第 38/2016 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二零零八年十二月四日透過第MSC.267（85）號決議通過了《2008年國際完整穩性規則》（2008年完穩規則），該規則自二零一零年七月一日起適用於澳門特別行政區；

基於此，行政長官根據第3/1999號法律《法規的公佈與格式》第六條第一款的規定，命令公佈包含上指規則的第MSC.267（85）號決議的中文及英文文本。

二零一六年五月十七日發佈。

行政長官　崔世安

Aviso do Chefe do Executivo n.º 38/2016

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 4 de Dezembro de 2008, o Comité de Segurança Marítima da Organização Marítima Internacional, através da resolução MSC.267(85), adoptou o Código Internacional de Estabilidade Intacta, 2008 (Código IS 2008), e que tal Código é aplicável na Região Administrativa Especial de Macau desde 1 de Julho de 2010;

O Chefe do Executivo manda publicar, nos termos do n.º 1 do artigo 6.º da Lei n.º 3/1999 (Publicação e formulário dos diplomas), a resolução MSC.267(85), que contém o referido Código, nos seus textos em línguas chinesa e inglesa.

Promulgado em 17 de Maio de 2016.

O Chefe do Executivo, *Chui Sai On*.

第 MSC.267（85）號決議

（2008 年 12 月 4 日通過）

通過《2008 年國際完整穩性規則》（2008 年完穩規則）

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 28（b）條，

還憶及經第 MSC.75（69）號決議修正的標題為“國際海事組織法律書涵蓋的所有類型船舶的完整穩性規則”的第 A.749（18）號大會決議，

認識到更新上述規則的必要性和制定強制性國際完整穩性要求的重要性，

注意到第 MSC.269（85）號決議和第 MSC.270（85）號決議，特別是委員會以這兩個決議分別通過了對經修正的《1974 年國際海上人命安全公約》（以下簡稱《1974 年安全公約》）和對《1966 年國際載重線公約 1988 年議定書》（以下簡稱《1988 年載重線議定書》）的修正案，使《2008 年國際完整穩性規則》的引言和甲部分的規定在《1974 年安全公約》和《1988 年載重線議定書》下具有強制性，

在其第 85 屆會議上**審議了**所建議的《2008 年國際完整穩性規則》文本，

1. **通過了**《2008 年國際完整穩性規則》（《2008 年完穩規則》），其正文列於本決議的附件；

2. **提請**《1974年安全公約》締約國政府和《1988年載重線議定書》當事國注意，《2008年完穩規則》將在《1974年安全公約》和《1988年載重線議定書》的各自修正案生效後於2010年7月1日生效；

3. **要求**秘書長將本決議及載於附件中的《2008年完穩規則》正文的核證無誤副本發給《1974年安全公約》的所有締約國政府和《1988年載重線議定書》的所有當事國；

4. **進一步要求**秘書長將本決議及其附件的副本發給非《1974年安全公約》締約國政府和非《1988年載重線議定書》當事國的本組織會員；

5. **建議**有關政府使用《2008年完穩規則》乙部分中的建議性規定作為相關安全標準的基礎，除非其國家的穩性要求至少規定了同等的安全水平。

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《2008年國際完整穩性規則》

（2008年完穩規則）

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序言

1 編輯本規則的目的是以現有的海事組織文書為主要依據，在一份獨立的文件中，提供關於完整穩性的強制性要求（引言和甲部分）和建議性條款（乙部分）。如果本規則中的建議與海事組織其他規則中所規定的不同，應以其他的規則為準。出於完整性以及方便用戶使用的考慮，本規則還包含了強制性海事組織文書中的相關規定。

2 本規則所包括的衡準以制訂時已有的最“先進”的概念為基礎，並考慮到了穩妥的設計和工程學原理和船舶運作中所取得的經驗。此外，由於現代船舶的設計技術在飛速發展，本規則不應一成不變，而應在必要時予以重新評價和修訂。為此，本組織將根據經驗和新的發展定期審議本規則。

3 許多方面的影響，例如死船狀態、風對有大受風面船舶的作用、橫搖特徵、惡劣海況等，均根據制訂本規則時的最新技術和知識被考慮在內。

4 人們認識到，鑑於船舶的類型和大小及其營運和環境條件的巨大差異，總的來說防止穩性事故的安全問題尚未解決。特別是，在海洋中航行的船舶的安全涉及到至今尚未得到充分探究和理解的複雜的流體力學現象。航行中船舶的運動應被作為一個動力系統對待，船舶與環境狀況（如波浪和風的干擾）之間的關係被公認為極其重要的因素。以流體力學因素和對航行中船舶的穩性分析為基礎來制訂穩性衡準是一個需要進一步研究的複雜問題。

引言

1 宗旨

1.1 本規則旨在提出強制性和建議性的穩性衡準及其他確保安全操作船舶的措施，最大限度地降低對這些船舶、船上人員以及環境構成的風險。本引言和規則的甲部分涉及強制性衡準，乙部分包含建議和附加的導則。

1.2 除非另行說明，本規則載有適用於長度為 24 米及以上的下列類型的船舶和其他海上運載工具：

.1 貨船；

.2 運輸木材甲板貨物的貨船；

.3 客船；

.4 漁船；

.5 特種用途船；

.6 近海供應船；

.7 移動式近海鑽井裝置；

.8 躉船；及

.9 甲板上裝載集裝箱的貨船和集裝箱船。

1.3 主管機關可以對新穎設計的船舶或本規則未作規定的船舶做出設計方面的補充要求。

2 定義

就本規則而言，下述定義適用。所用術語如未在本規則中界定，則經修訂的《1974年安全公約》中的定義適用。

2.1 *主管機關*係指船舶有權懸掛其國旗的國家的政府。

2.2 *客船*係指經修正的《1974年安全公約》第I/2條所界定的載運12名以上旅客的船舶。

2.3 *貨船*係指除客船、軍艦和運兵船、非機動船、原始方式建造的木船、漁船或移動式近海鑽井裝置以外的任何船舶。

2.4 *油船*係指主要為了在其貨物處所運載散裝油類而建造或改建的船舶，包括混裝船和《防污公約》附則II中界定的化學品船（當其載運的貨物全部或部分為散裝油類時）。

2.4.1 *混裝船*係指設計成既可散裝運輸油類又可散裝運輸固體貨物的船舶。

2.4.2 *原油船*係指從事原油運輸的油船。

2.4.3 *成品油船*係指從事原油以外油類運輸的油船。

2.5 *漁船*係指用於捕撈魚類、鯨、海豹、海象或其他海洋生物資源的船舶。

2.6 *特種用途船舶*係指《2008年特種用途船舶安全規則》（第MSC.266（84）號決議）中界定的特種用途船舶。

2.7 *近海供應船*係指主要從事向近海設施運輸補給品、材料和設備，為了在海上裝卸貨物，居住艙室和駕駛台建築物設計在船舶前部，後部設有露天貨物甲板的船舶。

2.8 *移動式近海鑽井裝置*（MODU 或鑽井裝置）係指能夠為勘探或開採液態或氣態的碳氫化合物、硫或鹽等海底資源而從事鑽井作業的船舶。

2.8.1 *柱穩式鑽井裝置*係指用支柱或沉箱將主甲板連接到水下殼體或樁靴上的鑽井裝置。

2.8.2 *水面式鑽井裝置*係指具有單體或多體結構的船型或駁船型排水船體，用於漂浮狀態下作業的鑽井裝置。

2.8.3 *自升式鑽井裝置*係指其活動樁腿能將船體升至海面以上的鑽井裝置。

2.8.4 *沿海國*係指對裝置的鑽井作業行使管理控制的國家政府。

2.8.5 *作業模式*係指鑽井裝置在就位或轉移過程中可能的作業或工作的狀態或方式。裝置作業模式包括以下：

.1 *作業狀態*係指一鑽井裝置為開展鑽井作業而就位，並且環境和運行的組合荷載處於為該種作業所確定的設計限制之內的狀態。裝置可以處於漂浮狀態或處於被支撐在海床上的狀態，視具體情況而定。

.2 *抗強風暴狀態*係指一鑽井裝置可能受到該裝置的設計最重環境荷載的狀態。由於環境荷載的嚴重性認定鑽井作業已被中斷，裝置可以處於漂浮狀態或處於被支撐在海床上的狀態，視具體情況而定。

.3 *轉移狀態*係指一鑽井裝置從一個地理位置移動到另一個地理位置的狀態。

2.9 *高速船*（HSC）係指最大航速，以米每秒（m/s）計，能夠等於或大於：

3.7*▽ $^{0.1667}$ 的船舶

其中▽為對應於設計水線的排水量（m^3）。

2.10 *集裝箱船*係指主要用於運輸海運集裝箱的船舶。

2.11 *乾舷*係指勘定的載重線與乾舷甲板之間的距離。

2.12 *船舶長度*。長度應取為量自龍骨上邊的最小型深 85%處水線總長的 96%，或沿該水線從首柱前邊至舵杆中心的長度，如其為大者。對於設計成有傾斜龍骨的船舶，計量本長度的水線應與設計水線平行。

2.13 *型寬*為船舶的最大寬度，對於金屬船殼的船舶，在船中量至兩舷肋骨型線，對於任何其他材料船殼的船舶，在船中量至船體兩舷的外表面。

2.14 *型深*為從龍骨板頂部量至乾舷甲板舷側處橫樑頂部的垂直距離。對木質和混合材料構造船舶，該距離從龍骨槽口的下邊緣量起。如船中剖面下部的形狀是凹形，或如裝有加厚的龍骨翼板，此距離從船底的平坦部分向內延伸線與龍骨側邊相交點量起。對於有圓弧形舷緣的船舶，型深應量至甲板和船側形線延伸的交點，即將舷緣視作方角設計。如乾舷甲板為階梯形且此甲板的升高部分延伸至超過確定型深的一點，型深應量至從該甲板較低部分延伸且與升高部分相平行的基準線。

2.15 *近岸航行*係指在一國海岸附近的航行，由該國主管機關確定。

2.16 *躉船*通常被視為：

.1 非自航；

.2 無配員；

.3 僅載運甲板貨物；

.4 方型系數為 0.9 或以上；

.5 寬/深比大於 3；以及

.6 除了用密封蓋封閉的小的人孔外，甲板上沒有艙口。

2.17 *木材*係指鋸成的木料或木材、木方、原木、木柱、紙漿木材或其他類型的鬆散或包裝木材。本術語不包括木紙漿或類似貨物。

2.18 *木材甲板貨物*係指在乾舷甲板或上層建築甲板無遮蓋的部分載運的木材貨物。本術語不包括木紙漿或類似貨物。

2.19 *木材載重線*係指為符合《1966 年國際載重線公約》或《1988 年載重線議定書》所規定的若干與其結構有關的條件的船舶所勘定的、在貨物符合《1991 年載運木材甲板貨物船舶安全操作規則》(第 A.715（17）號大會決議）的積載和繫固條件時使用的特殊載重線。

2.20 *傾斜試驗壓重驗證*係指對試驗壓重上標出的重量進行核實。試驗壓重應採用經核驗的磅秤予以證明。稱重應儘可能在接近傾斜試驗的時間進行，以確保所測重量的精確性。

2.21 *吃水*係指型基線至水線的垂直距離。

2.22 *傾斜試驗*涉及到移動一系列已知重量的壓重，通常是橫向移動，然後測量由此導致的船舶平衡傾角的變化。通過使用這些信息和應用基本造船學原理，確定船舶的垂直重心（VCG）。

2.23 *空載狀況*係指船舶在各方面均已完備，但船上沒有消耗品、物料、貨物、船員及其個人物品，除營運所需數量的機器和管道液體如潤滑劑和液壓劑外，船上沒有其他任何液體的狀況。

2.24 *空載檢驗*涉及在傾斜試驗時，對船上應增加、減少或重新定位的所有物品進行審核，以便能將觀察到的船舶狀況調整到空載狀況。應對每一物品的重量、縱向、橫向和垂向位置做出準確測定和記錄。使用這些信息、在船舶傾斜試驗時通過測量船舶的乾舷或經核證的吃水標記所確定的船舶靜浮水線、船舶的水靜力資料和海水密度，可確定空載排水量和縱向重心（LCG）。對移動式近海鑽井裝置（MODU）和中線不對稱或其內部佈置或舾裝的偏心重量會造成固有橫傾的其他船舶也可測定其橫向重心（TCG）。

2.25 *服役中傾斜試驗*係指為驗證預先計算的 *GM* 和實際裝載狀況下的載重重心而進行的傾斜試驗。

2.26 *穩性儀*係指安裝在某一特定船上的一台儀器，通過該儀器能夠確定在穩性手冊中規定的該船舶的穩性要求在任何營運裝載條件下均獲滿足。穩性儀包括硬件和軟件。

甲部分

強制性衡準

第 1 章 – 總則

1.1 適用範圍

1.1.1 本部分第 2 章下所規定的衡準給出了一系列最低要求，適用於長度為 24 米及以上的貨船和客船。

1.1.2 第 3 章下規定的衡準為某些類型船舶的特殊衡準。就甲部分而言，引言中的定義適用。

1.2 波浪中的動態穩性現象

主管機關須意識到，某些船舶在風浪中更容易遇到嚴重穩性狀況的危險。為解決此現象的嚴重後果，在設計中可能需要採取必要的防範措施。下文確定了航行中可能引起較大橫搖角和/或加劇的現象。

考慮到本節所描述的現象，主管機關可以對某一艘或一組特定船舶適用能表明船舶充分安全的衡準。適用此種衡準的任何主管機關應將有關細節通報給本組織。本組織認識到，需要制訂和實施以表現為目標的針對本節所列的已確定現象的衡準，以保證國際統一的安全水平。

1.2.1 *復原力臂的變化*

任何在波谷和波峰狀態時復原力臂變化大的船舶可能會出現參數橫搖或單純失去穩性或者出現兩種情況的組合。

1.2.2 *死船狀態下的共振橫搖*

失去推進和操舵能力的船舶在自由漂浮時可能會受到共振橫搖的危險。

1.2.3 *橫轉側面受風和其他與操縱有關的現象*

船舶在順浪或尾斜浪時可能無法保持穩定的航線，儘管使用最大操舵，此情況可能會導致最大橫傾角。

第 2 章－總體衡準

2.1 總則

2.1.1 所有衡準均須適用於乙部分第 3.3 和 3.4 款所列的所有裝載狀態。

2.1.2 在乙部分第 3.3 和 3.4 款所列的所有裝載狀態下均須考慮到自由液面效應（乙部分 3.1）。

2.1.3 如果船上裝有防搖裝置，主管機關須確認在防搖裝置工作時衡準能夠得以維持，供電故障或裝置故障不會導致船舶無法滿足本規則的相關規定。

2.1.4 許多因素，例如水線以上積冰、甲板上存水等，對穩性有不利影響。建議主管機關在其認為必要時，將這些影響考慮在內。

2.1.5 在航行的各個階段均須做出安排保持穩性的安全餘度，注意到重量的增加，如因吸水和積冰（關於積冰的細節見乙部分第 6 章－積冰的考慮）以及重量的減少，例如由於燃油和物料的消耗而造成的重量減少。

2.1.6 須為每艘船舶提供一份經主管機關批准的穩性手冊，手冊中載有能使船長按照本規則的適用要求操作船舶的充足信息（見乙部分，3.6）。如果為確定其符合相關穩性衡準而使用穩性儀作為穩性手冊的補充，該穩性儀須經過主管機關批准（見乙部分，第 4 章－用穩性儀進行穩性計算）。

2.1.7 如果使用最小營運穩心高度（GM）或最大重心高度（VCG）曲線或圖表來確保符合相關的完整穩性衡準，那些限制曲線須延伸到營運縱傾的全範圍，除非主管機關同意縱傾的影響不大。如果沒有最

小營運穩心高度（GM）或最大重心高度（VCG）對應於覆蓋全部營運縱傾吃水的曲線或圖表，船長必須驗證營運狀況沒有偏離經過研究的裝載狀況，或者通過計算驗證在考慮到縱傾的影響後對此裝載狀況的穩性衡準已得到滿足。

2.2 關於復原力臂曲線特性的衡準

2.2.1 復原力臂曲線（GZ 曲線）下的面積，在橫傾角 φ＝30°或以下時，不得小於 0.055 米－弧度，在橫傾角為 φ＝40°或以下或者浸水角 φ_f（如果該角小於 40°），不得小於 0.09 米－弧度。此外，當橫傾角在 30°和 40°之間或在 30°和 φ_f 之間（如果 φ_f 小於 40°），復原力臂曲線（GZ 曲線）下的面積不得小於 0.03 米－弧度。

2.2.2 在橫傾角等於或大於 30°時，復原力臂（GZ）須至少為 0.2 米。

2.2.3 最大復原力臂須出現在橫傾角不小於 25°時。如果這不現實，經主管機關批准後，可適用基於同等安全水平的替代衡準。

2.2.4 初始穩心高度 GM_0 不得小於 0.15 米。

2.3 強風和橫搖衡準（氣候衡準）

2.3.1 每一船舶承受橫風和橫搖的綜合效應的能力須參照圖 2.3.1 證明如下：

.1 船舶承受到垂直作用於船舶中心線的穩定風壓，產生穩定風傾側力臂（l_{w1}）；

.2 假定由於波浪的作用使船舶從合成平衡角（φ_0）迎風橫搖至橫搖角（φ_1）。穩定風的作用所造成的橫傾角（φ_0）不得超過 16°或甲板緣淹沒角的 80%，取小者；

.3 然後船舶受到陣風壓力，產生陣風傾側力臂（l_{w2}）；及

.4 在這些情況下，*b* 區域須等於或大於 *a* 區域；如下圖 2.3.1 所示：

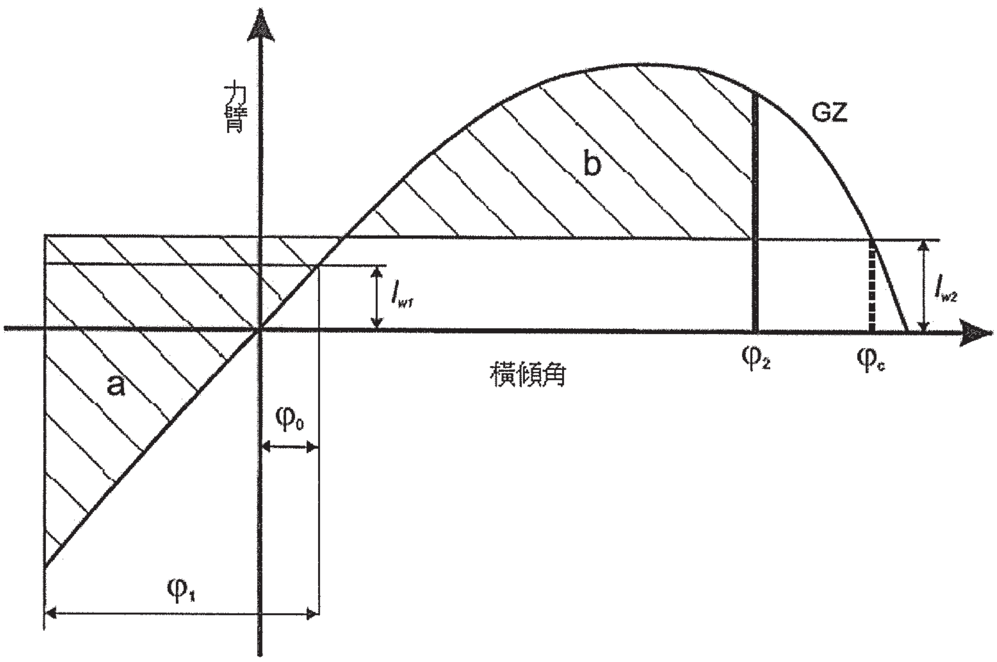


圖 2.3.1 強風和橫搖

圖 2.3.1 中各角的定義如下：

φ_0＝穩定風作用下的橫傾角

φ_1＝波浪作用下的迎風橫搖角（參見 2.3.1.2、2.3.4）

φ_2＝下向浸水角（φ_f）或 50°或 φ_c，取其小者，

其中：

φ_f＝不能關閉成風雨密的船體、上層建築或甲板室上的開口浸水時的橫傾角。在適用此衡準時，不會發生連續進水的小開口不必視為打開。

φ_c＝風壓橫傾力臂 l_{w2} 和 GZ 曲線間的第二截點角。

2.3.2 在 2.3.1.1 和 2.3.1.3 中所述的風壓橫傾力臂 l_{w1} 和 l_{w2} 為在任何傾斜角度時的恒定值並須按下式計算：

$$l_{w1} = \frac{P*A*Z}{1000*g*\Delta}(\text{米})\text{和}$$

$$l_{w2} = 1.5*l_{w1}(\text{米})$$

其中：

P＝504Pa 的風壓。經主管機關批准，對於在受限制區域內運營的船舶所用的 P 值可酌減

A＝船舶和甲板貨水線以上部分的投影側面積（m^2）

Z＝自 A 的中心至水下側面積的中心或至約一半吃水處的垂直距離（米）

Δ＝排水量（噸）

g＝重力加速度，取 9.81 米/秒 ^{2}

2.3.3 如令主管機關滿意，可以接受等效於第 2.3.2 款計算的確定風壓橫傾力臂（l_{w1}）的替代方式。如果開展此種替代試驗，須參照本組織制訂的導則。試驗中使用的風速須為 26m/s，全範圍均勻風速。對於在限制區域中營運的船舶使用的風速值可減少至令主管機關滿意的水平。

2.3.4 2.3.1.2 中所述橫搖角（φ_1）須按下式計算：

$$\varphi_1 = 109*k*X_1*X_2*\sqrt{r*s}(\text{度})$$

其中：

X_1＝表 2.3.4-1 中所示系數

X_2＝表 2.3.4-2 中所示系數

k＝下列系數：

對於無舭龍骨或立龍骨的圓舭型船舶，$k=1.0$

對於尖舭型船舶，$k=0.7$

對於有舭龍骨、立龍骨或兩者皆有的船舶，k 值見表 2.3.4-3

$r=0.73+0.6\ OG/d$

其中：

OG＝KG－d

d＝船舶平均型吃水（米）

s＝表 2.3.4-4 中所示系數，其中 T 係指船舶自然橫搖周期。在缺乏足夠的信息時，可使用下列近似公式：

橫搖周期 $$T=\frac{2*C*B}{\sqrt{GM}}(秒)$$

其中：

$$C = 0.373+0.023(B/d)-0.043(L_{wl}/100)。$$

表 2.3.4-1、2.3.4-2、2.3.4-3 和 2.3.4-4 及橫搖周期公式中的符號定義如下：

L_{wl}＝船舶水線長度（米）

B＝船舶型寬（米）

d＝船舶平均型吃水（米）

C_B＝方形系數（－）

A_k＝舭龍骨的總面積，或立龍骨的投影側面積，或這些面積之和（m^2）

GM＝按自由液面效應修正後的穩心高度（m）。

表 2.3.4-1 － X_1 系數值

B/d	X_1
≤2.4	1.0
2.5	0.98
2.6	0.96
2.7	0.95
2.8	0.93
2.9	0.91
3.0	0.90
3.1	0.88
3.2	0.86
3.4	0.82
≥3.5	0.80

表 2.3.4-2 － X_2 系數值

C_B	X_2
≤0.45	0.75
0.50	0.82
0.55	0.89
0.60	0.95
0.65	0.97
≥0.70	1.00

表 2.3.4-3 － *k* 系數值

$\frac{A_k \times 100}{L_{WL} \times B}$	k
0	1.0
1.0	0.98
1.5	0.95
2.0	0.88
2.5	0.79
3.0	0.74
3.5	0.72
≥4.0	0.70

表 2.3.4-4 － *s* 系數值

T	s
≤6	0.100
7	0.098
8	0.093
12	0.065
14	0.053
16	0.044
18	0.038
≥20	0.035

（這些表中的數據的中間值須通過線性內插法獲得）

2.3.5 2.3.4 中所述的表格和公式基於以下船舶的數據：

.1 *B/d* 小於 3.5；

.2 （*KG/d-1*）介於-0.3 和 0.5 之間；和

.3 *T* 小於 20s。

對於參數在以上限制之外的船舶，作為替代方法，橫傾角（φ_1）可通過對標的船舶的模型試驗通過 MSC.1/Circ.1200 號通函中所述的程序來確定。此外，如果主管機關認為合適，可以接受對任何船舶使用替代的確定方法。

