measures should be supervised by persons skilled in noise control techniques.

1.3 Some of the measures which can be taken to control the noise level or reduce the exposure of seafarers to potentially harmful noise are indicated in sections 2 to 10 of this appendix. It is emphasized that it will not be necessary to implement all or any of the measures recommended in this appendix on all ships. This Code does not provide detailed technical information needed for putting constructional noise control measures into effect, or for deciding which measures are appropriate in particular circumstances.

1.4 In applying noise control measures, care should be taken to ensure that rules and regulations concerning ship structure, accommodation and other safety matters are not infringed and the use of sound reduction materials should not introduce fire, safety or health hazards nor should such material, by virtue of flimsy construction or attachment, introduce hazards that may tend to impede either evacuation or de-watering of the spaces.

1.5 The need for noise control should be taken into account at the design stage when deciding which of different designs of engines and machinery are to be installed, the method of installation and the siting of machinery in relation to other spaces, and the acoustic insulation and siting of the accommodation spaces.

1.6 Due to the normal method of ship construction, it is most probable that noise originating from machinery and propellers reaching the accommodation and other spaces outside the machinery spaces will be of the structure-borne type.

1.7 When designing efficient and economic measures for noise control of machinery installations in existing ships, the measurement of sound produced in terms of A-weighted sound level may need to be supplemented by some form of frequency analysis.

2 Isolation of sources of noise

2.1 Where practicable, any engines or machinery producing noise levels in excess of the limits set out in section 4.2 of the Code should be installed in compartments which do not require continuous attendance (see also paragraph 6.1 of this appendix).

2.2 Accommodation should be sited both horizontally and vertically as far away as is practicable from sources of noise such as propellers and propulsion machinery.

2.3 Machinery casings should, where practicable, be arranged outside superstructures and deckhouses containing accommodation spaces. Where this is not feasible, passageways should be arranged between the casings and accommodation spaces, if practicable.

2.4 Consideration should be given, where practicable, to the placing of accommodation spaces in deck houses not in superstructures extending to the ship's side.

2.5 Consideration may also be given, where applicable, to the separation of accommodation spaces from machinery spaces by unoccupied spaces, sanitary and washing rooms.

2.6 Suitable partitions, bulkheads, decks, etc., may be needed to prevent the spread of sound. It is important that these be of the correct construction and location in relation to the source of sound and the frequency of the sound to be attenuated.

2.7 Where a space, such as a machinery space, is being divided into noisy (not continually manned) and less noisy (capable of being continually manned) spaces, it is preferable to have complete separation.

2.8 It may be advisable to provide sound absorbing material in certain spaces in order to prevent increase of noise level due to reflection from partitions, bulkheads, decks, etc.

3 Exhaust and intake silencing

3.1 Exhaust systems from internal combustion engines, air-intake systems to machinery spaces, accommodation spaces and other spaces should be so arranged that the inflow or discharge orifices are remote from places frequented by seafarers.

3.2 Silencers, noise-cancelling equipment or attenuators should be fitted when necessary.

3.3 To minimize accommodation noise levels it is normally necessary to reduce structure-borne noise by isolating exhaust systems and certain pipe work and duct work from casings, bulkheads, etc.

4 Machinery enclosure

4.1 In continuously manned spaces or spaces where seafarers might reasonably be expected to spend lengthy periods of time on maintenance or overhaul work, and where separation as detailed in section 2 of this appendix is not practicable, consideration should be given to the fitting of sound insulating enclosures or partial enclosures to engines or machinery producing sound pressure levels in excess of the limits set out in section 4.2 of the Code.

4.2 Where the noise level produced by engines or machinery installed in spaces as in paragraph 4.1 above falls within the criteria of paragraph 5.3.1 of the Code and zone A of figure 5.1, it is essential that noise reduction measures are provided.

4.3 When sound insulating enclosures are fitted, it is important that they entirely enclose the noise source.

5 Reduction of noise in the aft body

To reduce the noise influence in the aft body of the ship, especially to the accommodation spaces, consideration may be given to noise emission problems during the design procedures relating to the aft body, propeller, etc.

6 Enclosure of the operator

6.1 In most machinery spaces it would be desirable and advisable to protect operating or watchkeeping seafarers by providing a sound reducing control room or other similar space (see paragraph 2.1 of this appendix).

6.2 In continuously manned machinery spaces of small ships and of existing ships where noise levels are in excess of 85 dB(A), it would be desirable to provide a noise refuge at the control station or manoeuvring platform where the watch keeper might be expected to spend the major part of the time.

7 Control of noise accentuation into accommodation spaces

7.1 To reduce noise levels in accommodation spaces it may be necessary to consider the isolation of deckhouses containing such spaces from the remaining structure of the ship by resilient mountings.

7.2 Consideration may also be given to the provision of flexible connections to bulkheads, linings and ceilings and the installation of floating floors within accommodation spaces.

7.3 The provision of curtains to side scuttles and windows and the use of carpets within accommodation spaces assist in absorbing noise.

8 Selection of machinery

8.1 The sound produced by each item of machinery to be fitted should be taken into account at the design stage. It may be possible to control noise by using a machine producing less airborne, fluid-borne or structure-borne sound.

8.2 Manufacturers should be requested to supply information on the sound produced by their machinery and also to provide recommended methods of installation in order to keep noise levels to a minimum.

9 Inspection and maintenance

All items of machinery, equipment and associated working spaces should be periodically inspected as part of the onboard safety management system with respect to any noise control/reduction features. Should such inspection reveal defects in the means for noise control, or other defects causing excessive noise, these should be rectified as soon as is practical.

10 Vibration isolation

10.1 Where necessary, machines should be supported on carefully selected resilient mountings. To ensure the effectiveness of the isolation, the mountings should be installed on a sufficient stiff foundation.

10.2 Where structure-borne sound from auxiliary machinery, compressors, hydraulic units, generating sets, vents, exhaust pipes and silencers produces unacceptable noise levels in accommodation spaces or on the navigating bridge, use of resilient mountings should be considered.

10.3 When sound insulating enclosures are fitted consideration may be given to the machine being resiliently mounted and pipe, trunk and cable connections to it being flexible.

11 Noise prediction

11.1 In the design phase of new ships, the designer/yard may predict by calculations, qualified assessments or the like, the expected noise levels in areas of the ship likely to have noise levels over acceptable levels from chapter 4.

11.2 The noise predictions referred to in paragraph 11.1 should be used in the design phase to identify possible areas in the ship where special consideration must be given to noise reduction measures in order to observe the noise level limits stipulated in section 4.2 of the Code.

11.3 The noise predictions and any noise reduction measures planned in the design phase should be documented, especially in cases where, according to the noise predictions, it must be expected that compliance with any of the noise level limits of section 4.2 of the Code will be difficult to achieve, despite reasonable technical initiatives.

12 Noise-cancelling equipment

12.1 Noise cancellation, also known as anti-noise, is the process whereby mostly low-frequency (below 500 Hz) repetitive noises such as made by engines and rotating machinery, is cancelled out by introducing a cancelling anti-noise signal which is equal to but 180 degrees out of phase with the noise. This anti-noise is introduced to the environment in a way that it matches the noise in the region of interest. The two signals then cancel each other out, effectively removing a significant portion of the noise energy from the environment.

12.2 Several applications for this technology exist. They include:

- .1 Active mufflers – have been shown in other modes of transportation to reduce exhaust noise from internal combustion engines, compressors, and vacuum pumps without the inefficiencies caused by back pressure.
- .2 Active mounts – these can contain vibration from rotating machines to improve comfort, decrease wear on moving parts, and reduce secondary acoustic noise from vibration.
- .3 Noise-cancelled quiet zones – currently silent seats and (automobile) cabin quieting systems for various modes of transportation exist. The possibility exists for producing active-quieted bunks of other spaces for seafarer comfort and recovery.
- .4 Noise-cancelling headsets – these can extend hearing protection beyond passive ear defenders to include low frequencies. Active headsets can also allow communication, by permitting normal conversation, and improve work place safety.