第 3 章－某些類型船舶的特殊衡準

3.1 客船

客船須符合第 2.2 和 2.3 的要求。

3.1.1 此外，對於客船，當下文所界定的乘客集中在一舷時所產生的橫傾角不得超過 10°。

3.1.1.1 須假設每位乘客的最小重量為 75 千克，但經主管機關批准，此值可以增加。此外，行李重量和分佈須經主管機關批准。

3.1.1.2 乘客的重心高度須假設等於：

.1 站立的乘客，在甲板水平上 1 米。如必要可計入甲板的樑拱和舷弧；及

.2 坐着的乘客，在座位以上 0.3 米。

3.1.1.3 當評定是否符合 2.2.1 至 2.2.4 中的衡準時，須假定乘客和行李位於其通常可自行使用的處所。

3.1.1.4 當分別評定是否符合 3.1.1 和 3.1.2 中的衡準時，須假定不帶行李的乘客的分佈會產生在實際中可能出現的最不利的乘客傾側力矩和/或初穩心高度的組合。在這方面，沒有必要取值超過每平方米四人。

3.1.2 此外，在利用下列公式計算時，回轉產生的橫傾角不得超過 10°：

$$M_R = 0.200 * \frac{v_0^2}{L_{WL}} * \Delta * \left(KG - \frac{d}{2} \right)$$

其中：

M_R＝傾側力矩（千牛頓米）

v_o＝營運航速（米/秒）

L_{WL}＝水線處船長（米）

Δ＝排水量（噸）

d＝平均吃水（米）

KG＝重心在基線以上的高度（米）

3.2 5,000 載重噸及以上的油船

在引言第 2 節（定義）中所界定的油船須符合《73/78 年防污公約》附則 I 第 27 條的規定。

3.3 載運木材甲板貨的貨船

載運木材甲板貨的貨船須符合 2.2 和 2.3 的要求，除非主管機關認可適用第 3.3.2 示的替代方法。

3.3.1 適用範圍

下述規定適用於所有長度為 24 米及以上的從事運輸木材甲板貨物的船舶。標有並使用木材載重線的船舶還須符合《1966 年載重線公約》第 41 至 45 條以及其《1988 年議定書》的要求。

3.3.2 替代穩性衡準

對於載運木材甲板貨物的船舶，如果貨物縱向延伸於上層建築物之間（如船舶後端無限制性上層建築，則木材甲板貨物須至少延伸到最後艙口的後端），橫向延伸至在適當計入圓形舷緣的餘量後的整個船寬，圓形舷緣不超過船寬的 4%，並（或）固定住支撐立柱，使立柱在大橫傾角時仍能牢固地被固定住，則：

3.3.2.1 復原力臂曲線（GZ 曲線）下的面積，當傾側達到 φ＝40°或浸水角（如果此浸水角小於 40°）時，須不小於 0.08 米－弧度。

3.3.2.2 復原力臂（GZ）的最大值至少須為 0.25 米。

3.3.2.3 在航行中的任何時間，穩心高度 GM 不得少於 0.1 米，並慮及甲板貨物吸水和（或）暴露表面積冰情況（關於積冰的細節載於乙部分第 6 章（積冰的考慮））。

3.3.2.4 當決定船舶承受第 2.3 款所述的横風和横搖的組合影響的能力時，須符合在穩定風作用下的 16°傾斜角限制，但可以忽略附加的 80%甲板緣淹沒角。

3.4 散裝運輸穀物的貨船

從事穀物運輸的船舶的完整穩性須符合由第 MSC.23（59）號決議通過的《國際散裝穀物安全運輸規則》的要求。

3.5 高速船

引言第 2 節（定義）中定義的適用《1974 年海上人命安全公約》第 X 章的 1996 年 1 月 1 日或以後但在 2002 年 7 月 1 日前建造的高速船，須符合《1994 年高速船規則》（第 MSC.36（63）號決議）的穩性要求。《1974 年海上人命安全公約》第 X 章適用的任何高速船，無論其建造日期，如果經過重大修理、改裝或改造，以及 2002 年 7 月 1 日或以後建造的高速船，須符合《2000 年高速船規則》（第 MSC.97（73）號決議）的穩性要求。

乙部分

對某些類型船舶的建議和附加導則

第 1 章－總則

1.1 宗旨

規則本部分旨在：

.1 為確保某些類型船舶的安全營運，建議穩性衡準和其他措施，以最大限度地降低對這些船舶、船上人員和環境的風險；以及

.2 為穩性資料、防止傾覆的操作性規定、積冰的考慮、關於水密完整性的考慮和確定空載參數提供指導。

1.2 適用範圍

1.2.1 規則的本部分含有甲部分沒有包括的某些類型船舶和其他海上裝置的建議完整穩性衡準，或者旨在對甲部分的衡準就有關尺度和操作的特殊情況進行補充。

1.2.2 主管機關可以對新穎設計的船舶的設計方面或本規則未涵蓋的船舶做出附加要求。

1.2.3 如果沒有適用國家要求，本部分所述的衡準應為主管機關提供指導。

第 2 章－某些類型船舶的建議設計衡準

2.1 漁船

2.1.1 *適用範圍*

下述規定適用於引言第 2 節（定義）中界定的有甲板遠洋漁船。在 3.4.1.6 中規定的所有裝載狀況下均應符合下文 2.1.3 和 2.1.4 中規定的穩性衡準，除非主管機關認為通過營運取得的經驗證明可採用不同做法。

2.1.2 *防止傾覆的一般預防措施*

除在乙部分 5.1、5.2 和 5.3 中所述一般預防措施外，下述措施應作為有關影響安全的穩性問題的初步指南：

.1 所有漁具和其他重物應適當積載並放在船內儘可能低的位置；

.2 當漁具的拉力可能對穩性有不利影響時，例如當漁網由動力滑車拉起或拖網在海床上被障礙物掛住時，應特別謹慎；應從船舶水線以上的儘可能低的位置拉曳漁具；

.3 在甲板裝載捕獲物（例如：鯡魚）的漁船上，用於釋放甲板貨載的裝置應保持良好工作狀態；

.4 當攔魚板對主甲板作出分隔以運輸甲板貨載時，在它們之間應有適當尺寸的縫隙，使水易於流到舷牆排水口，以防止積水；

.5 為防止散裝的魚移動，應在艙中適當架設活動隔板；

.6 依賴自動舵可能是危險的，因為這樣會妨礙在壞天氣時可能需要的航向改變；

.7 在所有裝載狀況下，均應採取必要措施保持充足的乾舷，並且，在載重線的規定適用時，應在任何時候都嚴格遵守；和

.8 當漁具的拉力造成危險傾角時，應予特別注意。當漁具纏繞到水下障礙物或當操作漁具，特別是操作圍網時，或當拖網索中有一根被拉斷時，會發生這種情況。漁具在這種情況下造成的傾角可使用能減少或消除漁具拉力過度的裝置予以消除。這種裝置在非預期用途情況下使用時不應對船舶造成危險。

2.1.3 ***建議的一般衡準***

2.1.3.1 甲部分第 2.2.1 至 2.2.3 中規定的一般穩性衡準應適用於長度為 24 米及以上的漁船，但對單層甲板漁船所要求的初穩心高度 GM（甲部分，2.2.4）不應小於 0.35 米。對有完整上層建築或船長為 70 米及以上的船舶，初穩心高度可減至令主管機關滿意的程度，但在任何情況下不應小於 0.15 米。

2.1.3.2 由各國對其自己的各類和各級船舶規定出應用此基本穩性值的簡化衡準，是一種經濟地判斷穩性的實際並有價值的方法。

2.1.3.3 如果設有除舭龍骨以外的其他裝置來限制橫搖角度，主管機關應確認船舶在一切營運狀況下均保持 2.1.3.1 中所述的穩性衡準。

2.1.4 ***漁船的強風和橫搖衡準（氣候衡準）***

2.1.4.1 主管機關可對船長 45 米及以上的漁船適用甲部分 2.3 的規定。

2.1.4.2 對於長度介於 24 米和 45 米之間的漁船，主管機關可適用甲部分 2.3 的規定。也可以從下表中查取替代的風壓值（參見甲部分，2.3.2）：

h（米）	1	2	3	4	5	6 及以上
P（Pa）	316	386	429	460	485	504

其中 *h* 是水線以上船舶垂直投影區域中心至水線的垂直距離。

2.1.5 ***對長度小於 30 米的甲板漁船的臨時簡化穩性衡準的建議***

2.1.5.1 對長度小於 30 米的甲板船，應採用計算所有營運狀況下最小穩心高度 GM_{min}（米）的下述近似公式作為衡準：

$$GM_{\min} = 0.53 + 2B\left[0.075 - 0.37\left(\frac{f}{B}\right) + 0.82\left(\frac{f}{B}\right)^2 - 0.014\left(\frac{B}{D}\right) - 0.032\left(\frac{l_s}{L}\right)\right]$$

其中：

L 為在最大負載狀況水線處的船舶長度（米）

l_s 為延伸於船舶全寬的圍閉上層建築的實際長度（米）

B 為在最大負載狀況水線處的船舶最大寬度（米）

D 為在船中處從基線垂直量至舷側上甲板頂部的船舶深度（米）

f 為從舷側上甲板頂部垂直量至實際水線的最小乾舷（米）

公式適用於下述船舶：

.1 f/B 在 0.02 和 0.2 之間；

.2 l_s/L 小於 0.6；

.3 B/D 在 1.75 和 2.15 之間；

.4 船舶首尾的舷弧至少等於或超過《1966 年國際載重線公約》或經修訂的《1988 年議定書》（如適用）第 38（8）條中規定的標準舷弧；及

.5 計算中所包括的上層建築高度不小於 1.8 米。

對參數在上述限制值以外的船舶，應用上述公式時應特別謹慎。

2.1.5.2 上述公式並不是要取代在第 2.1.3 和 2.1.4 中規定的基本衡準，而是僅在判定特定船舶的穩性時沒有或得不出穩性橫交曲線、穩心高度 KM 曲線和相應的復原力臂 GZ 曲線的情況下使用。

2.1.5.3 穩心高度 GM 的計算值應與在所有裝載狀況下的船舶穩心高度 GM 實際值進行比較。如果使用基於估計排水量的傾斜實驗或另一種確定實際穩心高度 GM 的近似方法，則應在計算出的最小穩心高度 GM_{min} 上增加安全餘量。

2.2 躉船

2.2.1 *適用範圍*

下述規定適用於海洋躉船。被視為躉船者通常為：

.1 非自航；

.2 不配備人員；

.3 僅裝運甲板貨；

.4 方形系數為 0.9 或更大；

.5 寬/深比大於 3.0；及

.6 甲板上無艙口，但由密封蓋關閉的小人孔除外。

2.2.2 *穩性圖及計算*

下述為要求提交給主管機關批准的典型信息：

.1 線型圖；

.2 靜水力曲線；

.3 穩性橫交曲線；

.4 吃水和密度讀數以及空船排水量及縱向重心計算的報告；

.5 對假設垂直重心的合理性的說明；及

.6 簡化的穩性指導，例如裝載圖，以便躉船按照穩性衡準裝載。

2.2.3 *有關計算方式*

建議參照下述指導：

.1 不計甲板貨物的浮力（充分緊固的木材的浮力可適當考慮）；

.2 對吸水（如：木材）、貨物中積水（如：管子）和積冰等因素應予以考慮；

.3 在進行風力橫傾計算時：

.3.1 風壓應是恒定的，對一般作業而言，應被視為作用於延伸於貨物甲板長度上的一個具有假設高度的實體；

.3.2 貨物的重心應被假設在貨物高度的中點上，和

.3.3 風的力臂應取從甲板貨物的中心到平均吃水的一半處；

.4 應該對營運吃水的全範圍進行計算；以及

.5 下向進水角應取為可發生連續浸水的開口被浸沒時的角度。該開口不是由水密人孔蓋關閉的開口或裝有自由關閉裝置的通風孔。

2.2.4 ***完整穩性衡準***

2.2.4.1 至最大復原力臂角內的復原力臂曲線下的面積不應小於 0.08 米－弧度。

2.2.4.2 由 540 Pa（風速 30 米/秒）的均佈風荷載造成的靜橫傾角不應超過對應於有關裝載狀況的一半乾舷的角度，其中風力傾斜力臂的計量是從受風力面積的矩心至吃水的一半處。

2.2.4.3 穩性的最小範圍應是：

對於船長≤100 米：	20°；
對於船長≥150 米：	15°；
對兩者間的船長：	用內插法計算。

2.3 大於 100 米的集裝箱船

2.3.1 ***適用範圍***

這些要求適用於引言第 2 節（定義）中所定義的船長大於 100 米的集裝箱船。也可將其用於在此長度範圍內的有較大外張或有大的水線面面積的其他貨船。主管機關可以用下列衡準代替甲部分第 2.2 中的衡準。

2.3.2 *完整穩性*

2.3.2.1 復原力臂曲線（GZ 曲線）下面積在橫傾角至 $\varphi = 30°$時不應小於 0.009/*C* 米－弧度，在橫傾角至 $\varphi = 40°$或小於 40°的進水角 φ_f（如甲部分 2.2 所界定）時不應小於 0.016/*C* 米－弧度。

2.3.2.2 此外，復原力臂曲線（GZ 曲線）下面積在傾斜角 30°與 40°之間或在 30°與 φ_f（如該角小於 40°）之間不應小於 0.006/*C* 米－弧度。

2.3.2.3 在橫傾角等於或大於 30°時，復原力臂 GZ 應至少為 0.033/*C* 米。

2.3.2.4 最大復原力臂 GZ 應至少為 0.042/*C* 米。

2.3.2.5 至進水角 φ_f 的復原力臂曲線（GZ 曲線）下面積不應小於 0.029/*C* 米－弧度。

2.3.2.6 在上述衡准中，應使用下述公式和圖 2.3-1 計算形狀因數 *C*：

$$C = \frac{dD'}{B_m^2}\sqrt{\frac{d}{KG}\left(\frac{C_B}{C_W}\right)^2}\sqrt{\frac{100}{L}}$$

其中：

d=平均吃水（米）

D'=按艙口圍內定義部分的容積根據以下公式予以修正後的船舶型深：

$$D' = D + h\left(\frac{2b - B_D}{B_D}\right)\left(\frac{2\Sigma l_H}{L}\right),$$ 按圖 2.3-1 中規定；

D＝船舶型深（米）；

B_D＝船舶型寬（米）；

KG＝針對自由液面效應進行修正後的龍骨上的重心高度（米）；所取值不小於 d（米）；

C_B＝方形系數；

C_W＝水線平面系數；

l_H＝船中前後 L/4 內每個艙口圍的長度（米）（見圖 2.3-1）；

b＝船中前後 L/4 內艙口圍的平均寬度（米）（見圖 2.3-1）；

h＝船中前後 L/4 內艙口圍的平均高度（米）（見圖 2.3-1）；

L＝船長（米）；

B＝水線處船寬（米）；

B_m＝平均吃水一半處水線上的船寬（米）。

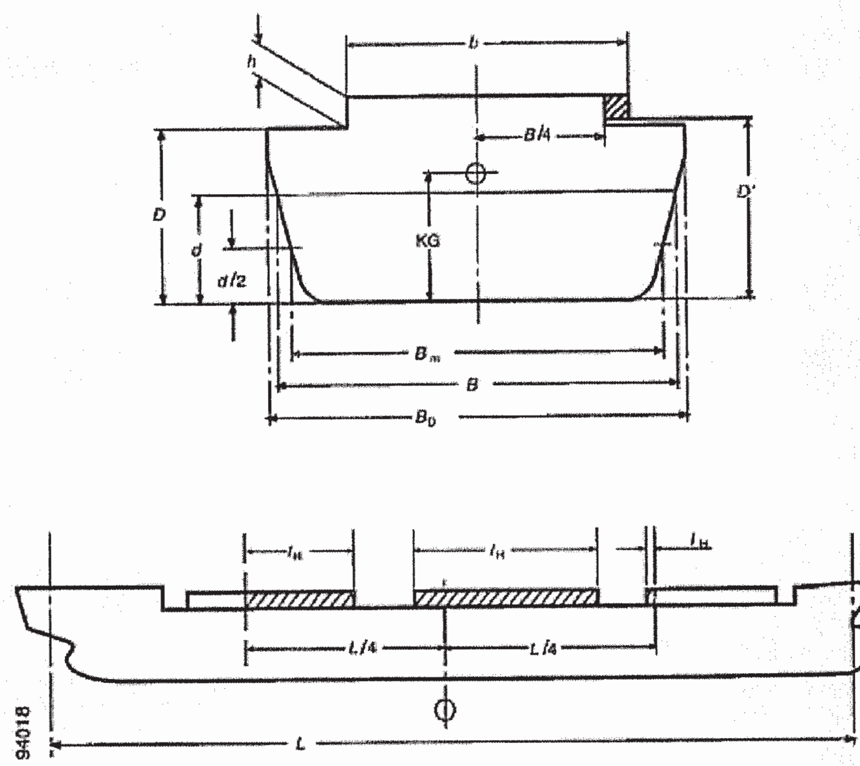


圖 2.3-1

圖 2.3-1 中的陰影面積代表被認定當船舶在波峰上的最大傾角時對抵抗傾覆有貢獻的部分容積。

2.3.2.7 在確定船舶在不同營運狀況下的縱傾和穩性時，鼓勵使用電子裝載和穩性儀。

2.4 近海供應船

2.4.1 *適用範圍*

2.4.1.1 以下規定適用於船長為 24 米及以上的、引言第 2 節（定義）中所界定的近海供應船。2.4.5 中的替代穩性衡準適用於船長不超過 100 米的船舶。

2.4.1.2 對“定義”一節中所界定的從事近岸航行的船舶，主管機關在制訂其國家標準時應以 2.4.2 中的原則為指南。對於在其沿岸附近從事近海航行的船舶，如果主管機關認為因其營運狀況使其符合該規則的規定不合理或不必要，則可允許對這些船舶放寬該規則的要求。

2.4.1.3 如果採用“定義”一節中所界定的近海供應船以外的船舶進行類似服務，主管機關應決定該船需符合本規則的規定的範圍。

2.4.2 ***有關近海航行的原則***

2.4.2.1 為本規則而對近海航行作出規定的主管機關，不應對從事此種航行的有權懸掛其他國家旗幟的船舶規定出比對有權懸掛其本國旗幟的船舶更為嚴格的設計和建造標準。在任何情況下，主管機關不應對有權懸掛其他國家旗幟的船舶規定出超出本規則對從事非近海航行船舶的規定。

2.4.2.2 對於定期在另一國沿岸附近從事近海航行的船舶，主管機關應對其規定至少等同於該船所航行海域的沿海國政府所規定的設計和建造標準。但此種標準不應超過本規則對從事非近海航行船舶的規定。

2.4.2.3 其航行超出近海航行之外的船舶應符合本規則。

2.4.3 ***防傾覆的構造性預防措施***

2.4.3.1 如可能，機器處所的入口應安排在船首樓內。從露天貨物甲板至機器處所的任何入口應配備有兩道風雨密關閉裝置。露天貨物甲板下處所的入口最好應位於上層甲板內或之上。

2.4.3.2 貨物甲板的舷側舷牆上的排水孔的面積應至少符合《1966 年國際載重線公約》或經修正的《1988 年議定書》（如適用）第 24 條的要求。對排水孔的佈置應給予細緻考慮，以確保最有效地排泄積存在管狀甲板貨物內或首樓後端凹進處的水。對在很可能會積冰的區域營運的船舶，排水孔中不應安裝任何擋板。

2.4.3.3 主管機關應根據船舶特性特別注意管子積載位置的充分排水。但為管子積載位置的排水所提供的排水孔面積應超過對貨物甲板舷牆中排水孔所要求的面積並不應裝有擋板。

2.4.3.4 從事拖帶作業的船舶應配備拖纜快速釋放裝置。

2.4.4 ***防傾覆操作程序***

2.4.4.1 甲板積載貨物的佈置應能避免對排水孔或對管子積載位置向排水孔排水的必要區域造成任何阻礙。

2.4.4.2 應在所有營運狀況下保持至少 0.005L 的船尾最小乾舷。

2.4.5 ***穩性衡準***

2.4.5.1 甲部分 2.2 中的穩性衡準應適用於所有近海供應船，但因其特性而使符合甲部分第 2.2 的規定為不可行者除外。

2.4.5.2 如果因船舶特性而使符合甲部分 2.2 的規定不可行時，應適用以下等效衡準：

.1 如果最大復原力臂（GZ）發生在傾角 15°，復原力臂曲線（GZ 曲線）下的面積在傾角 15°以內時不應小於 0.070 米－弧度，如果最大復原力臂（GZ）在 30°或以上傾角時發生，復原力臂曲線（GZ 曲線）下的面積在傾角 30°以內時應不小於 0.055

米－弧度。如果最大復原力臂發生在 15°和 30°之間，復原力臂曲線（GZ）下的對應面積應為：

$0.055 + 0.001 (30° - \varphi_{max})$ 米－弧度；

.2 復原力臂曲線下在傾角 30°和 40°之間或在 30°和 φ_f 角（如果 φ_f 角小於 40°）之間的面積應不小於 0.03 米－弧度；

.3 在傾角等於或大於 30°時，復原力臂（GZ）至少應為 0.20 米；

.4 最大復原力臂（GZ）發生時的傾角應不小於 15°；

.5 橫向初穩心高度（GM_o）應不小於 0.15 米；以及

.6 另參見甲部分 2.1.3 至 2.1.5 及乙部分 5.1。

2.5 特種用途船

2.5.1 ***適用範圍***

下述規定適用於不小於 500 總噸的、引言第 2 節（定義）中所界定的特種用途船。主管機關也可在合理且可行時將這些規定適用於小於 500 總噸的特種用途船。

2.5.2 ***穩性衡準***

特種用途船舶的完整穩性應符合甲部分第 2.2 中的規定，但乙部分第 2.4.5 中適用於近海供應船的替代衡準也可適用於具有類似設計和特性、長度小於 100 米的特種用途船舶。

2.6 移動式近海鑽井裝置（MODU）

2.6.1 ***適用範圍***

2.6.1.1 下述規定適用於在 1991 年 5 月 1 日或以後鋪放龍骨或處於類似建造階段的、引言第 2 節（定義）中所界定的移動式近海鑽井裝置。對此日期前建造的移動式近海鑽井裝置，應適用第 A.414（XI）號決議第 3 章的相應規定。

2.6.1.2 沿海國考慮到當地的環境狀況，可允許設計標準低於本章的任何鑽井裝置從事作業。但任何此種裝置應符合該沿海國認為適合其預定營運的安全要求，並確保該裝置和裝置上人員的總體安全。

2.6.2 *復原力矩和風壓傾側力矩曲線*

2.6.2.1 應考慮到最大數量的甲板貨物和設備處於適用的最不利位置繪製類似於圖 2.6-1 的復原力矩和風壓傾側力矩曲線，並附有覆蓋全部營運吃水範圍（包括轉移狀況的營運吃水）的計算。復原力矩曲線和風壓傾側力矩曲線應與最關鍵的軸線相關聯。應計入艙櫃內液體的自由液面。

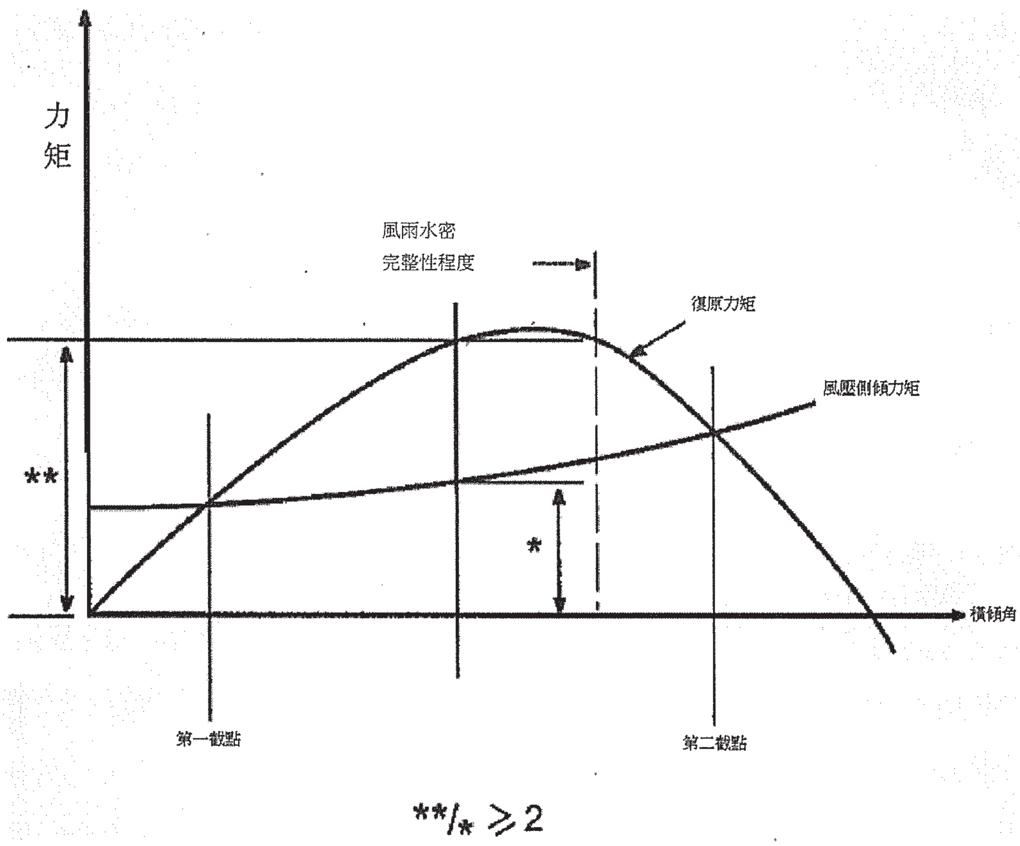


圖 2.6-1－復原力矩和風壓傾側力矩曲線

2.6.2.2 如果設備可以降下並積載，則可要求繪製附加的風壓傾側力矩曲線，並且這些數據應載明這種設備的位置。

2.6.2.3 風壓傾側力矩曲線應按以下公式求得的風力來繪製：

$$F = 0.5 * C_s * C_H * \rho * V^2 * A$$

式中：

F 係指風力（牛頓）

C_S 係指根據受風構件的形狀而確定的形狀系數（見表 2.6.2.3-1）

C_H 係指根據受風構件在海平面以上的高度而確定的高度係數（見表 2.6.2.3-2）

ρ 係指大氣密度（1.222 千克/米 ^{3}）

V 係指風速（米/秒）

A 係指在直立或傾側狀態時所有暴露表面的投影面積（米 ^{2}）。

表 2.6.2.3-1－系數 C_S 的值

形狀	C_S
球形	0.40
圓柱形	0.50
大的平面（船體、甲板室、平滑的甲板下區域）	1.00
鑽井架	1.25
鋼索	1.20
甲板下暴露的樑和桁	1.30
小部件	1.40
孤立形狀（起重機、樑等）	1.50
甲板室群或類似結構	1.10

表 2.6.2.3-2－系數 C_H 的值

海平面以上的高度（米）	C_H
0－15.3	1
15.3－30.5	1.1
30.5－46	1.2
46.0－61	1.3
61.0－76	1.37
76.0－91.5	1.43
91.5－106.5	1.48
106.5－122	1.52
122.0－137	1.56
137.0－152.5	1.6

152.5－167.5	1.63
167.5－183	1.67
183.0－198	1.7
198.0－213.5	1.72
213.5－228.5	1.75
228.5－244	1.77
244.0－256	1.79
256 以上	1.8

2.6.2.4 對於從任何方向作用於鑽井裝置的風力均應加以考慮，風速值如下：

.1 一般對於近海作業，在正常作業狀態下最小風速應取每秒 36 米（70 節）；強風暴狀態的最小風速應取每秒 51.5 米（100 節）；及

.2 如鑽井裝置限於在遮蔽區域（如湖泊、海灣、沼澤、河流等有掩護的內陸水域）作業，則正常作業狀態下可考慮將風速減至不小於每秒 25.8 米（50 節）。

2.6.2.5 在計算垂直平面的投影面積時，對由於橫傾或縱傾而造成的受風表面的面積，如甲板下面積等，應按適當的形狀系數計入。對於開式桁架，可大致取前後兩側實投影面積的 30%，即一側投影面積的 60%。

2.6.2.6 在計算風壓傾側力矩時，應取所有受風表面壓力中心至鑽井裝置水下結構體側向阻力中心的垂直距離為風壓傾覆力臂。應假定該鑽井裝置處於不受繫留約束的漂浮狀態。

2.6.2.7 風壓傾側力矩曲線應按能夠確定該曲線的足夠數量的橫傾角來計算。對於船形殼體，這一曲線可假定為按船體橫傾角的餘弦函數而變化。

2.6.2.8 對鑽井裝置具有代表性的模型進行風洞試驗所得出的風壓傾側力矩，可替代 2.6.2.3 至 2.6.2.7 中所述的方法。使用此種方法測定傾側力矩應包括在各個適用的橫傾角時的升力和拖力效應。

2.6.3 ***完整穩性衡準***

2.6.3.1 鑽井裝置在各種工況下的穩性應符合下列衡準（另見圖 2.6-2）：

.1 對於水面式和自升式鑽井裝置，復原力矩曲線之下至第二截點或浸水角範圍內的面積二者中的小者至少應比風壓傾側力矩曲線之下至同一限定角範圍內的面積大 40%；

.2 對於柱穩式鑽井裝置，復原力矩曲線之下至下向進水角範圍內的面積至少應比風壓傾側力矩曲線之下至同一限定角範圍內的面積大 30%；以及

.3 復原力矩曲線從平浮狀態至第二截點的所有角度範圍內均應為正值。

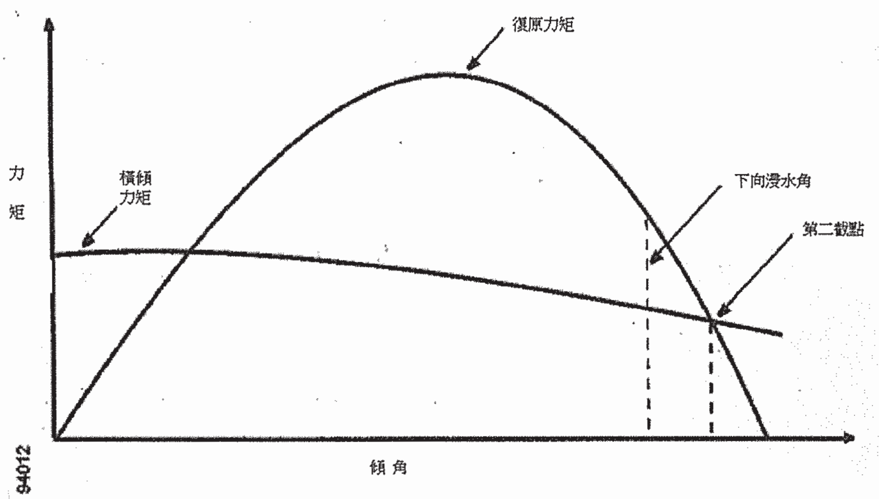


圖 2.6-2－復原力矩與傾側力矩曲線

2.6.3.2 每個鑽井裝置均應能在與氣象條件相一致的一定的時間內達到抗強風暴狀態。應將建議的操作程序和要求的大約時間載入 3.6.2 所述的操作手冊，這種操作程序和時間長度，既要考慮到作業狀態也要考慮到轉移狀態。應能夠在不需去掉或重新配置固體消耗品或其他可變負載的情況下達到抗強風暴狀態。但是，如果許可重心高度不超出要求，主管機關在下列條件下可允許鑽井裝置的負載超過須去掉或重新配置固體消耗品才能達到抗強風暴狀態的界限：

.1 處於年度或季節氣象狀況不會嚴重到需要鑽井裝置達到抗強風暴狀態的地理位置；或

.2 如果要求鑽井裝置短時期內支撐額外的甲板負載，而該時期在有良好氣象預報的時期內。

在操作手冊中應寫明允許這樣做的地理位置、天氣狀況和負載狀況。

2.6.3.3 只要能保持同等安全水平且已證實能夠提供足夠的初始正穩性，主管機關可以考慮替代的穩性衡準。在判定此種衡準是否可接受時，主管機關應至少考慮下列因素並視情選用：

.1 適合於全球範圍內營運的各種作業模式的代表現實的風（包括陣風）和浪的環境狀況；

.2 鑽井裝置的動態反應。分析應視情況包括風洞試驗、水波池模型試驗和非線性模擬的結果。使用的任何風浪譜應包括足夠的頻率範圍，以保證得到臨界運動響應；

.3 考慮到航行中的動態響應在內的進水可能性；

.4 考慮到鑽井裝置的恢復能量以及平均風速和最大動態響應引起的靜態傾斜，該裝置傾覆的可能性；及

.5 有足夠的安全餘量以應付各種不確定的情況。

第 2.6.4 節中列出了半潛雙浮箱柱穩式鑽井裝置完整穩性替代衡準的示例。

2.6.4 ***半潛雙浮箱柱穩式鑽井裝置完整穩性替代衡準的示例***

2.6.4.1 下文給出的衡準僅適用於在下列參數範圍內的抗強風暴狀態下的半潛雙浮箱柱穩式鑽井裝置：

V_p/V_t 在 0.48 至 0.58 之間

$A_{wp}/(V_c)^{2/3}$ 在 0.72 至 1.00 之間

$I_{wp}/[V_c*(L_{ptn}/2)]$ 在 0.40 至 0.70 之間

上述公式中使用的參數在第 2.6.4.3 段中有定義。

2.6.4.2 完整穩性衡準

鑽井裝置在倖存作業模式下的穩性應符合下列衡準。

2.6.4.2.1 傾覆衡準

這些衡準基於倖存吃水狀況下按本規則第 2.6.2 節所示方法計算得到的風壓傾側力矩和復原力矩曲線。儲備能量面積‘B’必須大於或等於圖 2.6-3 中所示的動態響應面積‘A’的 10%。

面積‘B’/面積‘A’≥0.10

式中：

面積‘A’為從 φ_1 至（φ_1+1.15*φ_{dyn}）測得的復原力臂曲線下的面積

面積‘B’為從（φ_1+1.15*φ_{dyn}）至 φ_2 測得的復原力臂曲線下的面積

φ_1 為與 100 節風力矩曲線的第一個截距

φ_2 為與 100 節風力矩曲線的第二個截距

φ_{dyn} 為波浪和不定風造成的動態響應角

φ_{dyn}＝（10.3+17.8*C）/（1+GM/（1.46+0.28*BM））

$C=(L_{ptn}{}^{5/3}*VCP_{wl}*A_w*V_p*V_c{}^{1/3})(I_{wp}{}^{5/3}*V_t)$

上述公式中使用的參數在第 2.6.4.3 段中有定義。

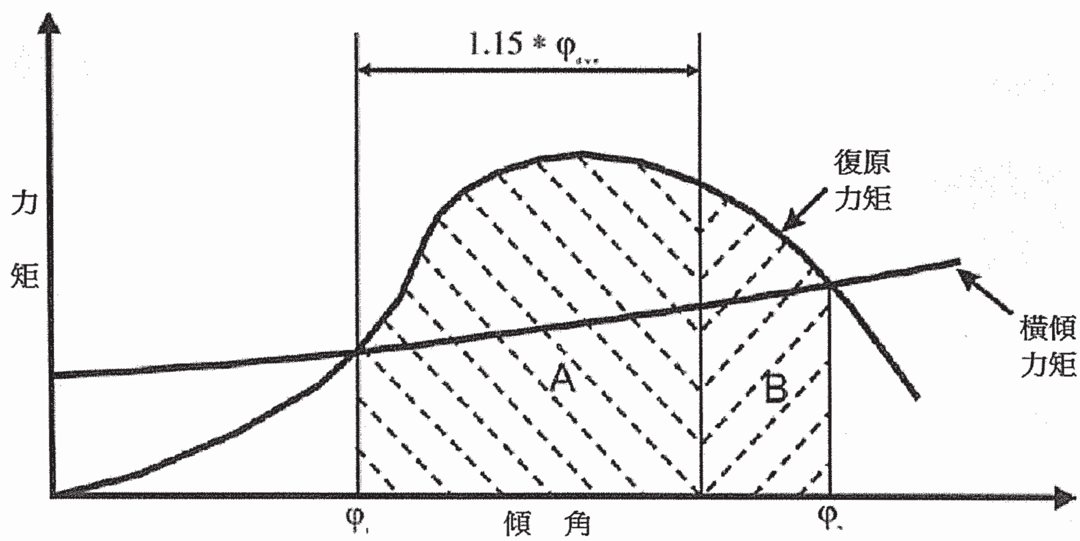


圖 2.6-3－傾側力矩和復原力矩曲線

2.6.4.2.2 下向進水衡準

這些衡準基於鑽井裝置的物理尺寸以及生存吃水狀況下量得的鑽井裝置相對於 75 節風造成的靜態傾側的運動。初始下向浸水距離（DFD_0）應大於圖 2.6-4 中所示的生存吃水狀況下的下向浸水距離的減小值。

$DFD_0 - RDFD > 0.0$

式中：

DFD_0 為至 D_m 的初始下向浸水距離（米）

RDFD 係下向浸水距離的減小值（米）等於 SF（$k*QSD_1+RMW$）

SF 等於 1.1，該數值為考慮到分析中不確定因素（例如非線性效應）後的安全系數，

k （相關系數）等於：

$0.55+0.08*(a-4)+0.056*(1.52-GM)$；

（GM 取值不可大於 2.44 米）

a 等於（FBD_0/D_m）*（$S_{ptn}*L_{cc}$）/A_{wp}

（a 取值不可小於 4）

QSD_1 等於 DFD_0 減去在 φ_1 處的準靜力下向浸水距離（米），但取值不可小於 3 米

RMW 係波浪引起的相對於 φ_1 的運動（米），等於 $9.3+0.11*(X-12.19)$

X 等於 $D_m*(V_t/V_p)*(A_{wp}^2/I_{wp})*(L_{ccc}/L_{ptn})$

（X 取值不可小於 12.19 米）

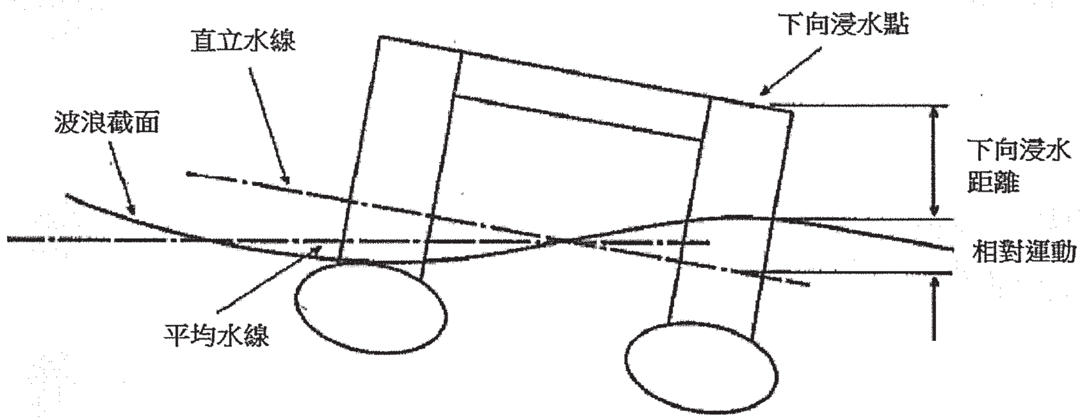


圖 2.6-4－下向浸水距離和相對運動的定義

上述公式中使用的參數在第 2.6.4.3 段中有定義。

2.6.4.3 幾何參數

A_{wp} 為倖存吃水狀況下的水線面面積，適用時包括拉緊件效應在內（m^2）。

A_w 為鑽井裝置在正立狀況下的有效風壓面積（即投影面積、形狀系數和高度系數的積）（m^2）。

BM 為鑽井裝置在正立狀況下從穩心至浮心的垂直距離（m）。

D_m 為初始倖存吃水（m）。

FBD_0 是從 D_m 至舷側上部暴露風雨密甲板頂點的垂直距離（m）。

GM 對於第 2.6.4.2.1 段，GM 為在橫搖軸線或對角軸線上測得的穩心高度，取其中得出最小儲備能量比‘B’/‘A’者。該軸線通常是對角軸線，因為從特性上說，它具有更大的風壓投影面積，影響到上述的三個特性角。

GM 對於第 2.6.4.2.2 段，GM 為在提供最小下向浸水距離餘量的軸線上測得的穩心高度（即通常在得出最大 QSD_1 的方向）（m）。

I_{wp} 為在倖存吃水狀況下的水線面第二慣性矩，適用時包括拉緊件的效應在內（m^4）。

L_{ccc} 為腿柱中心之間的縱向距離（m）。

L_{ptn} 是每一浮箱的長度（m）。

S_{ptn} 是浮箱中心線之間的橫向距離（m）。

V_c 為從浮箱頂部至柱結構的頂部的所有柱子的總容積，但任何包括在上甲板中的容積除外（m^3）。

V_p 為兩個浮箱的總合併容積（m^3）。

V_t 為鑽井裝置產生浮力的各個結構（浮箱、柱子和拉緊裝置）的總容積，從鑽井裝置的基線至柱結構的頂部，但任何包括在上甲板中的容積除外（m^3）。

VCP_{w1} 為 D_m 以上的風壓垂直中心（m）。

2.6.4.4 傾覆衡準評定表

輸入數據

GM .... = ... m

BM... = ... m

VCP_{w1} .... = ... m

A_w.. = ... m^2

V_t .... = ... m^3

V_c .... = ... m^3

V_p .... = ... m^3

I_{wp} .... = ... m^4

L_{ptn} .... = ... m

確定：

φ_1 .... = ... 度

φ_2 .... = ... 度

$C=(L_{ptn}^{5/3}*VCP_{w1}*A_w*V_p*V_c^{1/3})/(I_{wp}^{5/3}*V_t)$ = ... m^{-1}

$\varphi_{dyn}=(10.3+17.8C)/(1.0+GM/(1.46+0.28BM))$ .... = .. 度

面積 ‘A’ .... = ...m-度

面積 ‘B’ .... = ...m-度

結果　　儲備能量比：

‘B’ / ‘A’ =...................... （最小值＝0.1）

GM =..................m（KG＝.........m）

註：最小 GM 為 ‘B’ / ‘A’ 比＝0.1 者。

2.6.4.5 下向浸水衡準評定表

輸入數據

DFD_0 .... = ...m

FBD_0 .... = ...m

GM .... = ...m

D_m .... = ...m

V_t .... = ...m^3

V_p .... = ...m^3

A_{wp} .... = ...m^2

I_{wp} .... = ...m^4

L_{ccc} .... = ...m

L_{ptn} .... = ...m

S_{ptn} .... = ...m

SF .... = 1.1

確定：

φ_1 ....= ....度

DFD_1 ……………………………………… = ….m

$QSD_1 = DFD_0 - DFD_1$…………………… = ….m

a=（FBD_0/D_m）*（$S_{ptn}*L_{ccc}$）/A_{wp}…… = ….（$a_{min}=4$）

k=0.55+0.08*(a-4)+0.056*(1.52-GM). = ….m(GM_{max}=2.44m)

X=D_m*(V_t/V_p)*(A_{wp}^2/I_{wp})(L_{ccc}/L_{ptn}).. = ….m(X_{min}=12.19m)

RMW=9.3+0.11*（X－12.19）………. = ….m

RDFD=SF*（k*QSD_1+RMW）………. = ….m

結果　下向浸水餘量：

DFD_0－RDFD=…………..（最小值＝0.0m）

GM=……………...m（KG＝……...m）

註：最小 GM 為下向浸水餘量＝0.0m 者。

第 3 章－關於準備穩性資料的指導

3.1 液艙內液體的自由液面效應

3.1.1 對於所有裝載狀況，初穩心高度和復原力臂曲線應按液艙中液體的自由液面效應進行修正。

3.1.2 當液艙內的裝載水平低於全滿狀況的 98%時，應考慮到自由液面效應。當液艙名義上充滿時，即裝載水平達到 98%或以上，不需考慮自由液面效應。在 3.1.12 規定的情況下，可忽略小液艙的自由液面效應。

但是對於名義上充滿的貨艙應進行 98%的裝載水平自由液面效應的修正。在進行修正時，對初穩心高度的修正應基於液體表面在橫傾角為 5°時的慣性力矩除以排水量。對於復原力臂的修正建議基於液體貨物的實際移動力矩。

3.1.3 在確定自由液面修正時所考慮的液艙可能屬於以下兩類情況之一：

.1 裝載水平不變的液艙（如液貨艙、壓載水艙）。應在每一液艙內根據實際的裝載情況確定自由液面修正；或者

.2 裝載水平變化的液艙（如可消耗液體例如燃油、柴油和淡水，以及在液體轉移操作期間的液體貨物和壓載水）。除 3.1.5 和 3.1.6 中允許的情況外，應根據每一液艙中的與任何操作要求一致的預期裝載限制之內能夠取得的最大修正值的情況確定自由液面修正。

3.1.4 在計算裝有可消耗液體的自由液面效應時，應假設每種液體至少橫向的一對或一個中線液艙存在自由液面，所考慮的液艙或液艙組合應為自由液面效應最大者。

3.1.5 如果壓載水艙，包括防搖液艙和防傾液艙，將在航行途中充裝或排放，自由液面的計算應考慮到與此種作業有關的最危險的瞬時階段。

3.1.6 對於從事液體轉移作業的船舶，在液體轉移作業的任何階段的自由液面修正可根據在該轉移作業階段每一液艙的裝載水平來確定。

3.1.7 對初穩心高度的修改和對復原力臂曲線的修改應按下述分別進行。

3.1.8 在確定初穩心高度時，液艙的橫向慣性力矩應在傾角為 0°時根據 3.1.3 中所述的類別計算得出。

3.1.9 復原力臂曲線可在主管機關同意下，根據以下任何方法進行修正：

.1 基於計算出的每個傾角的實際液體移動力矩進行修正；或

.2 基於在 0°傾角時計算出並根據所計算的每個傾角作調整的慣性力矩進行修正。

3.1.10 可根據 3.1.2 中給出的類別計算修正值。

3.1.11 無論選擇那一方法來修正復原力臂曲線，在船舶的穩性手冊中只應列出該種方法。但是，如果還介紹了替代方法用於人工計算裝載狀況，還應包括對結果中可能出現的不同的解釋，以及每種方法的修正示例。

3.1.12 滿足下列對應於 30°傾角的條件的小液艙不必包括在修正之中：

M_{fs}/Δ_{min}<0.01m

其中：

M_{fs} 自由液面力矩（mt）

Δ_{min} 為在吃水 d_{min}（t）時計算所得船舶最小排水量

d_{min} 為船舶未裝貨物，裝有 10%物料和所需的最小壓載時的平均最小服務吃水（m）。

3.1.13 在計算修正時不必考慮通常在空艙中的剩餘液體，條件是剩餘液體的總量不會造成嚴重的自由液面效應。

3.2 永久性壓載

如果使用永久性壓載，其位置應符合主管機關批准的佈置並防止其移動位置。未經主管機關同意，不應將永久性壓載去掉或移動其位置。永久性壓載的細節應記錄在船舶的穩性手冊中。

3.3 對符合穩性衡準的評定

3.3.1 除非本規則中另有規定，就總體評定是否符合穩性衡準而言，應按船舶所有人對船舶營運預計的裝載狀況、運用本規則中給出的假設繪製穩性曲線。

3.3.2 如果船舶所有人未提供有關這些裝載狀況的充足的細節資料，應按標準裝載狀況進行計算。

3.4 需校核的標準裝載狀況

3.4.1 *裝載狀況*

本規則條文中所述標準裝載狀況如下。

3.4.1.1 對於客船：

.1 船舶滿載離港，裝有貨物、全部備品和燃料及全部乘客及其行李；

.2 船舶滿載抵港，裝有貨物、全部乘客及其行李，但僅有 10%的剩餘備品和燃料；

.3 船舶未裝貨物，但裝有全部備品和燃料和全部乘客及其行李；以及

.4 船舶處於上述.3 的同樣情況，但僅有 10%剩餘備品和燃料。

3.4.1.2 對於貨船：

.1 船舶滿載離港，所有貨物處所均勻裝載貨物，並裝有全部備品和燃料；

.2 船舶滿載抵港，所有貨物處所均勻裝載貨物，但僅有 10%剩餘備品和燃料；

.3 船舶壓載離港，未裝貨物，但裝有全部備品和燃料；以及

.4 船舶壓載抵港，未裝貨物，且僅有 10%剩餘備品和燃料。

3.4.1.3 對於擬載運甲板貨物的貨船：

.1 船舶滿載離港，貨物均勻分佈於各艙並在甲板上裝有規定體積和重量的貨物，還裝有全部備品和燃料；以及

.2 船舶滿載抵港，貨物均勻分佈於各艙並在甲板上裝有規定體積和重量的貨物，還裝有 10%的備品和燃料。

3.4.1.4 對於擬載運木材甲板貨的船舶：

載運木材甲板貨的船舶應予考慮的裝載條件在第 3.4.1.3 中規定。木材甲板貨物的積載應符合《1991 年載運木材甲板貨船舶安全操作規則》（第 A.715（17）號大會決議）第 3 章的規定。