12.3 It is suggested that information concerning experience from these active noise-reducing systems be provided to the Organization to better evaluate the performance parameters of these systems.

13 Noise recovery areas

13.1 Incorporation of noise recovery areas may be used as an alternative design approach for the construction of ships under 1,600 GT or ice-breaking vessels. Noise recovery areas may also be considered for incorporation in ship-specific applications where noisy operations (examples are extended air/helicopter operations or heavy weather operation of dynamic positioning equipment) are undertaken for time periods over and above those of normal, routine seagoing practices. The use of these spaces should be integrated into ship safe operations policies under the ISM Code.

13.2 Noise recovery areas should be provided if no other technical or organizational solutions are feasible to reduce excessive noise from sound sources.

Appendix 4

SIMPLIFIED PROCEDURE FOR DETERMINING NOISE EXPOSURE

1 General

1.1 In order to ensure that seafarers will not be exposed to an $L_{ex}(24)$ exceeding 80 dB(A), this appendix is providing information on a simplified procedure for determining the related noise exposure.

1.2 The determination of noise exposure should be usually carried out based on ISO 9612:2009.

1.3 A simplified method based on the noise measurements during sea trial/harbour stay and a job profile for crew members is described in the following:

2 Work analysis/Job profiling and off-duty hours

2.1 With the help of a crew list, different job categories (groups) will be defined.

Example:

- Master
- Chief engineer
- Electrician
- Cook
- etc.

2.2 For each job category, a job profile has to be defined individually. The job profile is related to the work spaces on board the vessel.

Example:

- Wheelhouse
- Ship office
- Machinery control room
- Workshop
- Engine-room
- Galley
- etc.

2.3 For each job category, the working shift is to be divided into partitions (i) related to the work spaces. A similar assessment should be made for off-duty hours (the partitions are based on estimations by the owner/operator/employer).

Example:

A full day for an electrician may be divided into the following partitions:

i = 1	Workshop	=	$T_i = 5$ hours
i = 2	Machinery control room	=	$T_i = 2$ hours
i = 3	Ship office	=	$T_i = 2$ hours
i = 4	Engine-room	=	$T_i = 1$ hour
i = 5	Off-duty	=	$T_i = 14$ hours
	Total	=	$T_{total} = 24$ hours

3 Determination of estimated noise exposure levels

3.1 Based on the noise report and the estimated working times and off-duty hours for each job category, the noise exposure level can be calculated. It is assumed that the noise limits for cabins and recreation spaces according to this Code will not be exceeded. Using well-selected hearing protectors is recommendatory according to this Code. It is assumed that the maximum noise level of workers wearing hearing protectors does not exceed 85 dB(A).

3.2 The noise contribution from each space is calculated as follows:

$$L_{ex,24h,i} = L_{Aeq,i} + 10 \log(T_i/T_0)$$

where: T_i is the effective duration on board for each space
 T_0 is the reference duration 24 h
 $L_{Aeq,i}$ is the A-weighted equivalent continuous sound level for each space

3.3 The A-weighted noise exposure level is calculated from the noise contribution from each space as follows:

$$L_{ex,24h} = 10 \log \left(\sum_{i=1}^n 10^{\frac{L_{ex,24h,i}}{10}} \right)$$

Example: Result Sheet

Job category	Electrician	Location/Space						
		Navigating bridge	Ship Office	Machinery Control Room	Workshops	Engine-room	Galley	Off-duty
Measured A-weighted equivalent continuous sound level $L_{Aeq,i}$ [dB(A)]		64	63	75	84	85	72	60
Duration/Stay T_i [h]		0	2	2	5	1	0	14
Noise contribution $L_{ex,24h,i}$ [dB]		0	52.2	64.2	77.2	71.2	0	57.7
A-weighted noise exposure level $L_{ex,24h}$ [dB]	78.3							