3.4.1.5 對於近海供應船舶，標準裝載狀況應為如下：

.1 船舶滿載離港，裝載的貨物分佈在甲板下並在甲板上規定的位置裝有規定重量的貨物，還裝有全部備品和燃料，對應於符合所有相關穩心衡準的最不利營運狀況；

.2 船舶滿載抵港，載貨與 3.4.1.5.1 相同，但裝有 10%的備品和燃料；

.3 船舶壓載離港，未裝貨物，但裝有全部備品和燃料；

.4 船舶壓載抵港，未裝貨物，且僅裝有 10%剩餘備品和燃料；以及

.5 船舶處於預期最不利的運營狀況。

3.4.1.6 對於漁船，2.1.1 中所述的標準裝載狀況如下：

.1 離港開往漁場，裝有全部燃料、備品、冰、漁具等；

.2 離開漁場，裝有全部捕獲物和主管機關同意的一定百分比的備品、燃料等；

.3 抵達基地港，裝有 10%的剩餘備品、燃料等以及全部捕獲物；以及

.4 抵達基地港，裝有 10%的剩餘備品、燃料等以及最低數量的捕獲物，其數量通常為全部捕獲物的 20%，但如果主管機關認為該漁船的運營方式證明合理的話，也可能高達 40%。

3.4.2 ***計算裝載狀況的假設***

3.4.2.1 對於在 3.4.1.2.1、3.4.1.2.2、3.4.1.3.1 和 3.4.1.3.2 中所述滿載狀況，如一艘乾貨船有液貨艙，則上述裝載狀況的有效載重量應根據兩種假設來分配，即液貨艙滿載和液貨艙空載。

3.4.2.2 在 3.4.1.1.1、3.4.1.2.1 和 3.4.1.3.1 中所述狀況中，應假設船舶裝載至分艙載重線或夏季載重線，或如果將載運木材甲板貨物，裝載至夏季木材載重線，壓載水艙空載。

3.4.2.3 如果在任何裝載狀況下需有壓載水，應計算出計及壓載水的附加曲線圖。應說明壓載水的數量和配置。

3.4.2.4 在所有情況下，均假設貨艙中貨物為完全均勻，除非這種狀況與實際營運不一致。

3.4.2.5 在所有情況下，在載運甲板貨物時，應假設現實的積載重量，包括貨物高度，並應予說明。

3.4.2.6 考慮到木材甲板貨，在計算 3.4.1.4 中所述的裝載狀況時應做出以下假設：

.1 貨物和壓載量應對應於滿足甲部分 2.2 中的所有相關穩性衡準或滿足甲部分 3.3.2 中給出的替代衡準的最不利營運狀況。在抵港狀況下，應假設由於吸水甲板貨物重量增加了 10%。

3.4.2.7 對於近海供應船，計算裝載狀況假設應如下述：

.1 如船舶設有液貨艙，3.4.1.5.1 和 3.4.1.5.2 的滿載狀況應予修改，先假設液貨艙滿載，再假設液貨艙空載；

.2 如果在任何裝載狀況下需有壓載水，應計算出計及壓載水的附加曲線圖，壓載水的數量和配置應在穩性資料中說明；

.3 在裝載甲板貨物的所有情況下，應假設實際的積載重量並在穩性資料中予以說明，包括貨物的高度及其重心；

.4 如果在甲板上裝載管子，應假設在管子之中和周圍的積水量等於管子甲板貨物淨體積的某一百分比。淨體積應是管子內體積加上管子間體積。如果船中乾舷等於或小於 0.015L，該百分比應為 30；如船中乾舷等於或大於 0.03L，則百分比為 10。對船中乾舷的中間值，可用線性內插法得到該百分比。在估算積水量時，主管機關可考慮到船尾的正舷弧或負舷弧、實際縱傾和營運區域；或

.5 如船舶在可能發生結冰的區域營運，應按第 6 章（積冰的考慮）的規定做出結冰的餘量。

3.4.2.8 對於漁船，計算裝載狀況的假設應如下述：

.1 應計及甲板上的濕漁網和濕索具等的重量；

.2 在預計會發生結冰時，應按照 6.3 的規定計及積冰情況；

.3 在所有情況下應假定貨物是均勻分佈的，除非這與實際不符；

.4 如預計有甲板貨物時，3.4.1.6.2 和 3.4.1.6.3 中所述狀況應包括甲板貨物；

.5 通常僅應包括專用壓載水艙中的壓載水。

3.5 穩性曲線的計算

3.5.1 *總則*

應為營運裝載狀況的縱傾範圍繪製靜水力曲線和穩性曲線，並應考慮到由於橫傾而導致的縱傾變化（自由縱傾靜水力學計算）。該計算應考慮到至甲板覆蓋層上表面的體積。此外，在計算靜水力和穩心交叉曲線時，還需考慮到附屬體和海底閥箱。如果存在左右舷不對稱的情況，應採用最不利的復原力臂曲線。

3.5.2 *可能需要考慮的上層建築、甲板室等等*

3.5.2.1 符合《1966 年載重線公約》及其經修正的《1988 年議定書》第 3（10）（b）條的圍閉上層建築可考慮在內。

3.5.2.2 更多層數的類似圍閉上層建築也可考慮在內。作為指導，第二層以上的其他層如果計入浮力，這些層上的窗子（窗格玻璃和窗框）若無舷窗蓋，其設計強度應能承受一個相對於周圍結構所要求強度的安全餘度。

3.5.2.3 乾舷甲板上的甲板室可計入，條件是他們要符合《1966 年載重線公約》及其經修正的《1988 年議定書》第 3（10）（b）條規定的圍閉上層建築的條件。

3.5.2.4 如甲板室符合上述條件，但沒有通向上面甲板的額外出口，此種甲板室不應計入；但是這些甲板室內部的任何甲板開口即使未裝設關閉裝置也應視為是關閉的。

3.5.2.5 門不符合《1966 年載重線公約》及其經修正的《1988 年議定書》第 12 條要求的甲板室不應計入；但是如果甲板室內部的任何甲板開口的關閉裝置符合《1966 年載重線公約》及其經修正的《1988 年議定書》第 15、17 或 18 條的要求，這些開口應視為是關閉的。

3.5.2.6 乾舷甲板以上的甲板上的甲板室不應計入，但其內部的開口可被視為是關閉的。

3.5.2.7 但是，不被視為圍閉的上層建築和甲板室，在到其開口浸水角之前可計入穩性計算（在開口浸水角，靜穩性曲線應出現一個或數個階梯狀，在其後計算中，浸水處所應被視為不存在）。

3.5.2.8 如果船舶因任何開口浸水會沉沒，穩性曲線應在相應浸水角處截止，船舶應被認為已完全失去穩性。

3.5.2.9 小的開口，如供鋼纜或錨鏈、索具和錨穿過者，以及流水孔、排放和衛生管道孔，如果它們在傾角大於 30°時被水淹沒，則不應被視作是打開的。如它們在等於或小於 30°傾角時被水淹沒，如果主管機關認為這是一個嚴重進水源，這些開口應被假定為是打開的。

3.5.2.10 圍壁可被考慮在內。在考慮到艙口關閉設備的有效性後，艙口也可計入。

3.5.3 ***載運木材甲板貨物的船舶的穩性曲線計算***

除上述規定者以外，主管機關還可允許計入甲板貨的浮力，假定這種

貨物的滲透率為這些貨物所佔體積的 25%。如果主管機關認為必須調查甲板貨物的不同滲透率和（或）假定的有效高度的影響，可要求附加的穩性曲線。

3.6 穩性手冊

3.6.1 穩性資料和有關圖紙應以船上的工作語言和主管機關可能要求的任何其他語言寫成。另參見本組織以第 A.741（18）號大會決議通過的《國際安全管理規則》。穩性手冊的所有譯文應經過批准。

3.6.2 應為每艘船舶提供經主管機關批准的穩性手冊，它應載有能使船長按照本規則內的適用要求操作船舶的充足信息。主管機關還可提出附加要求。在移動式近海鑽井裝置上，穩性手冊可被稱為操作手冊。穩性手冊可包括縱向強度的信息。本規則只涉及手冊中與穩性有關的內容。

3.6.3 對於載運木材甲板貨的船舶：

.1 應提供考慮到木材甲板貨物的全面穩性資料。這些資料應使船長能迅速簡便地獲得船舶在不同營運條件下的穩性的準確指導。已經證明，全面的橫搖周期表或圖對確定實際穩性狀況非常有幫助；

.2 當甲板貨物的滲透率與 25%有顯著差別時，主管機關可認為有必要向船長提供信息說明甲板貨物與所示裝載狀況的不同（參見 3.5.3）；以及

.3 標明的條件應指出，在慮及營運中可能會出現的最輕積載率的情況下，甲板貨物的最大許可數量。

3.6.4 穩性手冊的格式和所載資料將視船型和營運而有所不同。在制訂穩性手冊時，應考慮包括下述資料：

.1 對船舶的總體描述；

.2 手冊使用須知；

.3 表明水密艙室、圍壁、通風口、下向浸水角、固定壓載、允許甲板裝載和乾舷圖表的總佈置圖；

.4 根據自由縱傾計算出的在正常營運狀況下預期的各種排水量和縱傾的靜水力曲線或圖表和穩性橫交曲線；

.5 表明每一貨物積載處所的容量和重心的艙容圖表；

.6 表明每一液艙容積、重心和自由液面資料的液艙測深表；

.7 關於裝載限制的資料，例如可用於確定是否符合適用的穩性衡準的最大重心高度（KG）或最小穩心高度（GM）的曲線或圖表；

.8 標準營運狀況以及使用穩性手冊所載資料制訂其他可接受裝載狀況的實例；

.9 對所作穩性計算的簡要說明，包括假定情況；

.10 防止意外進水的一般預防措施；

.11 有關使用任何特別横貫注水的資料及對可能需要横貫注水的破損狀況的說明；

.12 在正常和緊急情況下對船舶安全操作的任何其他必要指南；

.13 每本手冊的目錄和索引；

.14 船舶傾斜試驗報告，或：

.14.1 如果穩性資料基於一艘姊妹船，該姊妹船的傾斜試驗報告連同所述船舶的空船丈量報告；或

.14.2 如果空船細節不是來自於該船或其姊妹船的傾斜試驗而是通過其他方法確定的，關於確定這些細節所用方法的摘要；

.15 對通過服役期間傾斜試驗方法確定船舶穩性的建議。

3.6.5 作為 3.6.1 所述穩性手冊的代替，有關主管機關可自行決定要求提供載有足夠資料使船長能按本規則的適用規定操作船舶、格式業經認可的簡化手冊。

3.7 載運木材甲板貨船舶的操作性措施

3.7.1 在任何時候，包括在裝卸木材甲板貨的過程中，船舶的穩性都應為正值並達到主管機關可接受的標準。穩性的計算應考慮到：

.1 由於下列原因造成的木材甲板貨物重量增加：

.1.1 乾或風乾木材的吸水，和

.1.2 積冰，如適用（第 6 章（積冰的考慮））；

.2 消耗品的變化；

.3 液艙內液體的自由液面效應；和

.4 木材甲板貨物，特別是原木，虧艙的積水重量。

3.7.2 船長應該：

.1 在發生橫傾而又無令人滿意的解釋，繼續裝貨則屬輕率行為時，停止所有裝貨作業；

.2 在出海之前確保：

.2.1 船舶處於直立狀態；

.2.2 船舶具有充分的穩心高度；和

.2.3 船舶滿足要求的穩性衡準。

3.7.3 長度小於 100 米的船舶的船長還應：

.1 作出準確判斷，確保載運甲板上堆載原木的船舶有足夠的附加浮力以避免超載和在海上失去穩性；

.2 意識到在離港狀況時計算的 GM_0 由於原木甲板貨物的吸水、燃油、水和備品的消耗而可能會不斷減小，並確保船舶在整個航行中有適當的 GM_0；及

.3 意識到在離港後壓載可能造成船舶營運吃水超過木材載重線。加壓載和減壓載應按照《1991 年載運木材甲板貨物船舶安全操作規則》（第 A.715（17）號決議）中提供的指南進行。

3.7.4 載運木材甲板貨的船舶在營運時應儘可能有安全的穩性餘量，其穩心高度應符合安全要求，但這種穩心高度不應允許低於甲部分 3.3.2 中規定的最低建議值。

3.7.5 然而，還應避免過量的初穩性，因為它在惡劣海況中會導致急速猛烈的運動，使貨物承受巨大的滑動和擠壓力，造成繫索的高應

力。營運經驗表明，只要能滿足甲部分 3.3.2 中規定的相關穩性衡準，穩心高度最好不超過船寬的 3%，以防止橫搖時出現過度加速。

此建議可能並不適用於所有船舶，船長應考慮到從船舶穩性手冊中獲得的穩性信息。

3.8 某些船舶的操作手冊

3.8.1 對於特種用途船舶和新穎船艇，在穩性手冊中還應提供附加資料，例如設計限制、最大速度、最不利氣候條件或船長安全操作船舶所需的其他關於操縱船舶的信息。

3.8.2 對於設計成橫向單貨艙的雙殼油船，應提供貨油裝卸的操作手冊，包括裝卸貨油的操作程序和油船初穩心高度以及在裝卸貨油（包括加、減壓載）和貨油洗艙期間貨油艙和壓載艙內液體自由液面修正的詳細資料。

3.8.3 滾裝客船的穩性手冊應包括關於緊固和保持所有封閉水密的重要性的信息。因為當水進入車輛甲板時會導致急速失穩，隨後可能迅速釀成船舶傾覆。

第 4 章－用穩性儀進行穩性計算

4.1 穩性儀

船上安裝的穩性儀應涵蓋適用於該船的所有穩性要求。軟件需經主管機關批准。第 4.1.2 款界定了主動和被動系統。這些要求僅涵蓋被動系統以及主動系統的離線工作模式。

4.1.1 *概述*

4.1.1.1 穩性計算軟件的範圍應符合經批准的穩性手册，並應至少包括確保符合適用的穩性要求所需要的所有信息並進行所有確保符合適用的穩性要求所需要的計算或核驗。

4.1.1.2 經批准的穩性儀並不代替經批准的穩性手册，而是用作對經批准的穩性手册的補充，以便利穩性計算。

4.1.1.3 輸入/輸出的信息應易於與經批准的穩性手册進行比較，從而避免產生混淆和可能被操作者誤解。

4.1.1.4 應為穩性儀提供操作手册。

4.1.1.5 穩性計算結果的顯示和打印以及操作手册所用的語言應與船上經批准的穩性手册所用的語言相同。還可能需要翻譯成認為合適的語言。

4.1.1.6 穩性儀為具體船舶專用的設備，穩性儀的計算結果僅適用於其使用業經核准的船舶。

4.1.1.7 如果船舶的改動導致對穩性手册的修改，對任何原穩性計算軟件的具體核准將不再有效。軟件需要作相應調整並重新獲得核准。

4.1.1.8 與穩性計算有關的軟件版本的任何變化應向主管機關報告，並應經主管機關核准。

4.1.2 ***數據輸入系統***

4.1.2.1 被動系統要求人工數據輸入。

4.1.2.2 主動系統通過傳感器讀取並輸入液艙等的內容，部分取代了人工輸入。

4.1.2.3 根據傳感器提供的輸入來控制和啟動的任何一體化系統，除穩性計算的部分外，不在本規則的範圍之內。

4.1.3 ***穩性軟件的類型***

根據船舶的穩性要求，可以接受穩性軟件進行的三種計算類型：

1 型

僅計算完整穩性的軟件（用於不需滿足破艙穩性衡準的船舶）。

2 型

計算完整穩性並基於限制曲線（例如，對於適用《安全公約》第 II-1 章 B-1 部分破艙穩性計算的船舶等）或先前批准的裝載狀況來檢查破損穩性的軟件。

3 型

計算完整穩性並通過直接應用為每種裝載狀況預設的破損情況計算破艙穩性的軟件（對某些油船等）。主管機關可接受穩性儀所進行的直接計算的結果，即使這些結果不同於經批准的穩性手冊中所載的最小 GM 或最大 VCG 要求。

此種偏差可以接受的條件是直接計算的結果能符合所有相關穩性要求。

4.1.4 *功能要求*

4.1.4.1 穩性儀應給出每種裝載狀況的相關參數，以便幫助船長判斷船舶的裝載是否處在經批准的限制內。對每一特定的裝載狀況，應給出以下參數：

.1 詳細的載重數據項目，包括重心和自由液面，如適用；

.2 縱傾；橫傾；

.3 在吃水標記和垂線處的吃水；

.4 裝載狀況排水量的概況；VCG、LCG、TCG、VCB、LCB、TCB、LCF、GM 和 GM_L；

.5 標明復原力臂相對於橫傾角包括縱傾和吃水情況的圖表；

.6 下向浸水角和相應的下向浸水開口；以及

.7 對穩性衡準的符合：列出所有計算出的穩性衡準、限制值、得出值和結論（滿足衡準或不滿足衡準）。

4.1.4.2 如果進行直接破艙穩性計算，則應按照適用規則預設有關破損情況以自動核驗特定的裝載狀況。

4.1.4.3 如果有任何限制不能滿足，應在顯示屏上或打印出的紙張上給出清晰的警告。

4.1.4.4 由顯示屏上或打印出的紙張上顯示的數據應清晰明確。

4.1.4.5 已保存的計算數據的日期和時間應作為屏幕顯示或打印結果的一部分。

4.1.4.6 每份打印出的結果應包含對計算程序的標識，包括其版本號。

4.1.4.7 計量單位應明確標出，並且其在一次裝載計算中的使用應保持一致。

4.1.5 *可接受的公差*

根據程序的類型和範圍，可接受的偏差將根據第 4.1.5.1 或 4.1.5.2 確定出不同的值。偏離這些公差應不予接受，除非主管機關認為該出入有令人滿意的解釋，並且對船舶的安全沒有不利影響。

結果的準確性應使用獨立程序或具有相同輸入數據的經批准的穩性手冊來確定。

4.1.5.1 僅使用來源於經批准的穩性手冊的預設數據作為穩性計算基礎的程序在打印輸入數據時的公差應為零。

輸出數據的公差應接近於零，但是，與計算時取有效數字和簡略輸入數據有關的微小不同可以接受。此外，與使用縱傾的靜水力和穩性數據有關的差異以及因計算自由液面力矩方法不同於經批准的穩性手冊中的方法而產生的差異在主管機關審查後可以接受。

4.1.5.2 使用船體型式模型作為穩性計算依據的程序，應算出打印出的基本計算數據相對於源自經批准的穩性手冊的數據或使用主管機關批准的模型取得的數據間的公差。

4.1.6 *批准程序*

4.1.6.1 認可穩性儀的條件

對軟件的認可包括：

.1 對型式認可的驗證，如果有的話；

.2 驗證所用的數據符合船舶的當前狀況（參見第 4.1.6.2）；

.3 驗證和批准試驗條件；以及

.4 驗證軟件適合於該船舶類型及所要求的穩性計算。

穩性儀的滿意工作應通過安裝時的試驗來驗證（參見第 4.1.8）。船上應備有一份經批准的試驗條件和穩性儀的操作手冊。

4.1.6.2 具體認可

4.1.6.2.1 計算結果以及安裝在具體船舶上的計算程序所使用的實船數據的準確性應使主管機關滿意。

4.1.6.2.2 在應用數據驗證時，最低應從船舶經認可的穩性手冊中選用四種裝載狀況，把它們作為試驗條件來使用。對於載運散裝液體的船舶，至少一種狀況應包括液艙部分裝滿。對於載運散裝穀物的船舶，穀物的一種裝載狀況應包括穀物艙室部分充滿。在這些試驗條件內，每個艙室應至少裝載一次。試驗條件通常應包括從預期的最深吃水的載重狀況到最低的壓載狀況的載重吃水，並應包括至少一個離港狀況和一個抵港狀況。

4.1.6.2.3 申請人提交的以下數據應與該船的佈置和依照存檔的當前計劃和文件中的最近獲得批准的空載特性相一致，並且在船上可能會受到進一步的驗證：

.1 明確計算程序，包括其版本號。主要尺度、靜水力細節以及，適用時，船舶剖面圖；

.2 首柱和尾柱的位置，並且如適用，推導在船舶吃水標記實際位置處的前後吃水的計算方法；

.3 從最近批准的傾斜試驗或輕載檢驗中推導出的船舶空載和重心；

.4 線型圖、補償表或其他對船體型式數據的表達，包括船舶模型所需的所有船體附屬體；

.5 艙室的界定，包括框架距離、型心以及艙容表（測深/液面表），以及適用時，自由液面修正；及

.6 每種裝載狀況的貨物和消耗品的分佈。

主管機關的驗證並不解除船東確保穩性儀程序中編入的信息與船舶的現狀和經批准的穩性手冊相一致的責任。

4.1.7 *用戶手冊*

應提供與穩性手冊相同的語言寫成的簡單易懂的用戶手冊，包含對至少以下內容的適當介紹和須知：

.1 安裝；

.2 功能鍵；

.3 菜單顯示；

.4 輸入和輸出數據；

.5 運行軟件的最低硬件要求；

.6 試驗裝載狀況的使用；

.7 計算機引導的對話步驟；以及

.8 警告清單。

除文字手冊外，可提供電子格式的用戶手冊。

4.1.8 ***安裝試驗***

4.1.8.1 在最終和更新的軟件安裝以後，為確保穩性儀的正確工作，船長有責任在主管機關的驗船師在場的情況下使穩性儀按照以下方式進行計算。從經批准的試驗狀況中，至少應計算一種裝載情況（空船除外）。

註：實際裝載結果不適合於驗證穩性儀的正確工作情況。

4.1.8.2 通常，試驗條件永久儲存在穩性儀中。採取的步驟為：

.1 提取試驗裝載狀況並開始計算運行；將取得的穩性結果與文件中的穩性結果相比較；

.2 對一些載重項目（液艙重量和貨物重量），做出足以將吃水或排水量改變至少 10%的變動。對結果進行複審以確保其以符合邏輯的方式有別於經批准的試驗狀況；

.3 修訂上述修改後的裝載狀況以恢復初始試驗狀況並比較結果。經批准的試驗狀況的有關輸入和輸出數據應與其一致；以及

.4 或者，應選擇一個或更多試驗狀況，並且通過將每個選中的試驗狀況的所有載重數據輸入程序進行計算，仿佛其為建議的裝載。應驗證該結果與經認可的試驗狀況的副本中的結果相同。

4.1.9 ***定期試驗***

4.1.9.1 在每次年度檢驗中使用至少一個經批准的試驗狀況來檢查穩性儀的準確性是船長的責任。如果在檢查穩性儀時主管機關的代表不在場，本檢查取得的試驗狀況結果的副本應保留在船上作為進行了滿意試驗的檔案供主管機關的代表核驗。

4.1.9.2 在每次換新檢驗中，應在主管機關的代表在場的情況下進行這種對所有經批准的裝載狀況的檢查。

4.1.9.3 試驗程序應根據第 4.1.8 進行。

4.1.10 ***其他要求***

4.1.10.1 應提供保護防止意外或未經授權修改程序和數據。

4.1.10.2 程序應監督運行，並在程序被不正確或非正常使用時發出警報。

4.1.10.3 對系統中存儲的程序和任何數據應予保護，防止因失電而損毀。

4.1.10.4 應包括有關限制的錯誤信息例如裝載超出艙容或重複裝載，或超出了勘定的載重線等。

4.1.10.5 如果在船上安裝了與穩性措施有關的任何軟件，例如船舶的抗浪能力、運營中傾斜試驗評估和處理結果用於進一步計算以及對橫搖周期測量的評估，這些軟件應報告給主管機關審議。

4.1.10.6 程序功能應包括質量和力矩計算，用數字和圖形顯示結果，例如初始穩性值、復原力臂曲線、復原力臂曲線下的面積以及穩性範圍。

4.1.10.7 來自自動測量傳感器（如表測裝置或吃水讀數系統）的所有輸入數據均應提供給用戶供其驗證。用戶應能手動消除錯誤讀數。

第 5 章－防止傾覆的操作性規定

5.1 防止傾覆的一般預防措施

5.1.1 不論在任何情況下，符合穩性衡準既不保證不會傾覆，也不解除船長的責任。因此，船長應注意到年度的季節、天氣預報和航行區域，謹慎行事並發揮良好船藝，還應根據當時情況的需求採用適當的航速和航向。

5.1.2 應注意使配給船舶的貨物的積載能夠符合衡準。如必要，貨物數量應限制到可需要壓重的範圍以內。

5.1.3 航次開始前，應注意確保貨物、船上貨吊和大件設備得到適當積載或綁紮，以便船舶在海上時，將橫搖和縱搖的加速作用造成縱向和橫向位移的可能性減至最低限度。

5.1.4 船舶在從事拖帶作業時，應具有充足的穩性儲備以承受由拖纜造成的預期傾覆力矩而不對主拖船舶造成危險。主拖船上的甲板貨的裝載位置應不會危及甲板上船員的安全工作，也不會阻礙拖帶的設備的正常功能，並應妥善繫固。拖纜安排應包括拖帶彈簧以及迅速釋放拖帶的方法。

5.1.5 因部分充滿的或未滿的液艙對穩性有不利影響，它們的數目應保持在最低限度。應考慮到已灌注的游泳池對穩性的負面影響。

5.1.6 甲部分第 2 章所載的穩性衡準確定了最小值，但未建議最大值。最好避免過大的穩心高度值，因為可能導致不利於船舶、其人員、設備和貨物安全運輸的加速力。在特別情況下，未滿的液艙可被用作減少過大穩心高度值的一種方法。在這種情況下，應充分考慮到液體晃蕩的影響。

5.1.7 在運輸某些散貨時，應注意其對穩性的可能不利影響。在這方面，應注意國際海事組織《固體散裝貨物安全實用規則》。

5.2 惡劣氣候中的操作性預防措施

5.2.1 凡水可通過並進入船殼或甲板室、艏樓等的所有的門和其他開口，在不利氣候狀況下應適當緊閉，相應地，所有此種關閉設備應在船上得到保養並處於良好狀態。

5.2.2 風雨密和水密艙口、門等應在航行中保持關閉，除為船舶操作而必需打開時外，應能夠隨時立即關閉，且有清晰標誌說明這些裝置除進出外應保持關閉。漁船上的艙蓋和平甲板小艙口在捕撈作業期間如果不使用應保持適當緊固。所有活動舷窗蓋應維護在良好狀態並在壞天氣時牢固關閉。

5.2.3 為燃油艙透氣管提供的任何關閉裝置應在壞天氣時緊固。

5.2.4 在未首先確定艙中活動隔板已適當架設之前，不得散裝魚。

5.3 惡劣氣候中的操船

5.3.1 在所有裝載狀況下，均應對保持適航乾舷給予必要注意。

5.3.2 在惡劣天氣時，如有螺旋槳出水、甲板上水或有嚴重拍擊現象發生時，應降低船速。

5.3.3 應特別注意船舶在順浪、尾斜浪或迎浪中的航行，因參數的諧振、橫向受風、在浪峰上穩性的減少和過度橫搖的危險現象會單獨地、先後地或以多種組合同時發生而造成傾覆的危險。應適當地改變航速和（或）航向，以避免上述現象。

5.3.4 依賴自動舵會有危險，因為不能隨時作出航向改變，而在壞天氣時可能需要這樣做。

5.3.5 應避免甲板阱中存水。如果舷牆排水口不足以排空甲板阱中的水，應降低船速或改變航向或既降速又改向。裝有關閉裝置的舷牆排水口應能夠一直發揮作用並不被閉鎖。

5.3.6 船長應注意在某些區域或在某些風和流的混合作用（河口、淺水域、漏斗形海灣等）下，會發生陡浪和破碎浪。這些浪特別危險，尤其對於小船。

5.3.7 在惡劣氣候中，橫風壓力可能導致很大的傾角。如果使用抗傾措施（例如壓載、使用抗傾裝置等）來彌補由於風造成的傾斜，改變船舶相對於風向的航向可能會導致危險的傾角或造成傾覆。因此，由於風造成的傾斜不應使用抗傾措施來彌補，除非，經過計算證實該船在最惡劣的情況下（即不當或不正確地使用、機械故障、意外航向改變等）具備充分的穩性，並經主管機關批准。對使用抗傾措施的指導應在穩性手冊中提供。

5.3.8 建議使用在惡劣氣候狀況下避免危險情況的操作指南或基於電腦的船上系統。該方法應簡單易用。

5.3.9 高速船在運作中不應故意超出有關證書中或證書中引用的文件中規定的最壞預計條件和操作限制。

第 6 章－積冰的考慮

6.1 通則

6.1.1 在可能發生對船舶穩性有不利影響的積冰區域中營運的船舶，在分析裝載狀況時，應包括積冰的預留量。

6.1.2 建議主管機關考慮積冰的情況，並在認為環境條件表明需要高於下述章節中建議的標準時，允許主管機關適用國家標準。

6.2 載運木材甲板貨的貨船

6.2.1 船長應考慮到由於吸水和（或）積冰而引起的甲板貨重量增加以及消耗品的變化，確定或核證其船舶在最惡劣營運狀況下的穩性。

6.2.2 當運輸木材甲板貨物並預計會出現結冰時，應在抵達狀況中預留出額外的重量。

6.3 漁船

漁船的裝載情況的計算（參見 3.4.2.8）應按下述規定視情包括積冰預留量。

6.3.1 *積冰預留量*

對在可能會發生積冰的區域作業的漁船，在穩性計算中應作出下述積冰預留量：

.1 在露天甲板和步橋上，每平方米 30 千克；

.2 船舶各舷水線面之上的側投影面積，每平方米 7.5 千克；

.3 計算無帆船舶的欄杆、各種吊杆、柱（桅杆除外）和索具的不連續表面的側投影面積和其他小構件的側投影面積應將連

續表面的總投影面積增加 5%，將該面積的靜力矩增加 10%。

將在已知會發生積冰的區域作業的漁船應：

.4 設計成能把積冰降低到最低程度；以及

.5 裝備有主管機關可能要求的除冰裝置，例如電動和氣動裝置，和（或）如斧頭或木棒等專門工具來除去舷牆、欄杆和上層建築的積冰。

6.3.2 ***關於積冰的指南***

上述標準應適用於下述冰區：

.1 西經 28°和冰島西海岸之間，北緯 65°30'以北的區域；冰島北海岸以北的區域；從北緯 66°、西經 15°到北緯 73°30'、東經 15°的恒向線以北的區域；在東經 15°和 35°之間北緯 73°30'以北和東經 35°以東的區域；以及在波羅的海北緯 56°以北的區域；

.2 北緯 43°以北，西部以北美洲海岸為界，東部由從北緯 43°、西經 48°到北緯 63°、西經 28°的恒向線並沿西經 28°為界的區域；

.3 第 6.3.2.1 和 6.3.2.2 款界定的區域以西，北美大陸以北的所有海區；

.4 在冰季中的白令海和鄂霍次克海和韃靼海峽；以及

.5 南緯 60°以南。

本章結尾處附有說明這些區域的海圖。

對在預期會發生積冰的區域作業的船舶：

.6 在已知其結冰情況與 6.3.1 中所述有顯著區別的 6.3.2.1、6.3.2.3、6.3.2.4 和 6.3.2.5 中規定的區域內，適用的積冰要求可為規定預留量的一倍半到兩倍；以及

.7 在積冰預計超過 6.3.1 規定預留量兩倍的、6.3.2.2 界定的區域內，可採用比 6.3.1 中的規定更為嚴格的要求。

6.3.3 ***冰形成原因及其對船舶適航性影響的簡明調查***

6.3.3.1 漁船船長應了解冰的形成是一個複雜的過程，它取決於氣象條件、裝載狀況和船舶在暴風氣象中的行為以及上層建築和索具的尺寸和位置。冰形成的最通常原因是小水珠在船舶結構上的積濺。這些水珠來自浪峰的飛沫和船舶產生的飛沫。

6.3.3.2 在下雪、海霧（包括北冰洋煙霧）、環境溫度劇降等狀況下以及落在船舶結構物上的雨滴的凍結也可造成結冰。

6.3.3.3 船舶甲板上浪和留存在甲板上的水有時也會引起或加劇結冰。

6.3.3.4 大量結冰通常發生在船首、舷牆和舷牆欄杆、上層建築和甲板室的前牆、錨鏈孔、錨、甲板機械、船首樓甲板和上甲板、排水口、天線、支索、側支索、桅和柱等。

6.3.3.5 應牢記積冰最危險的區域是亞北極區域。

6.3.3.6 迎面風浪會造成最嚴重的積冰。在橫風或後側風中，船舶受風一側積冰較快，因此會導致極危險的恒定傾側。

6.3.3.7 下列氣象狀況會造成最常見的船舶飛沫積冰。同時也給出了排水量在 100 噸至 500 噸範圍內典型漁船的積冰重量的實例。對更大的船舶來說，重量將相應更大。

6.3.3.8 在下述情況下發生慢速積冰：

.1 在－1°C 至－3°C 的環境溫度和任何風力下；

.2 在－4°C 和更低的環境溫度中，風力從 0 至 9 米/秒；以及

.3 降水、霧或海上輕靄後環境溫度急劇下降。

在所有這些條件下的積冰量不會超過 1.5 噸/小時。

6.3.3.9 在－4°C 至－8°C 的環境溫度和 10 至 15 米/秒的風力下，會發生快速積冰。這種狀況下的積冰量會在 1.5 至 4 噸/小時的範圍內。

6.3.3.10 在下述情況下會發生非常快速的積冰：

.1 環境溫度為－4°C 及以下，風力為 16 米/秒及以上；以及

.2 環境溫度為－9°C 及以下，風力為 10 米/秒至 15 米/秒。

在這些條件下的積冰量會超過 4 噸/小時。

6.3.3.11 船長應牢記，結冰對船舶適航性有不利影響，因結冰會導致：

.1 由於船舶表面積冰使船舶重量增加，從而使乾舷和浮力減少；

.2 由於在船舶結構的高位置結冰會使船舶重心上升，從而相應降低穩性水平；

.3 由於船舶上部結冰引起受風面增加，因此由於風的作用造成橫傾力矩的增加；

.4 由於冰在船舶長度上不平衡分佈，從而造成縱傾的改變；

.5 由於冰在船舶寬度上不平衡分佈，從而產生恒定橫傾；

.6 影響船舶操縱性能並降低船速。

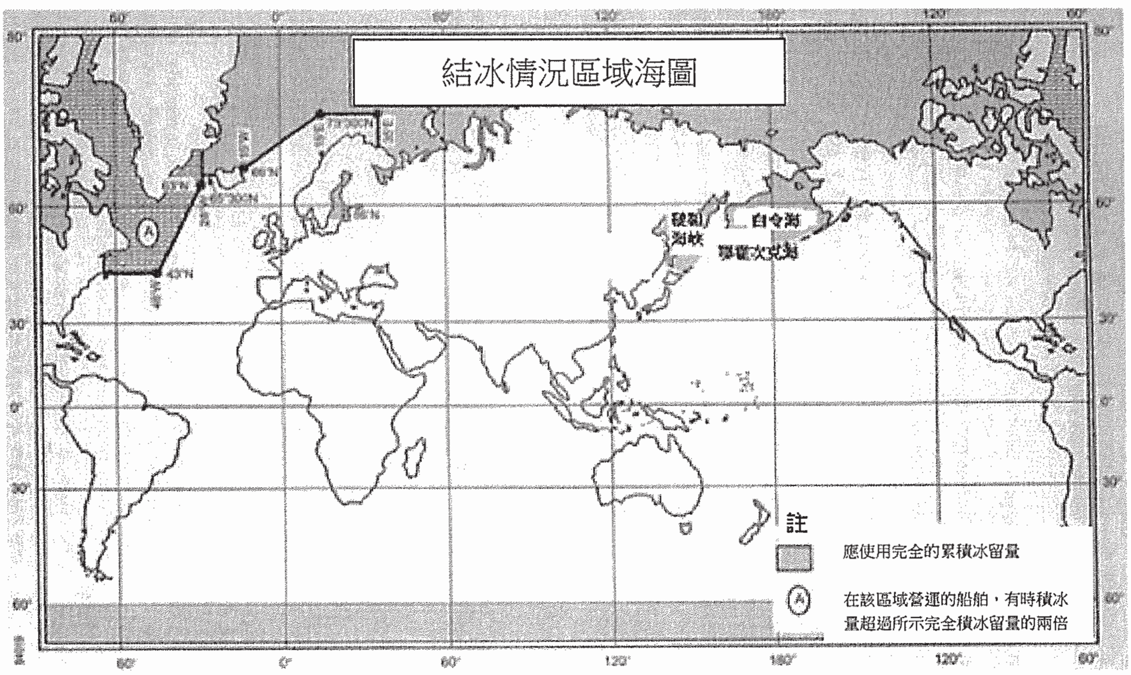
6.3.4 與確保在結冰狀況下漁船的耐受力有關的操作程序見附件 2（對漁船船長在結冰情況下保證船舶耐受力的建議）。

6.4 長度 24 米至 100 米的近海供應船

對於在可能會發生積冰的區域營運的船舶：

.1 排水孔不應裝設擋板；

.2 關於防止傾覆的操作性預防措施，參見第 6.3.3 款和附件 2（對漁船船長在結冰情況下保證船舶耐受力的建議）中所載的對漁船船長在結冰情況下保證船舶耐受力的建議。



第 7 章－對水密和風雨密完整性的考慮

7.1 艙口

7.1.1 適用《1966 年國際載重線公約》及其經修訂的《1988 年議定書》的船舶，其貨物艙口和其他艙口應符合該公約及其議定書第 13、14、15、16 和 26（5）條。

7.1.2 適用《1993 年托雷莫利諾斯議定書》的漁船，其艙口應符合該議定書的第 II/5 和 II/6 條。

7.1.3 長度為 12 米及以上，但小於 24 米的甲板漁船，其艙口應符合以下要求：

7.1.3.1 所有艙口應設有艙蓋，在捕撈作業時可能被打開的艙口通常應佈置在船舶中心線附近。

7.1.3.2 就強度計算而言，應假設非木質艙口蓋將承受 10 千牛頓/米 ^{2} 的靜荷載或其上面的預計載貨重量，取較大者。

7.1.3.3 如果艙口蓋為低碳鋼製成，根據 7.1.3.2 規定的荷載乘以 4.25 所得的最大應力不應超過材料的最小極限強度。在此荷載下艙口蓋的撓度應不大於跨距的 0.0028 倍。

7.1.3.4 非低碳鋼或非木質材料製成的艙口蓋應至少具備與低碳鋼艙口蓋相同的強度，並且其構造應具有足夠的剛性，以保證在 7.1.3.2 中規定的荷載下的風雨密。

7.1.3.5 艙口蓋應設置足以保證風雨密的夾緊裝置和密封墊或其他等效裝置。

7.1.3.6 鑑於木質艙口蓋難以迅速保證其風雨密，因此通常不建議使用。但如裝有木質艙口蓋，應能夠被緊固成風雨密。

7.1.3.7 木質艙口蓋的成品厚度應包括由於惡劣作業造成的磨損餘量。在任何情況下，這些艙口蓋的成品厚度應至少按每 100 毫米無支撐跨距 4 毫米計，但至少為 40 毫米，且其支承表面寬度應至少為 65 毫米。

7.1.3.8 在工作甲板露天部分上的艙口圍板在甲板上的高度，對長度為 12 米的船舶，至少為 300 毫米，對長度為 24 米的船舶，至少為 600 毫米。對長度居於兩者之間的船舶，最小高度應由線性內插法求得。上層建築甲板露天部分的艙口圍板在甲板上的高度應至少為 300 毫米。

7.1.3.9 如果營運經驗證明合理並經主管當局批准，除直接通往機器處所者外，艙口圍板的高度可低於 7.1.3.8 中規定的高度或完全省去圍板，但應裝有有效水密的非木質艙口蓋。這種艙口應儘可能小，艙口蓋應裝有永久性的鉸鏈或等效裝置並能迅速關閉或封牢。

7.2 機器處所開口

7.2.1 適用《1966 年國際載重線公約》或其經修正的《1988 年議定書》的船舶，其機器處所開口應符合第 17 條。

7.2.2 適用《1993 年托雷莫利諾斯議定書》的漁船和長度為 12 米及以上但小於 24 米的新甲板漁船，應符合該議定書第 II/7 條的下述要求：

.1 機器處所開口應由與鄰接的上層建築具有同等強度的門套框住及圍蔽。通向外部的出入口應設置符合該議定書第 II/4 條

要求的門，或，對長度小於 24 米的漁船，設置符合本章第 7.1.3 的要求的非木質艙口蓋；及

.2 非出入口的開口應設置與未穿孔的結構具有同等強度的、永久接連在結構上且能關閉成風雨密的艙口蓋。

7.2.3 對近海供應船，如可能，通往機器處所的出入口，應安排在船首樓內。從露天貨物甲板通往機器處所的任何出入口應配有兩重風雨密關閉裝置。通往露天貨物甲板以下處所的出入口應最好起始於上層建築之內或之上的某一位置。

7.3 門

7.3.1 對適用《1974 年國際海上人命安全公約》的客船，門應符合該公約的第 II-1/13 和 16 條。

7.3.2 對適用《1966 年國際載重線公約》或其經修正的《1988 年載重線議定書》的船舶，門應符合該公約第 12 條的規定。

7.3.3 對適用《1993 年托雷莫利諾斯議定書》的漁船，門應符合該議定書第 II/2 和第 II/4 條。

7.3.4 對於長度 12 米或以上但小於 24 米的甲板漁船：

.1 水密門可為鉸鏈式並應能從門的兩側就地操作。門的每側應貼有通告，說明在海上時門應保持關閉。

.2 甲板上層建築圍閉艙壁上的任何進出開口，如果可能進水並危及船舶，應裝有永久連接在艙壁上的門，門應有框架和加強材，使整個結構的強度與未穿孔的結構相同，且在關閉時應風雨密，並應提供裝置使其能從艙壁的每一側操作。

.3 位於工作甲板和上層建築甲板之上、直接通往該甲板暴露於風雨和海部分的門道、升降口、甲板上層建築和機艙棚的門檻在甲板之上的高度應至少等於 7.1.3.8 中規定的艙口圍板的高度。

.4 如果營運經驗證明合理並經主管當局批准，7.3.4.3 中規定的門道（除直接通往機器處所者外）的門檻在甲板之上的高度，對長度為 24 米的船舶，在上層建築甲板上可減至不小於 150 毫米，在工作甲板上不小於 380 毫米；或對長度為 12 米的船舶，在工作甲板上不小於 150 毫米。對長度居於兩者之間的船舶，工作甲板上門道的門檻可接受的降低後高度應由線性內插法求得。

7.4 裝貨舷門和其他類似開口

7.4.1 對適用《1966 年國際載重線公約》或其經修正的《1988 年載重線議定書》的船舶，裝貨舷門和其他類似開口應符合該公約第 21 條。

7.4.2 對適用《1993 年托雷莫利諾斯議定書》的漁船，水能夠進入船內的開口及尾拖網船的魚艙蓋的開口應符合該議定書第 II/3 條。

7.4.3 對適用《1974 年國際海上人命安全公約》的客船，裝貨舷門和其他類似開口應符合該公約第 II-1/15、17 和 22 條。此外，適用於該公約的滾裝客船的此類開口應符合該公約第 II-1/17-1 條。

7.4.4 對適用《1974 年國際海上人命安全公約》的貨船，裝貨舷門和其他類似開口應符合該公約第 II-1/15-1 條。

7.5 舷窗、窗的排水孔、進水口和排出口

7.5.1 對適用《1974年國際海上人命安全公約》的客船，艙壁甲板以下船殼板上的開口應符合該公約的第II-1/15條。

艙壁甲板以上的水密完整性應符合該公約第II-1/17條。

此外，在滾裝客船上，艙壁甲板以下的水密完整性應符合該公約第II-1/23條的要求，上層建築和船體的完整性應符合該公約第II-1/17-1條。

7.5.2 對適用《1966年國際載重線公約》或其經修正的《1988年議定書》（如適用）的船舶，排水孔、進水口和排出口應符合該公約的第22條，而舷窗應符合該公約第23條。

7.5.3 對適用《1993年托雷莫利諾斯議定書》的漁船，舷窗和窗子應符合該議定書第II/12條的規定，進水口和排出口應符合該議定書第II/13條。

7.5.4 對長度為12米及以上但小於24米的甲板漁船，舷窗、窗子和其他開口及進水口和排出口應符合以下規定：

.1 工作甲板以下處所和工作甲板上圍蔽處所的舷窗應裝有能關閉成風雨密的鉸鏈式舷窗蓋；

.2 舷窗的裝設位置應使其底檻高於一條平行於舷側工作甲板的直線，其最低點在最深營運水線500毫米以上；

.3 舷窗及其玻璃和舷窗蓋應有令主管當局滿意的堅實結構；

.4 通往工作甲板以下處所的天窗應結構堅實並能被關閉和緊固成風雨密，並應設有適當的關閉裝置，在鑲嵌件損壞時使用。應儘可能避免安裝通往機器處所的天窗；

.5 操舵室所有露天的窗子應裝鋼化安全玻璃或適當的同等強度永久透明材料。慮及窗所用的材料，其緊固方式和承受面寬度應合適。操舵室的窗戶如沒有.6 要求的保護裝置，則從操舵室通往甲板下處所的開口應裝有風雨密關閉裝置；

.6 如果沒有其他方法防止水通過破裂的窗戶或舷窗進入船體，應裝有舷窗蓋或適當數目的風暴蓋；

.7 如主管當局認為不會影響船舶的安全，則可接受位於工作甲板或其之上的甲板上層建築的側艙壁或後艙壁上的舷窗和窗戶不設舷窗蓋；

.8 工作甲板以下的船側開口數量應為與設計和船舶的正常營運相適應的最小數目，此種開口應裝有適當強度的關閉裝置，以確保風雨密和周圍結構的結構完整性；

.9 從工作甲板下各處所或甲板上層建築內的各處所穿過船殼的排水孔，應裝有防止水流入船內的有效和可以接近的裝置。通常每個單獨排水孔應有一個自動止回閥；該閥應有一個從易於接近的位置將其關閉的可靠裝置。如主管當局認為水通過該開口進入船舶不會導致危險浸水且管子的厚度足夠，則可不要求此種閥門。帶有可靠關閉裝置的止回閥的操作裝置應配有指示器指示止回閥開閉情況。任何排水系統的船內開放端應位於最深操作水線以上，其傾角應令主管機關滿意；

.10 在機器處所，機器運作所必需的主、輔海水吸入口和排水口應就地控制。控制器應易於接近並應配有指示器表明閥門的開閉狀況。應裝有顯示水漏入處所內的適當警告裝置；以及

.11 裝在船殼上的附件和所有閥門應由鋼、銅或其他延性材料製成。船殼和閥之間的所有管路應為鋼製，但對於非使用鋼材建造的船舶，可使用其他合適材料。

7.5.5 對適用《1974 年國際海上人命安全公約》的貨船，外部開口應符合該公約第 II-1/15-1 條。

7.6 其他甲板開口

7.6.1 適用《1966 年國際載重線公約》或其經修正的《1988 年議定書》（如適用）的船舶，乾舷甲板和上層建築甲板上的各種開口應符合該公約第 18 條。

7.6.2 對於 12 米及以上的有甲板漁船，如為捕撈作業所必需，可安裝螺栓式、卡鎖式或等效的平甲板小艙口和人孔，但它們應能被關閉成水密，而且這些裝置應永久性地連接在附近結構上。考慮到開口的大小和配置及關閉裝置的設計，可裝設金屬對金屬的有效水密關閉裝置。工作甲板或上層建築甲板上的艙口、機器處所開口、人孔和小平艙口之外的其他開口應由裝有風雨密門或其等效裝置的圍蔽結構加以保護。升降口應儘可能佈置在船舶中心線上。

7.7 通風口、空氣管和探測裝置

7.7.1 適用《1966 年國際載重線公約》或其經修正的《1988 年議定書》（如適用）的船舶，其通風口，應符合該公約第 19 條；空氣管應符合該公約第 20 條。

7.7.2 適用《1993 年托雷莫利諾斯議定書》的漁船，其通風口應符合該議定書的第 II/9 條；空氣管應符合第 II/10 條。探測裝置應符合該議定書第 II/11 條。

7.7.3 長度 12 米及以上但小於 24 米的漁船上的通風口和空氣管應符合下述規定：

.1 通風口應有結構堅固的圍板並應能由永久固定在通風口或鄰近結構上的裝置關閉成風雨密。通風口應儘可能佈置在船舶中心線上，並在可行時應延伸過甲板上層建築或升降口的頂部；

.2 通風口圍板應儘可能高。在工作甲板上，除機器處所通風口外，其他通風口在甲板上的高度不應小於 760 毫米，在上層建築甲板上不應小於 450 毫米。如果這種通風口的高度可能干擾船舶作業，其圍板高度可降低到主管當局認可的高度。機器處所通風口在甲板上的高度應使主管當局滿意；

.3 如通風口圍板在工作甲板上的延伸高度超過 2.5 米或在甲板室頂部或上層建築以上的高度超過 1.0 米，則通風口上不必安裝關閉裝置；

.4 如液艙或其他甲板下處所的空氣管延伸到工作甲板或上層建築甲板之上，則管子的露天部分應結構堅固，並應儘可能靠近船舶中心線並加以保護，防止漁具或提升裝置對其造成損壞。這類管子的開口應由永久固定在管子上或鄰近結構上的有效關閉裝置加以保護，但如果主管當局認為它們有防止甲板積水的保護裝置，則可免去這些關閉裝置；以及

.5 如果空氣管靠近船舷，在工作甲板上，其高度應比水可能進入甲板下的位置至少高出 760 毫米，在上層建築甲板上，應至少高出 450 毫米。為了避免妨礙捕撈作業，主管當局可允許降低通氣管的高度。

7.7.4 近海供應船的空氣管和通風口應符合下述規定：

.1 空氣管和通風口應安裝在保護位置上，以避免在作業期間貨物對其造成損壞並最大限度地降低浸水的可能性。在露天貨物甲板和首樓甲板上的空氣管應裝有自動關閉裝置；及

.2 對機器處所通風口的位置應給予充分注意。它們最好安裝在上層建築甲板之上的某一位置，或者，如果未設上層建築甲板，在相等的高度之上的某一位置。

7.8 舷牆排水口

7.8.1 如乾舷甲板或上層建築甲板或漁船工作甲板的露天部分上的舷牆形成阱時，排水孔應沿舷牆長度方向佈置，以保證甲板上的水能最迅速而有效地排出。排水舷口的下緣應儘可能靠近甲板。

7.8.2 對適用《1966 年國際載重線公約》或其經修正的《1988 年議定書》（如適用）的船舶，舷牆排水口應符合該公約第 24 條。

7.8.3 在長度為 12 米及以上的甲板漁船上，舷牆排水口應符合下述規定：

7.8.3.1 漁船每側的最小排水口面積 A（平方米），就工作甲板上的每個阱而言，應由形成阱的舷牆的長度 l 和高度按下式確定：

.1 $A=K*l$

其中：

對長度 24 米及以上的船舶： K=0.07；

對長度為 12 米的船舶： K=0.035；

對長度居於兩者之間的船舶，K 值應由線性內插法求得（l 不必大於船舶長度的 70%）

.2 如果舷牆平均高度大於 1.2 米，高度每增加 0.1 米，所要求的排水孔面積應按每米阱長增加 0.004 平方米；

.3 如果舷牆平均高度小於 0.9 米，高度每減少 0.1 米，所要求的排水孔面積應按每米阱長減少 0.004 平方米。

7.8.3.2 若主管機關或主管當局認為船舶的舷弧不足以保證迅速而有效地將水從甲板上排出，則應增大按 7.8.3.1 計算所得的排水口面積。

7.8.3.3 經主管機關或主管當局同意，上層建築甲板上每個阱的最小排水口面積應不小於 7.8.3.1 中規定的面積 A 的一半，但當上層建築甲板構成捕撈作業的工作甲板時，其每側的最小面積不應小於面積 A 的 75%。

7.8.3.4 排水口應沿舷牆的長度的方向佈置，以便甲板上的水能最迅速而有效地排出。排水口的下緣應儘可能靠近甲板。

7.8.3.5 魚池欄板以及積載和操作漁具的裝置的佈置不應妨礙排水舷口的有效性或使甲板積水不易流到排水口。魚池欄板的構造應能在使用時被鎖定就位，並且不會阻礙船上積水的排泄。

7.8.3.6 深度超過 0.3 米的排水口應設置間距不大於 0.23 米也不小於 0.15 米的鐵條或其他合適的保護裝置。如果排水口設有蓋板，則其構造應經認可。如需在捕魚作業中鎖住排水口蓋，則該裝置應令主管當局滿意，並能從易於接近的位置方便地操作。

7.8.3.7 對於擬在結冰區域營運的船舶，其排水口蓋和保護裝置應能易於拆除，以限制積冰。開口的大小及用以拆除此類保護裝置的屬具應令主管當局滿意。

7.8.3.8 此外，對於長度為 12 米及以上但小於 24 米的漁船，如在工作甲板或上層建築甲板上裝設底部高於最深營運水線的阱或尾阱，則應配備向舷外排泄的有效止回裝置。如果這些阱或尾阱的底部低於最深營運水線，應提供艙底排泄裝置。

7.8.4 對於近海供應船，主管機關應根據具體船舶的特性，對管子積載位置的適當排泄給予特別注意。但管子積載位置的排泄面積應大於貨物甲板舷牆的規定排水口面積且不應裝有蓋子。

7.9 雜項

7.9.1 從事拖帶作業的船舶應裝設拖纜快速釋放裝置。

第 8 章－空船參數的確定

8.1 適用範圍

8.1.1 每艘客船，不論其大小，以及《1966 年國際載重線公約》或其經修正的《1988 年議定書》（如適用）所界定的船長為 24 米以上的每艘貨船，應在完建時做傾斜試驗，並確定其穩性要素。

8.1.2 主管機關可允許對具體船舶免除 8.1.1 中所要求的傾斜試驗，條件是能從其姊妹船的傾斜試驗中得到基本穩性數據，並向主管機關表明可從這些基本數據中得到被免除船舶的可靠穩性資料。

為免除傾斜試驗，空載重量的差異不得超過：

對於 L<50 米 已試驗船舶或穩性資料中給出的空載重量的 2%；

對於 L>160 米 已試驗船舶或穩性資料中給出的空載重量的 1%；

對於 L 的中間值 用線性內插法。

並且空載縱向重心（LCG）就所提及的 L 而言的差異不應大於已試驗船舶空載縱向重心或穩性資料中給出的無論船舶長度的空載縱向重心的 0.5%。

8.1.3 對專門設計用於運輸液體或散裝礦砂的具體一艘或一類船舶，如果參閱類似船舶的現有數據清楚地表明由於其比例和佈置，船舶在所有可能的裝載狀況下均具有充分的穩心高度，主管機關可允許免除傾斜試驗。

8.1.4 如船舶的任何改動對穩性有實質性影響，應對船舶重做傾斜試驗。

8.1.5 每隔不超過五年，應對所有客船進行空載檢驗，以驗證其空載排水量和縱向重心有無任何變化。經與經認可的穩性資料比較，每當發現或預計輕載排水量的差異超過 2%或縱向重心的差異超過船長 L 的 1%時，均應對船舶重做傾斜試驗。

8.1.6 如果採取特別預防措施以保證試驗程序的精確，則對長度小於 24 米的船舶也可調整所規定的傾斜試驗。

8.2 傾斜試驗的準備工作

8.2.1 ***通知主管機關***

按主管機關的要求或在試驗前的適當時候應把傾斜試驗的書面通知書送交主管機關。主管機關的代表應出席見證傾斜試驗，及試驗結果應提交供審查。

船廠、船舶所有人或造船工程師應負責準備、開展傾斜試驗和空載檢驗、記錄數據並計算出結果。雖然符合本文所述程序將便利傾斜試驗的迅速和準確進行，但人們認識到替代程序或安排可能同樣有效。但是，為了最大限度地降低延誤的風險，建議在傾斜試驗前把所有此種變動提交主管機關審查。

8.2.1.1 通知書的細節

書面通知書應提供主管機關可能要求的下列資料：

.1 如適用，通過船名和船廠的船體編號對船舶作出識別；

.2 試驗的日期、時間和地點；

.3 傾斜試驗的壓重資料：

.1 類型；

.2 數量（單位數目和單位重量）；

.3 驗證；

.4 搬運方法（即滑軌或吊車）；

.5 預計的兩舷最大傾角；

.4 測量工具：

.1 擺式傾斜指示器－大致位置和長度；

.2 U－型管－大致位置和長度；

.3 傾斜儀－位置和認可及校準的細節。

.5 大約縱傾；

.6 液艙狀況；

.7 為使船舶處於真正的空載狀況而減去、完成和重新定位的預計壓重；

.8 對傾斜試驗期間輔助計算而使用的任何計算軟件的詳細說明；以及

.9 負責開展傾斜試驗的人員的姓名和電話號碼。

8.2.2 *船舶的一般狀況*

8.2.2.1 在作傾斜試驗時，船舶應儘可能完備。試驗的安排應使對船舶的交付日期或其營運承諾的影響減至最小。

8.2.2.2 留待完成的工作（即將要增加的重量）的數量和類型會影響評定空載特性的準確性，因而應作出明智判斷。如果對要增加的項目的重量或重心不能作出有把握的判斷，則最好在加上該項目後進行傾斜試驗。

8.2.2.3 暫時放在船上的材料、工具箱、腳手架、沙、殘料等在傾斜試驗前應減至絕對的最小程度。不直接參與傾斜試驗的多餘船員或人員應在試驗前離船。

8.2.2.4 甲板上應沒有水。甲板積水會以與液艙中液體類似的方式移位和形成水泡。試驗前應清除船上聚積的任何雨水、雪或冰。

8.2.2.5 試驗的預計液體荷載應包括在試驗的計劃內。所有液艙最好應是空的和清潔的，或完全滿裝的。未滿裝的液艙數目應保持在絕對最小數目上。液體的黏度、液體的深度和液艙形狀應使自由液面效應得到精確測定。

8.2.2.6 船舶應錨泊於平靜而有遮蔽的、沒有外力（如過往船舶的螺旋槳的激蕩或來自岸邊泵的突然排放）的區域。應考慮到試驗期間的潮流狀況和船舶縱傾。在試驗前，應在儘可能多的位置上測量水深並作出記錄，以確保船舶不會觸底。水的比重應精確記錄。船舶的繫泊方式應允許無限制地傾斜。進出跳板應撤掉。接岸的電線、軟管等應為最低數目並在所有時候均保持鬆弛。

8.2.2.7 船舶應儘可能直立；傾斜壓重在起始位置時，半度以內的橫傾可接受。如果可行，在靜水力數據中應考慮到實際縱傾和龍骨變形。為避免水線面在傾斜期間的顯著變化引起的過大誤差，應事先檢查實際縱傾和預計最大傾角的靜水力數據。

8.2.2.8 所使用的總壓重應足以在每舷提供 1 度的最小傾斜和 4 度的最大傾斜。但對於大船，主管機關可接受一個更小的傾斜角，條件是要滿足 8.2.2.9 中對於擺式傾斜指示器偏離或 U－型管高度差的要求。試驗壓重應堅實，其外形應使壓重的垂直重心能得到準確測定。每一壓重應標有識別編號和重量。在傾斜試驗前應重新驗證壓重。在傾斜試驗期間應配備具有足夠功率和伸距的吊車或其他裝置，以便迅速而安全地移動甲板上的壓重。在使用固體壓重進行傾斜不可行時，如果主管機關能夠接受，可以進行壓載水的轉移。

8.2.2.9 建議使用三個擺式傾斜指示器，最少應使用兩個，以識別任一位置上的擺式傾斜指示器的錯誤讀數。每一指示器均應位於避風區域。主管機關可自行決定用其他測量儀器（U-型管或傾斜儀）代替一個或更多擺式傾斜指示器，不應使用替代的測量儀器來減少 8.2.2.8 中建議的最小傾斜角。

傾斜儀或 U－型管的使用應個案考慮。建議僅在與至少一個擺式傾斜指示器配合使用時，方使用傾斜儀或其他測量裝置。

8.2.2.10 在中央控制位置和壓重搬運工之間以及在中央控制位置和每個擺式傾斜指示器位置之間應提供有效的雙向通訊。在中央控制站應有一位人員對參與試驗的所有人員進行全面控制。

8.3 要求的圖紙

傾斜試驗的負責人在傾斜試驗期間應有一份下述各圖紙的副本：

.1 型線圖；

.2 靜水力曲線或靜水力數據；

.3 甲板、貨艙、內底等的總佈置圖；

.4 顯示貨物處所、液艙等的容量和垂直和縱向重心的艙容圖。如果使用壓載水進行傾斜試驗，必須有所涉及液艙在每種傾斜角時的橫向和垂直重心；

.5 液艙測深表；

.6 吃水標記位置；以及

.7 龍骨資料和吃水標記修正的進塢圖紙（如有的話）。

8.4 試驗程序

8.4.1 進行傾斜試驗和空載檢驗時採用的程序應符合本規則附件 1 中（開展傾斜試驗的詳細指導）給出的建議。

8.4.1.1 為確定船舶在傾斜試驗時的排水量，應記錄乾舷/吃水讀數，以確定水線位置。建議在船舶每舷大致等距離的位置上至少記錄五個乾舷讀數或記錄船舶每舷的所有吃水標記的讀數（船的前部、中部和後部）。吃水/乾舷讀數應在傾斜試驗之前或之後立即讀出。

8.4.1.2 標準試驗採用八次截然不同的壓重移動。如果在第 7 次移動後得到一條直線，則可省去重新檢查零位的第 8 次移動。如果在起始零位和六次壓重移動後得到一直線，則傾斜試驗已完成，並可省去第二次在零位上的檢查。如果未得到一直線，則應重複或解釋未產生可接受的製圖點的那些壓重移動。

8.4.2 如主管機關要求，應以可接受的報告格式，向主管機關提交一份傾斜資料的副本和傾斜試驗的計算結果。

8.4.3 在傾斜試驗期間和在撰寫傾斜試驗報告中進行的所有計算可使用合適的計算機程序進行。這種程序計算的輸出結果，如果清楚、簡潔、材料充分、格式和內容符合主管機關的要求，可用於顯示試驗報告中包含的全部或部分數據和計算。

8.5 移動式近海鑽井平台的傾斜試驗

8.5.1 對於同一設計的第一個鑽井裝置，應在儘可能接近於完備的情況下進行傾斜試驗，以準確確定空載數據（重量和重心位置）。

8.5.2 對於按同一設計相繼建造的鑽井裝置，如經載重量檢驗結果確認，由於機器、裝置或設備細小差別的重量變化引起的空載排水量或重心位置的差異小於該系列第一個鑽井裝置被測定的空載排水量和主要水平尺寸值的 1%，則主管機關可接受以該系列第一個鑽井裝置的空載數據代替傾斜試驗。應特別注意柱穩式和半潛式系列鑽井裝置的具體重量計算及其與原始鑽井裝置的比較，因為人們認識到，此類鑽井裝置，即使具有相同的設計，在重量和重心方面也不太可能達到可被接受的足以免除傾斜試驗的相似性。

8.5.3 傾斜試驗或載重量檢驗和按重量差異作出調整的傾斜實驗的結果應在操作手冊中載明。

8.5.4 所有影響空載數據的機器、結構、裝置和設備變化的記錄應寫入操作手冊或空載數據變化記錄簿，並在日常操作中予以考慮。

8.5.5 對於柱穩式鑽井裝置，應每間隔不超過 5 年進行一次載重量檢驗。如載重量檢驗表明與經計算的空載排水量的差異超過作業排水量的百分之一，則應進行一次傾斜試驗。

8.5.6 進行傾斜試驗或排水量檢驗時應有主管機關的官員或被認可組織的經正式授權的人員或代表在場。

8.6 躉船的穩性試驗

對躉船通常不要求傾斜試驗，但要對穩性計算的空載垂直重心（KG）假定一個保守值。垂直重心可假定在主甲板高度之上，儘管認識到如提供充分文件依據可接受一個更小的值。應由基於吃水和密度讀數的計算確定空載排水量和縱向重心。

附件 1

進行傾斜試驗的詳細指南

1 引言

本附件補充了本規則乙部分第 8 章（輕載參數的確定）提出的傾斜標準。本附件載有為確保船舶所有人、船廠和主管機關以最小成本得到最大精確度的有效結果的進行傾斜試驗的重要詳細程序。為了確保試驗妥善進行，對傾斜實驗結果的精確性作出檢查，完全了解傾斜試驗所使用的正確程序非常必要。

2 傾斜試驗的準備工作

2.1 自由液面和液艙容積

2.1.1 如果在船舶傾斜時船上有液體，不論這些液體在艙底還是在液艙內，當船舶傾斜時，它們將移動到低的一側。液體的這種移動將加劇船舶的傾斜。除非可以精確計算出移動液體的準確重量和距離，傾斜試驗計算出的重心高度（GM）將是錯誤的。應徹底排空液艙並確保所有艙底乾燥，或把液艙注滿使液體不可能移動，從而把自由液面降低到最小程度。後一方法並非最適宜，因為在液艙內構件之間的氣穴難於消除，而滿載液艙中的液體重量和中心應精確確定，以便相應調整空載值。當液艙必須非滿裝時，液艙的側部應是平行的垂直平面而且該液艙的俯視形狀應是規則的（即矩形、梯形等），從而可以對液體的自由液面力矩作出精確確定。例如，在具有平行垂直側面的液艙中液體的自由液面力矩可用下述公式容易地計算出：

$M_{fs} = l^* b^{3*} \rho_t / 12$（米噸）

其中：

l = 液艙長度（米）

b = 液艙寬度（米）

ρ_t = 液艙中液體的比重(噸/米^3)

$$\text{自由液面修正} = \frac{\sum_x M_{fs}(1) + M_{fs}(2) + \cdots + M_{fs}(x)}{\Delta}\ (\text{米})$$

其中：

M_{fs} = 自由液面力矩（米噸）

Δ = 排水量（噸）

自由液面修正獨立於船舶液艙的高度、液艙位置和傾斜方向。當液艙寬度增加時，自由液面力矩的值按其三次方冪增加。液體的可移動距離是決定性因素。因此，在寬的液艙或艙底中即使有最小量的液體通常也不可接受而應在傾斜實驗前除去。在其潛在移動可忽略不計的 V 形液艙或空處所（例如船頭的錨鏈艙）中的少量液體，如果液體排除困難或將會造成較長延誤，則可保留。

如果壓載水被用作傾斜壓重，應考慮到船舶傾角的變化計算壓載水的實際橫向和縱向移動。本段所界定的自由液面修正不應適用於傾斜液艙。

2.1.2 ***自由液面和未滿裝液艙***：未滿裝液艙數通常應限制在下述的一對左/右舷液艙或一個中心線上的液艙：

.1 備用淡水給水櫃；

.2 燃油/柴油貯藏櫃；

.3 燃油/柴油日用櫃；

.4 潤滑油櫃；

.5 衛生水櫃；或

.6 飲用水櫃。

為避免氣穴，未滿裝液艙的橫剖面通常應為規則的（即長方形、梯形等），如果是深艙，應裝至 20%至 80%，如果是雙層底艙，應裝至 40%至 60%。這些水平確保液體移動率在傾斜試驗的所有傾斜角上均保持恒定。如果在船舶傾斜時縱傾發生改變，還應對縱向氣穴給予考慮。當船舶傾斜時，應避免在未滿裝液艙中裝有黏度足以防止液體自由移動的液體（如低溫下的燃油），因為不能準確計算自由液面。除非這些艙被加溫以降低黏度，否則不應使用這種艙的自由液面修正。絕不允許液艙之間的流通。十字接頭，包括經過歧管的十字接頭應予關閉。未滿裝的成對液艙液面相同可能是十字接頭被打開的警告信號。在檢查十字接頭時，可查閱艙底水、壓載水和燃油的管路圖。

2.1.3 ***滿裝液艙***："滿裝"係指完全裝滿，沒有因縱傾或不適當透氣造成的空位。任何非 100%的滿載（例如就作業而言裝至 98%即被視為滿載）均不能接受。在最後測探前，最好使船舶從一側向另一側橫搖，以消除被夾持的空氣。在滿裝燃油艙時，應特別注意防止意外污染。圖 A1–2.1.3 是貌似"滿裝"，實則有夾持空氣的液艙示例。

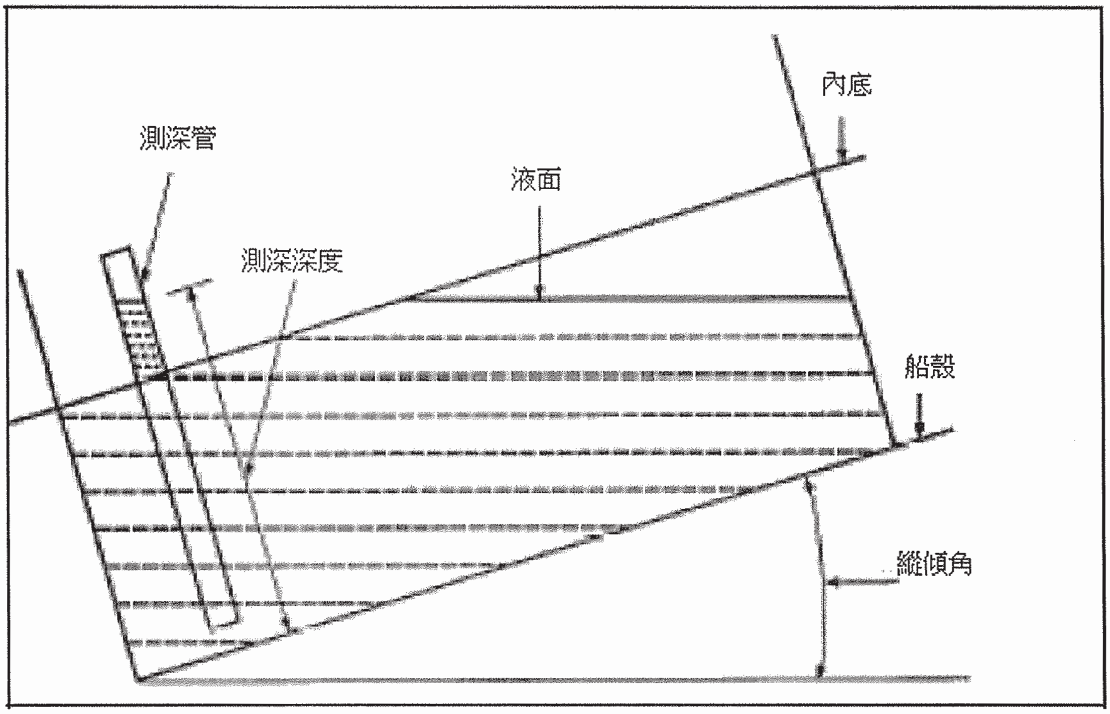


圖 A1－2.1.3

2.1.4 ***空艙***：一般說來，簡單地把液艙泵到失去吸力是不夠的。泵後必須進入艙中確定是否要用移動式泵或用人工作最後掃艙。非常狹窄的艙或艙底橫向斜度陡的液艙例外，因為它們的自由液面可忽視不計。由於所有空艙均應檢驗，所以應打開所有人孔，對液艙作徹底通風並證明進入是安全的。手頭應有安全測試儀器以測試是否有足夠的氧氣和毒性水平最低。如必要，應由合格的船舶化學技師出具的證書，證明人員進入所有燃油艙和化學品液艙是安全的。

2.2 繫泊裝置

好的繫泊裝置的重要性怎麼強調也不過分。裝置的選擇取決於許多因素。其中最重要的是水深、風和潮流影響。凡可能時，船舶應繫泊在平靜的、有遮蔽的、沒有外力（如過往船舶的螺旋槳水流或岸邊泵的突然排放等）的區域。船體下的水深應足以確保船體完全遠離水底。應考慮到試驗期間的潮況和船舶縱傾。在試驗前，應在多個位置測定水深並作出記錄，以確保船舶不會觸底。如果水深餘地不大，試驗應在高潮期間或將船舶移至更深的水中進行。

2.2.1 繫泊裝置應確保船舶在一段充足的時間內自由傾斜不受約束，以便能夠記錄因移動壓重而造成傾角的滿意讀數。

2.2.2 船舶應在船艏和船艉用纜繩繫住，纜繩繫在甲板繫纜樁和（或）索栓上。如果使用甲板裝置不能獲得對船舶的適當約束，應在儘可能接近船舶中心線和水線的位置安裝臨時眼板。如果船舶只能從一舷繫纜，為了保持對船舶的穩妥控制，較好的做法是使用兩條倒纜來輔助船艏和船艉纜，如圖 A1-2.2.2 所示。倒纜的導纜應儘可能長。在船舶與碼頭之間應設有圓柱形浮墊。在讀取數據時，所有纜繩應鬆弛使船舶離開棧橋和浮筒。

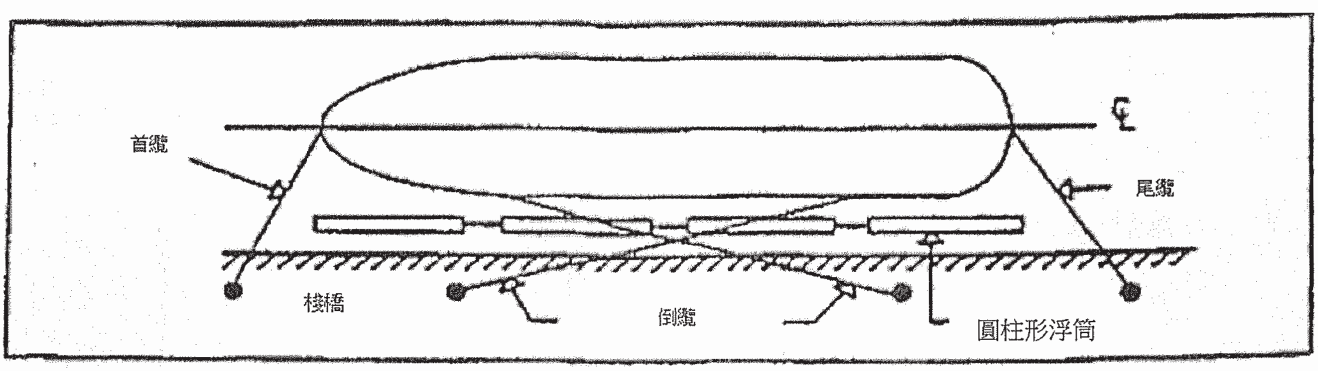


圖 A1-2.2.2

2.2.2.1 如果風和流的聯合效應使船離開棧橋，在整個試驗中疊加傾斜力矩將作用於船舶。在穩定情況下，這不會影響結果。陣風或一致的變向風和（或）流會使這些疊加力矩發生改變，因此可能需要額外試驗點，以獲得有效的試驗。可通過繪製所得到的試驗點來確定是否需要額外試驗點。

2.2.2.2 如果風和（或）流使船舶靠到護板上，則所有纜繩應是鬆弛的。圓柱形浮墊會防止對船舶的約束，但由於船舶壓在浮墊上，將會出現額外的疊加傾斜力矩。在可能時應避免這種情況，但如果使用，在取讀數時應考慮把船舶拉離碼頭和浮墊，讓船舶漂動。

2.2.2.3 另一種可接受的佈置是風和流的聯合作用使船舶可僅靠船頭或船尾的一根纜繩控制。在這種情況下，控制纜繩應繫在船舶中心線或靠近中心線處，在取讀數時，除控制纜外，其他纜均是鬆弛的，船舶可隨風和/或流自由移動。這種佈置有時可能會造成麻煩，因為風和（或）流變動可導致製圖失真。

2.2.3 在試驗前，應將繫泊佈置提交批准當局審議。

2.2.4 如果使用浮吊搬運傾斜壓重，浮吊不應繫泊在該船上。

2.3 試驗壓重

2.3.1 如使用有孔混凝土之類能吸收大量水分的壓重，必須在傾斜試驗開始前方秤重或出示最近的重量證書。每個壓重應標有識別號和重量。對於小船，可使用完全充滿水的桶。桶通常應裝滿並加蓋，以允許準確地控制重量。在此情況下，應在有主管機關代表在場時使用最近校準過的秤來驗證桶的重量。

2.3.2 應採取預防措施確保在移動壓重時甲板不會超載。如果對甲板的強度有疑問，應進行結構分析來確定現有船體構架是否能支持該重量。

2.3.3 一般而言，試驗壓重應放置在上層甲板儘可能靠外弦處。在計劃的傾斜試驗時間之前，試驗壓重應在船上就位。

2.3.4 如果使用固體壓重來造成傾斜力矩被證明為不可行，可允許採用移動壓載水作為替代方法。此種接受只能針對某一具體試驗加以准許，且需要由主管機關對試驗程序予以批准。可接受的最低前提條件如下：

.1 傾斜液艙應為平壁型，並且沒有能夠造成氣穴的大型縱樑或其他內部構件。主管機關可決定是否接受其他幾何形狀的液艙；

.2 各液艙應是對置的，以保持船舶的縱傾；

.3 應測定壓載水的比重並予記錄；

.4 傾斜艙的管道應是滿的。如果船舶的管道佈置不適合內部轉駁，可使用便攜泵和水管/水龍帶；

.5 在轉駁歧管中必須插入封蓋，以防止在轉駁期間液體“漏出”的可能性。在試驗期間應保持對閥門的連續控制；

.6 在每次移動之前和之後，應對所有傾斜艙作手工測深；

.7 應計算每次移動的垂向、縱向和橫向中心；

.8 必須提供準確的測深/虧量表。在傾斜前應確定船舶的初始傾角，以便在每一個傾角下得出傾斜液艙的準確體積值以及橫

向和垂向重心。在確定初始傾角時應使用船中吃水標記（左舷和右舷）；

.9 對液體移動數量的驗證可通過流量計或類似裝置來完成；以及

.10 應估算進行傾斜試驗所用的時間。如果認為液體轉駁所需時間過長，水壓重可能不可接受，因為時間長風可能會發生變化。

2.4 擺式傾斜指示器

2.4.1 擺式傾斜指示器應有足夠長度，以給出船舶直立至每舷至少 15 釐米的可測偏轉。一般來說，這要求擺式傾斜指示器的長度至少為 3 米。建議使用長度為 4－6 米的擺式傾斜指示器。通常擺式傾斜指示器越長，試驗精度越高。但如果對易斜船舶使用過長的擺式傾斜指示器，由於擺式傾斜指示器可能不會停下，對該擺式傾斜指示器的精度會產生疑問。在具有較高 GM 的大船上，可能需要長度超過上述建議長度的擺式傾斜指示器以獲得最小的偏轉。在這種情況下，槽內應充注高黏度的油，如圖 A1-2.4.6 所示。如果擺式傾斜指示器的長度不同，可避免記錄員之間共謀的可能性。

2.4.2 在小船上，如果沒有足夠的淨空高度懸掛長的擺式傾斜指示器，可通過增加試驗重量來增加傾斜的方式達到 15 釐米的偏轉。在大多數船上，典型的傾斜在一至四度之間。

2.4.3 擺錘線應是鋼琴線或其他單絲材料。指示器的頂部連接應提供不受限制的轉動樞點。例如，將裝有擺錘線的墊圈懸掛在一顆釘子上。

2.4.4 應設有一裝有液體的槽來阻尼指示器在每次壓重移動後的擺動。槽應有足夠深度，以防止擺錘碰到底部。在擺錘線末端使用有翼的鉛錘也能幫助阻尼指示器在液體中的擺動。

2.4.5 壓板應是光滑的淺色木材，1 至 2 釐米厚，並牢固地固定在位置上，使意外接觸不會使其移動。壓板應調定至緊靠擺錘線，但不接觸該線。

2.4.6 圖 A1-2.4.6 顯示了一個滿意的典型佈置。擺式傾斜指示器可縱向和橫向地置於船上任何位置。擺式傾斜指示器應在計劃的傾斜試驗時間前就位。

2.4.7 建議傾斜儀或其他測量裝置僅與至少一隻擺錘聯用。如發現這樣不可行，主管機關可批准替代佈置。

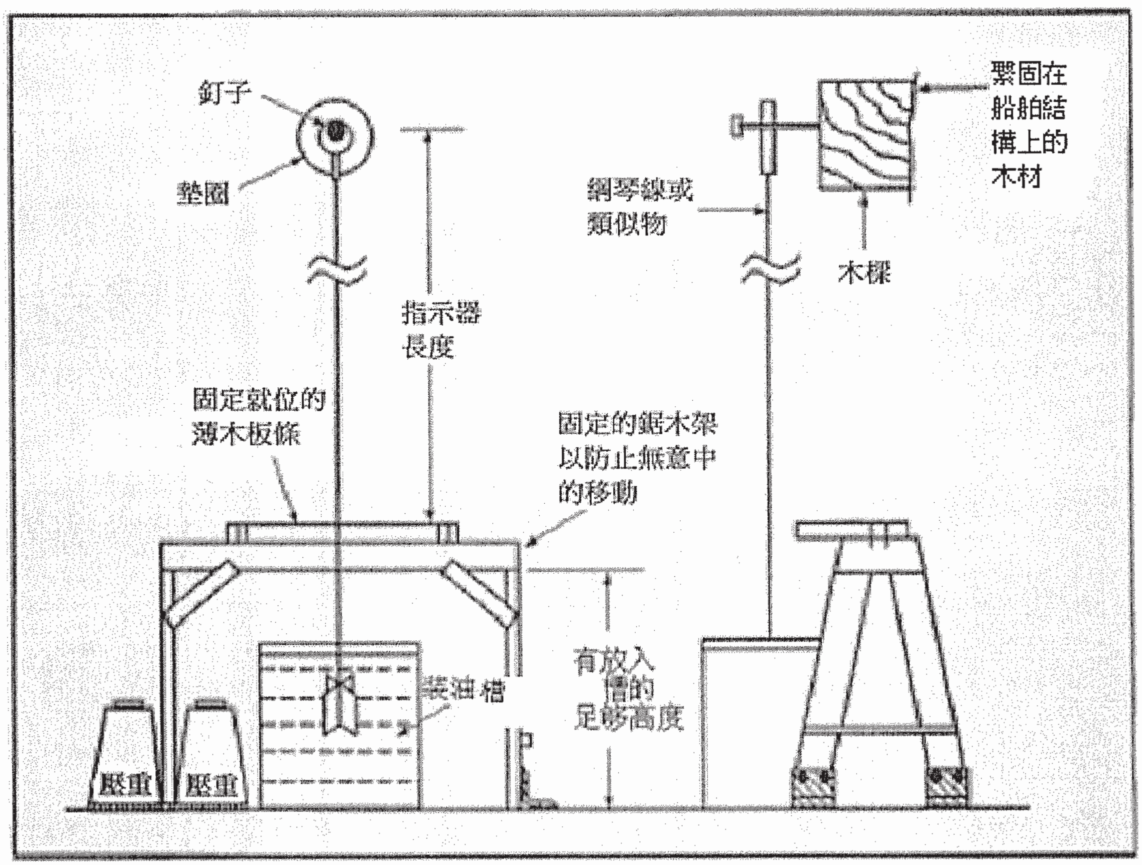


圖 A1-2.4.6

2.5 U－型管

2.5.1 裝置的端部應牢固地在儘可能遠的外舷上就位並應與船舶的中心線面相平行。端部之間的距離應垂直於中心線面量取。端部應儘可能垂直。

2.5.2 應做出在兩端記錄所有讀數的安排。為易於讀取和檢查氣泡，應全部使用透明的塑料管或軟管。U－型管在傾斜試驗前應進行壓力測試，以確保水密。

2.5.3 U－型管端部之間的水平距離應足以達到從直立到每舷最大傾斜之間至少能取得 15 厘米的高度差。

2.5.4 通常，應使用水作為 U－型管內的液體。也可以考慮使用其他低黏度的液體。

2.5.5 管中不應存在氣泡。應做出安排確保管內液體無障礙自由流動。

2.5.6 如果使用 U－型管作為測量裝置，應充分考慮到當時的氣象條件（見 4.1.1.3）：

.1 如果 U－型管直接暴露於陽光之下，應做出安排避免沿管的長度出現溫差；

.2 如果預期會出現 0º 以下的溫度，液體應為水和防凍添加劑的混合物；以及

.3 如果預期會有暴雨，應做出安排避免額外的水進入 U－型管。

2.6 傾斜儀

使用傾斜儀至少應遵從以下建議：

.1 其精度應等效於擺式傾斜指示器；

.2 傾斜儀的敏感度應在整個測量過程中記錄船舶的不穩定橫傾角；

.3 記錄時間段應充分，以準確測量傾斜。記錄能力通常應足以進行全部試驗；

.4 儀器應能夠在紙上繪出或印出所記錄的傾斜角；

.5 儀器應在預期的傾斜角範圍呈線性表現；

.6 儀器應帶有製造商的說明，給出校準的細節、操作說明等；及

.7 應能夠在傾斜測試期間展示令主管機關滿意的所要求的性能。

3 所需的設備

除了必要的物理設備如傾斜壓重、擺式傾斜指示器、小船等外，下述物品是必需的並應提供給傾斜試驗負責人：

.1 測量擺式傾斜指示器偏轉的工程比例尺（刻度的劃分應足以達到所需精度）；

.2 用以標記擺式傾斜指示器偏轉的尖頭鉛筆；

.3 用以標記傾斜壓重不同位置的粉筆；

.4 足夠長度的量尺，用於測量壓重移動和確定船上不同物件的位置；

.5 足夠長的測深尺，用於測量液艙深度和乾舷讀數；

.6 一隻或多隻保養良好的足以覆蓋比重在 0.999 至 1.030 之間的測定範圍的比重計，用以測定浮起船舶的水的比重（在有些地方可能需要能測量比重小於 1.000 的比重計）；

.7 測量船上任何液體比重所需的其他比重計；

.8 用於繪製相對於正切值的傾斜力矩的方格紙；

.9 用以在型線圖上劃出測定水線的直尺；

.10 記錄數據的本子；

.11 用以檢查液艙和其他圍閉處所（例如空位和空隔艙）中是否有充足氧氣和是否不存在致命氣體的防爆測試裝置；

.12 溫度計；和

.13 吃水量管（如需要）。

4 試驗程序

傾斜實驗、乾舷/吃水讀數和檢驗可以按任何順序進行而取得相同結果。如果進行傾斜試驗的人員確信檢驗將表明船舶處於可接受的狀況並且天氣可能會變壞，則建議首先進行傾斜試驗，最後進行檢驗。如進行試驗的人員對船舶是否完備到足以進行試驗有懷疑，建議首先進行檢驗，因為這可能使整個試驗無效，不管氣象條件如何。在整個試驗期間船上的所有壓重、人員數目等均保持不變非常重要。

4.1 初始巡視和檢驗

負責進行傾斜試驗的人員應在計劃的試驗時間之前及早上船，以確保船舶已做好進行試驗的適當準備。如果要傾斜的船舶是大型的，則可能須在實際傾斜的前一天作初步巡視。為確保巡視人員的安全和改進經檢驗的壓重的證據和缺陷，至少應有二人進行初步巡視。要檢查的事項包括：所有艙室是打開的、潔淨的和乾燥的，液艙得到徹底通風，無有害氣體，可移動或懸掛物體已被固定並且其位置已記入文件，擺式傾斜指示器已就位，壓重已上船並已就位，備有吊車或移動重物的其他方法，備有必要的圖紙和設備。在開始傾斜試驗前，進行試驗的人應：

.1 考慮氣象狀況。風、流和浪的聯合不利效應可造成各種困難或甚至會因以下原因使試驗無效：

.1 不能準確記錄乾舷和吃水；

.2 擺式傾斜指示器的擺錘過度或不規則擺動；

.3 不可避免的疊加傾斜力矩的變化。

在有些情況下，除非把船移到更好的位置使條件得到充分的改善，否則可能需要推遲或延期進行試驗。在試驗前應除去船上任何大量的雨水、雪或冰。如果及早探知了不利天氣狀況而天氣預報表明狀況不會改善，則應在主管機關代表離開辦公室前通知，並安排一個替代日期；

.2 對船舶作出快速全面檢驗，以確定船舶已完備到能夠進行試驗並確保所有設備已就位。作為提交主管機關的任何試驗程序的組成部分，應寫入對在傾斜試驗時將未完成的項目的估

計。這樣要求是因為如果主管機關的代表認為船舶尚未完備到可以進行傾斜試驗因此應予改期時，可向船廠/造船工程師作出通知。如果在試驗程序中沒有準確說明船舶在傾斜試驗時的狀況，而在傾斜試驗時主管機關的代表認為因船舶所處狀況不能進行準確的傾斜試驗，則該代表可拒絕接受傾斜試驗，並要求在一個較晚的日期進行傾斜試驗；

.3 在確定所有空液艙得到徹底通風且無有害氣體後，進入所有空液艙以確保其乾燥且沒有雜物。確保任何滿裝液艙確實滿裝並且沒有氣穴。傾斜試驗的預計液體負荷應列入要求提交給主管機關的程序中；

.4 檢驗全船，確定為使船舶達到空載狀況而需要裝到船上、從船上卸下或在船上重新放置的所有物件。每一物件應清楚地確定出重量及垂直和縱向位置。如需要，還應記錄橫向位置。傾斜壓重、擺式傾斜指示器、任何臨時設備和墊料以及傾斜試驗期間在船上的人員均屬於要達到空載狀況必須撤走的壓重。根據傾斜和檢驗中收集的數據計算空載特性的人員和/或審查傾斜試驗的人員試驗時不一定到現場，應能根據記錄的數據和船舶的圖紙確定物件的準確位置。對裝有液體的任何液艙應作準確測深並予記錄；

.5 對船上某些物料的重量或要加裝的某些物件的重量可能需要作出估計。如必須作出估計，為了安全，在估計時要多加安全餘量。因此應遵循下述經驗法則：

.1 在估計要增加重量時：

.1.1 對將加在船上高處的物件要往高估；及

.1.2 對將加在船上低處的物件要往低估；

.2 當估計要卸掉的重量時：

.2.1 對將從船上高處卸掉的物件要往低估；及

.2.2 對要從船上低處卸掉的物件要往高估；

.3 當估計要移位的重量時：

.3.1 對移位至船上更高處的物件要往高估；及

.3.2 對移位至船上更低位置的物件要往低估。

4.2 乾舷/吃水讀數

4.2.1 為了在傾斜試驗時確定船舶的排水量，應取得乾舷/吃水讀數以確定水線位置。建議在船舶每舷大約等距離地取至少五個乾舷讀數或在船舶每舷取所有吃水標記（艏、舯和艉）的讀數。應取吃水標記讀數來幫助確定由乾舷讀數劃定的水線，或用於驗證尚待確認的船舶吃水標記的垂向位置。應清晰地標出每個乾舷讀數的位置。應準確地確定沿船長的縱向位置並予記錄，因為每一位置處的（型）深均從船舶型線處取得。所有乾舷測定應包括一個註解，說明在測定中包括了艙口圍和艙口圍的高度。

4.2.2 應在傾斜試驗前後立即讀出吃水和乾舷讀數。壓重應在船上就位，在傾斜試驗期間將在船上的所有人員，包括要在船上讀取擺式傾斜指示器讀數的人員，在取讀數時，應在船上就位。這對小船特別重要。如讀數是在試驗後讀取，則應使船舶保持試驗期間的狀況。對小船來說，可能需要平衡掉乾舷測量人員造成的橫傾和縱傾影響。如果可能，應從一艘小艇上取讀數。

4.2.3 應備有一艘小艇以幫助讀取乾舷和吃水標記的讀數。小艇應有低的乾舷以允許精確地觀察讀數。

4.2.4 此時應確定浮起船的水的比重。應從足夠水深處取得樣品，以確保能夠真正代表使船浮起的水而不僅僅是表面水，因表面水可能含有來自雨水徑流的淡水。應將比重計放入水樣中讀取比重並予記錄。對大型船舶，建議在船舶的艏、舯和艉部提取水樣並取讀數的平均值。對於小船，在船舯取一個樣品就足夠了。如果必要，應測量水溫，並對所測比重根據其與標準值的偏差進行校正。如果比重是在傾斜試驗現場測定的，則不需對水的比重作出校正。如果測定比重時樣品的溫度不同於傾斜試驗時的溫度（例如，如果測試比重在辦公室內進行），則有必要作出校正。

4.2.5 如果當船在乾塢時已通過龍骨檢驗證明吃水標記的高度和位置是精確的，則可由在該縱向位置的某一已知乾舷讀數替代吃水標記讀數。

4.2.6 可使用吃水量管之類的裝置減弱波浪作用，改進乾舷/吃水讀數的精確性。

4.2.7 船舶線型圖上繪出的尺寸通常是型尺寸。就深度而言，係指船底殼板內側到甲板板材內側的距離。為了在線型圖上繪出船舶水線，乾舷讀數應轉換成型吃水。同樣，在繪圖前應將吃水標記讀數從最大吃水（龍骨底部）校正為型吃水（龍骨頂端）。應對乾舷/吃水讀數間的任何差異予以處理。

4.2.8 應為取得乾舷/吃水讀數的每一位置，計算出平均吃水（左、右舷讀數的平均值）並繪在船舶線型圖或側視圖上，以確保所有讀數的

一致性和並由所有讀數共同地劃定正確的水線。其合成繪圖應產生一條直線或一條中拱或中垂的水線。如果得到的讀數相互不一致，應重新測量乾舷/吃水。

4.3 傾斜

4.3.1 在移動任何壓重前，應做下列檢查：

.1 應檢查繫泊佈置以確保船舶自由漂浮（應在每次讀取擺式傾斜指示器的讀數前進行）；

.2 應測量擺式傾斜指示器並記錄其長度。應對擺式傾斜指示器進行調定，使鋼絲在船舶傾斜時與壓板接近到可以確保準確的讀數，但又不會碰到壓板。令人滿意的典型佈置如圖 A1-2.4.6 所示；

.3 壓重的初始位置要標劃在甲板上。可以通過在甲板上描出壓重的輪廓來完成；

.4 通訊安排適當；及

.5 所有人員就位。

4.3.2 在試驗期間應進行繪圖以確保隨時獲取可接受的數據。典型的情況是圖的橫坐標是傾側力矩 W（x）（重量乘以距離 x），縱坐標是傾角的正切函數（由擺式傾斜指示器的偏轉除以長度）。繪出的該線條不必通過原點或任何其他特定點，因為任何一點都不比其他點更重要。通常使用線性回歸分析來適合該直線。圖 A1-4.3.2-1 所示的壓重移動展示了一個在試驗繪圖上的良好分佈。

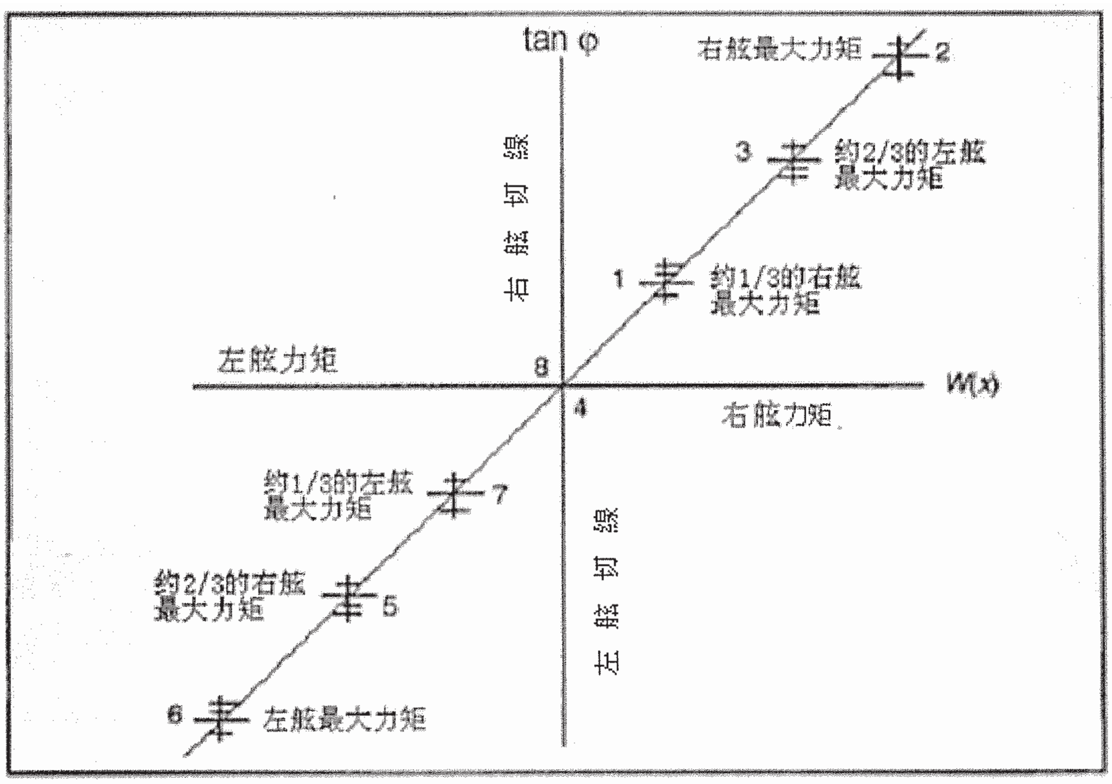


圖 A1-4.3.2-1

標繪出傾斜試驗期間每個擺式傾斜指示器的所有讀數有助於找出錯誤的讀數。由於 *W（x）/tanφ* 應為常量，繪出的線條應為直線。偏離直線表明在傾斜期間有其他力矩作用於船舶。應確定出這些其他力矩，對起因予以糾正，並重複移動壓重，直至得出一條直線。圖 A1-4.3.2-2 至圖 A1-4.3.2-5 顯示了如何探查在傾斜期間的此種其他力矩的示例，並就每種情況建議了解決辦法。為簡化起見，在傾斜圖中只顯示了平均讀數。

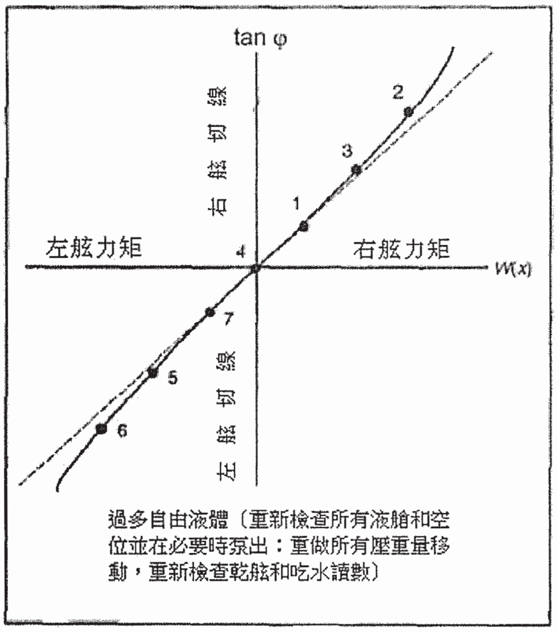


圖 A1-4.3.2-2

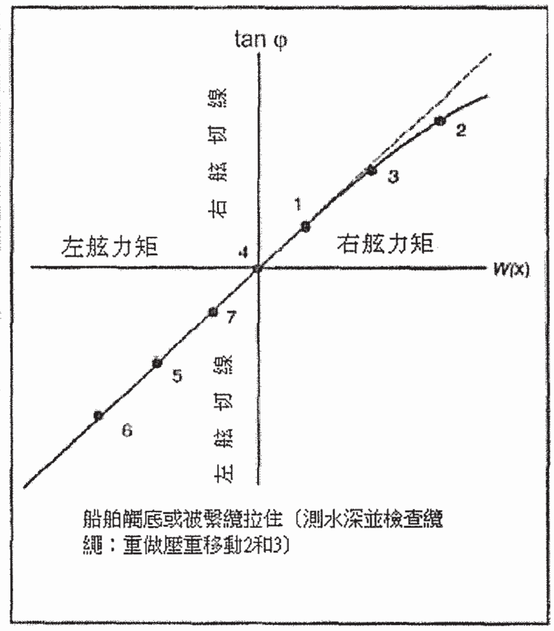


圖 A1-4.3.2-3

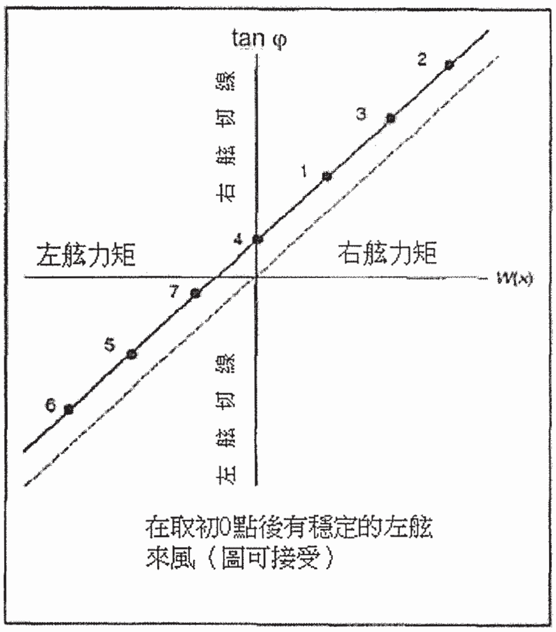


圖 A1-4.3.2-4

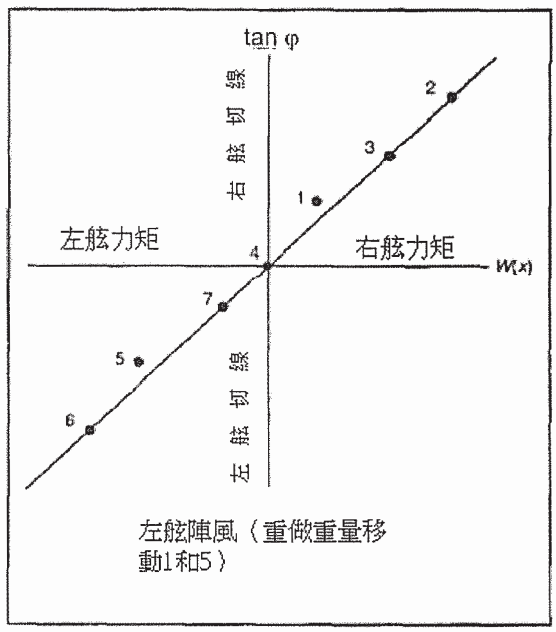


圖 A1-4.3.2-5

4.3.3 一旦所有物品和所有人員就位，便應取零位並應儘快進行試驗的其餘部分，同時要保持準確性和正確的程序，以便將試驗期間環境狀況改變的可能性降至最低。

4.3.4 在讀取每個擺式傾斜指示器的讀數前，每個擺式傾斜指示器位置的人員應在其停止擺動後向控制位置作出報告。然後，由控制位置發出“準備”的警告，接着發出“記錄”的命令。如果發出了“記錄”的命令，應在擺垂線位置的每個點位的壓板上做出標記。如果垂線有輕微擺動，應以擺動中心作為基準。如果任何擺式傾斜指示器的讀取人認為讀數不理想，讀數人應通知控制位置，所有指示器位置應重新取點。同樣，如果控制位置懷疑讀數的準確性，所有指示器位置應重複做一次。在壓板標記邊上應寫上壓重移動的編號，如初始位置為 0，壓重移動為從 1 至 7。

4.3.5 每次壓重移動應在同一方向，通常是橫向移動，以便不改變船舶的縱傾。在每次壓重移動後，應測定壓重移動的距離（中心到中心）並以壓重移動距離乘以壓重量計算傾側力矩。將擺式傾斜指示器的偏轉除以其長度便計算出每一指示器的正切值。將得出的正切值標繪在圖上。只要各傾斜指示器的 $tan\varphi$ 值有良好的一致性，則可用指示器讀數的平均值繪製曲線圖表而不必標繪每一讀數。

4.3.6 應使用傾斜數據表，以便不忘記任何數據，從而使數據清晰、準確並且形式和格式一致。在離船前，進行試驗的人員和主管機關的代表應簽署每張數據表，以表明同意所記錄的數據。

附件 2

關於漁船船長在結冰條件下確保漁船抗受能力的建議

1 離港前

1.1 首先，如同任何季節的任何航行，船長應確保船舶處於總體適航狀況，並充分注意到以下的基本要求：

.1 在季節的規定限制內裝船（下文第 1.2.1 段）；

.2 檢查貨物和進出艙口、船舶甲板和上層建築上的外部門和所有其他開口的關閉裝置的風雨密和可靠性，以及舷窗和在乾舷甲板以下兩舷的舷門或其他類似開口的水密性；

.3 檢查排出口和排水孔的狀況及其關閉裝置的操作可靠性；

.4 應急和救生設備及其操作可靠性；

.5 所有外部和內部通信設備的操作可靠性；以及

.6 艙底水和壓載水泵系統的狀況和操作可靠性。

1.2 另外，特別針對可能的積冰，船長應：

.1 充分注意到燃油和水的消耗、供應品、貨物和漁具的分佈，及慮及可能的積冰的餘量，按照經批准的穩性文件來考慮最不利的裝載狀況；

.2 認識到存放在露天風雨甲板的備用品和漁具因其結冰表面大、重心高而存在危險；

.3 確保船上備有一整批供全體船員穿着的保暖服裝以及一整套抗禦積冰的手工器具和其他設備，小船上這類物品的典型清單見本附件第 4 節；

.4 確保船員熟悉防積冰裝置的位置及其使用，並進行演練以使船員知道其職責並具備必要的實際技能以確保船舶在積冰狀況下的耐受能力；

.5 了解漁場區域和駛往目的地的途中的氣象狀況；研究這一區域的天氣圖和氣象預報；了解漁場附近的暖流、最近海岸線的救濟站、存在的有保護的海灣和冰原位置及其邊界；以及

.6 了解相關漁場區域的無線電台發佈氣象預報和積冰警告的時間表。

2 在海上

2.1 在航行期間和當船舶在漁場時船長應保持獲悉所有長期和短期的天氣預報並應安排對下述系統的氣象觀測做出系統記錄：

.1 空氣和海面溫度；

.2 風向和風力；

.3 波浪的方向和高度及海況；

.4 大氣壓，空氣濕度；以及

.5 每分鐘浪花濺起頻度和船舶上不同部位每小時的積冰密度。

2.2 所有觀測數據應記錄在船舶日誌中。船長應將天氣預報和冰圖與實際氣象狀況作比較，並應估計積冰的概率及其密度。

2.3 當出現結冰危險時，應立即採取以下措施：

.1 應備妥所有抗結冰的裝置；

.2 應停止所有捕撈作業，漁具應收回到船上並放在甲板下處所中。如果做不到，則所有漁具應按風暴狀況固定在其規定位置上。由於漁具結冰面積大且通常懸掛位置較高，因此懸掛着的漁具特別危險；

.3 甲板上裝魚的桶和容器、包裝物、所有器具和備用品以及便攜的機械應存放在圍蔽處所中儘可能低處並緊緊綁住；

.4 貨艙和其他艙室中的所有貨物應存放在儘可能低處並緊緊綁住；

.5 吊貨杆應放下並繫緊；

.6 甲板機械、絞車和小艇應蓋上帆布罩；

.7 救生索應在甲板上繫牢；

.8 裝有蓋子的排水口應處於工作狀況，排水孔和排水口附近和阻擋水從甲板上排出的所有物件應予清除；

.9 所有貨物和升降口艙口、人孔蓋、上層建築和甲板室的風雨密外部門和舷孔應關緊，以確保船舶的完全風雨密，只允許通過上層建築甲板從內部艙室進出露天甲板；

.10 應檢查船上的壓載水量及其位置是否符合“船長穩性指南”中的建議；如果有足夠乾舷，所有裝設壓載水管的空底艙應灌滿海水；

.11 應備妥所有救火、應急和救生設備；

.12 應檢查所有排水系統的有效性；

.13 應檢查甲板照明和探照燈；

.14 應檢查並確定每位船員均有保暖服裝；以及

.15 應建立與岸台和其他船舶的可靠無線電通信；安排好無線電定時呼叫。

2.4 船長應力求使船舶離開危險區域，記住冰原的背風面邊線、暖流區域和受保護的海岸區域是船舶在遇到結冰天氣時的良好庇護區域。

2.5 漁場的小漁船相互間及與大型船舶應保持靠近。

2.6 應記住船舶進入冰原會對船殼造成一定危險，特別是在較高湧浪時。因此船舶進入冰原時應垂直於冰原邊緣線以低速無慣性地進入。頂風進入冰區危險較小。如果船舶必須在尾風時進入冰原，應考慮到受風面的冰緣更厚。重要的是，應在浮冰塊最小處進入冰原。

3 在結冰期間

3.1 如果儘管採取了全部措施，船舶仍不能離開危險區域，則只要船上結冰，就應使用所有手段除冰。

3.2 視船型情況，可採用下述所有或某些防結冰的方法：

.1 以有壓力的冷水沖掉積冰；

.2 用熱水和蒸汽化掉積冰；以及

.3 用冰橇、斧頭、冰鎬、刮刀、大木錘打碎積冰並用鏟清除。

3.3 當結冰開始時，船長應考慮到下述建議並確保其嚴格執行：

.1 立即向船舶所有人報告冰情並與其建立持續無線電通信；

.2 與最近的船舶建立無線電通信並與其保持通信；

.3 不允許所結的冰在船上積聚，立即採取措施從船舶結構物上除冰，即使是上甲板上最薄的冰層和冰渣；

.4 通過測量結冰期間船舶的橫搖周期，不斷檢查船舶穩性。如果橫搖周期明顯增加，應立即採取一切可能措施增加船舶穩性；

.5 確保在露天甲板工作的每位船員穿著保暖服裝並繫有繫固在護欄上的安全繩；

.6 意識到船員從事除冰工作有造成凍傷的危險。因此必須確保定時輪換在甲板上工作的船員；

.7 應首先保持船舶的下述結構物和裝置無冰：

.7.1 天線；

.7.2 工作指示燈和航行燈；

.7.3 排水口和排水孔；

.7.4 救生艇筏；

.7.5 支索、側支索、桅杆和索具；

.7.6 上層建築和甲板室的門；以及

.7.7 起錨機和錨鏈孔；

.8 去除船舶大表面上的冰，從上層建築開始（例如駕駛台、甲板室等），因為上層建築上即使只有很少量的冰也會造成船舶穩性的嚴重惡化；

.9 如果冰的分佈不對稱而引起橫傾，必須首先清除底側的冰。要記住使用把燃料或水從一艙泵到另一液艙來修正船舶橫傾的方法在兩個液艙均未滿裝時會降低穩性；

.10 如因船首有大量積冰而出現縱傾，必須迅速除冰。為了減少縱傾，可重新配置壓載水。

.11 應及時清除排水口和排水孔的冰，以確保積水能從甲板上自由排出；

.12 定期檢查船體內的積水；

.13 避免在順浪中航行，因為這樣會嚴重惡化船舶的穩性；

.14 在船舶日誌中記入結冰的持續時間、性質和程度、船上的冰量，所採取的防積冰措施及其效果；

.15 如果儘管採取了一切措施確保船舶對積冰的耐受能力，船員仍然被迫棄船和登上救生艇筏（救生艇、筏），那麼，為保護生命，必須儘一切可能向所有船員提供保暖服裝或專用保溫袋以及足夠數量的救生索和戽斗以儘快把水舀出救生艇筏。

4 設備和手動工具清單

防結冰所需要的設備和手動工具的典型清單如下：

.1 冰橇或撬棒；

.2 長柄斧；

.3 冰鎬；

.4 金屬刮刀；

.5 金屬鏟；

.6 大木錘；

.7 在開敞甲板兩舷栓設的艏、艉救生繩，上面裝有可連接帶環短索的滑環。

應備有不少於船員人數 50%的帶彈簧鉤的安全帶（但不少於 5 套）。這種安全帶可繫在帶環短索上。

註： 1 船舶所有人可自行決定增加手動工具和救生設備數量。

2 可用於防冰的軟管應在船上隨時可用。

RESOLUTION MSC.267(85)
(adopted on 4 December 2008)

ADOPTION OF THE INTERNATIONAL CODE ON INTACT STABILITY, 2008
(2008 IS CODE)

THE MARITIME SAFETY COMMITTEE,

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

RECALLING ALSO resolution A.749(18) entitled "Code on Intact Stability for All Types of Ships Covered by IMO Instruments", as amended by resolution MSC.75(69),

RECOGNIZING the need to update the aforementioned Code and the importance of establishing mandatory international intact stability requirements,

NOTING resolutions MSC.269(85) and MSC.270(85), by which it adopted, *inter alia*, amendments to the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended (hereinafter referred to as "the 1974 SOLAS Convention") and to the Protocol of 1988 relating to the International Convention on Load Lines, 1966 (hereinafter referred to as "the 1988 Load Lines Protocol"), respectively, to make the introduction and the provisions of part A of the International Code on Intact Stability, 2008 mandatory under the 1974 SOLAS Convention and the 1988 Load Lines Protocol,

HAVING CONSIDERED, at its eighty-fifth session, the text of the proposed International Code on Intact Stability, 2008,

1. ADOPTS the International Code on Intact Stability, 2008 (2008 IS Code), the text of which is set out in the Annex to the present resolution;

2. INVITES Contracting Governments to the 1974 SOLAS Convention and Parties to the 1988 Load Lines Protocol to note that the 2008 IS Code will take effect on 1 July 2010 upon the entry into force of the respective amendments to the 1974 SOLAS Convention and 1988 Load Lines Protocol;

3. REQUESTS the Secretary-General to transmit certified copies of the present resolution and the text of the 2008 IS Code contained in the Annex to all Contracting Governments to the 1974 SOLAS Convention and Parties to the 1988 Load Lines Protocol;

4. FURTHER 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 1974 SOLAS Convention or Parties to the 1988 Load Lines Protocol;

5. RECOMMENDS Governments concerned to use the recommendatory provisions contained in part B of the 2008 IS Code as a basis for relevant safety standards, unless their national stability requirements provide at least an equivalent degree of safety.

ANNEX

INTERNATIONAL CODE ON INTACT STABILITY, 2008
(2008 IS CODE)

CONTENTS

PREAMBLE

1 This Code has been assembled to provide, in a single document, mandatory requirements in the introduction and in part A and recommended provisions in part B relating to intact stability, based primarily on existing IMO instruments. Where recommendations in this Code appear to differ from other IMO Codes, the other Codes should be taken as the prevailing instrument. For the sake of completeness and for the convenience of the user, this Code also contains relevant provisions from mandatory IMO instruments.

2 The criteria included in the Code are based on the best "state-of-the-art" concepts, available at the time they were developed, taking into account sound design and engineering principles and experience gained from operating ships. Furthermore, design technology for modern ships is rapidly evolving and the Code should not remain static but should be re-evaluated and revised, as necessary. To this end, the Organization will periodically review the Code taking into consideration both experience and further development.

3 A number of influences such as the dead ship condition, wind on ships with large windage area, rolling characteristics, severe seas, etc., were taken into account based on the state-of-the-art technology and knowledge at the time of the development of the Code.

4 It was recognized that in view of a wide variety of types, sizes of ships and their operating and environmental conditions, problems of safety against accidents related to stability have generally not yet been solved. In particular, the safety of a ship in a seaway involves complex hydrodynamic phenomena which, up to now, have not been fully investigated and understood. Motion of ships in a seaway should be treated as a dynamical system and relationships between ship and environmental conditions like wave and wind excitations are recognized as extremely important elements. Based on hydrodynamic aspects and stability analysis of a ship in a seaway, stability criteria development poses complex problems that require further research.

INTRODUCTION

1 Purpose

1.1 The purpose of the Code is to present mandatory and recommendatory stability criteria and other measures for ensuring the safe operation of ships, to minimize the risk to such ships, to the personnel on board and to the environment. This introduction and part A of the Code address the mandatory criteria and part B contains recommendations and additional guidelines.

1.2 This Code contains intact stability criteria for the following types of ships and other marine vehicles of 24 m in length and above, unless otherwise stated:

.1 cargo ships;

.2 cargo ships carrying timber deck cargoes;

.3 passenger ships;

.4 fishing vessels;

.5 special purpose ships;

.6 offshore supply vessels;

.7 mobile offshore drilling units;

.8 pontoons; and

.9 cargo ships carrying containers on deck and containerships.

1.3 Administrations may impose additional requirements regarding the design aspects of ships of novel design or ships not otherwise covered by the Code.

2 Definitions

For the purpose of this Code the definitions given hereunder shall apply. For terms used, but not defined in this Code, the definitions as given in the 1974 SOLAS Convention, as amended, shall apply.

2.1 *Administration* means the Government of the State whose flag the ship is entitled to fly.

2.2 *Passenger ship* is a ship which carries more than twelve passengers as defined in regulation I/2 of the 1974 SOLAS Convention, as amended.

2.3 *Cargo ship* is any ship which is not a passenger ship, a ship of war and troopship, a ship which is not propelled by mechanical means, a wooden ship of primitive build, a fishing vessel or a mobile offshore drilling unit.

2.4 *Oil tanker* means a ship constructed or adapted primarily to carry oil in bulk in its cargo spaces and includes combination carriers and any chemical tanker as defined in Annex II of the MARPOL Convention when it is carrying a cargo or part cargo of oil in bulk.

2.4.1 *Combination carrier* means a ship designed to carry either oil or solid cargoes in bulk.

2.4.2 *Crude oil tanker* means an oil tanker engaged in the trade of carrying crude oil.

2.4.3 *Product carrier* means an oil tanker engaged in the trade of carrying oil other than crude oil.

2.5 *Fishing vessel* is a vessel used for catching fish, whales, seals, walrus or other living resources of the sea.

2.6 *Special purpose ship* has the same definition as in the Code of Safety for Special Purpose Ships, 2008 (resolution MSC.266(84)).

2.7 *Offshore supply vessel* means a vessel which is engaged primarily in the transport of stores, materials and equipment to offshore installations and designed with accommodation and bridge erections in the forward part of the vessel and an exposed cargo deck in the after part for the handling of cargo at sea.

2.8 *Mobile offshore drilling unit* (MODU or unit) is a ship capable of engaging in drilling operations for the exploration or exploitation of resources beneath the sea-bed such as liquid or gaseous hydrocarbons, sulphur or salt.

2.8.1 *Column-stabilized unit* is a unit with the main deck connected to the underwater hull or footings by columns or caissons.

2.8.2 *Surface unit* is a unit with a ship- or barge-type displacement hull of single or multiple hull construction intended for operation in the floating condition.

2.8.3 *Self-elevating unit* is a unit with moveable legs capable of raising its hull above the surface of the sea.

2.8.4 *Coastal State* means the Government of the State exercising administrative control over the drilling operations of the unit.

2.8.5 *Mode of operation* means a condition or manner in which a unit may operate or function while on location or in transit. The modes of operation of a unit include the following:

.1 *operating conditions* means conditions wherein a unit is on location for the purpose of conducting drilling operations, and combined environmental and operational loadings are within the appropriate design limits established for such operations. The unit may be either afloat or supported on the sea-bed, as applicable;

.2 *severe storm conditions* means conditions wherein a unit may be subjected to the most severe environmental loadings for which the unit is designed. Drilling operations are assumed to have been discontinued due to the severity of the environmental loadings, the unit may be either afloat or supported on the sea-bed, as applicable; and

.3 *transit conditions* means conditions wherein a unit is moving from one geographical location to another.

2.9 *High-speed craft* (HSC) is a craft capable of a maximum speed, in metres per second (m/s), equal to or exceeding:

$3.7 * \nabla^{0.1667}$

where: ∇ = displacement corresponding to the design waterline (m^3).

2.10 *Containership* means a ship which is used primarily for the transport of marine containers.

2.11 *Freeboard* is the distance between the assigned load line and freeboard deck.

2.12 *Length of ship*. The length should be taken as 96% of the total length on a waterline at 85% of the least moulded depth measured from the top of the keel, or as the length from the fore side of the stem to the axis of the rudder stock on the waterline, if that be greater. In ships designed with a rake of keel the waterline on which this length is measured should be parallel to the designed waterline.

2.13 *Moulded breadth* is the maximum breadth of the ship measured amidships to the moulded line of the frame in a ship with a metal shell and to the outer surface of the hull in a ship with a shell of any other material.

2.14 *Moulded depth* is the vertical distance measured from the top of the keel to the top of the freeboard deck beam at side. In wood and composite ships, the distance is measured from the lower edge of the keel rabbet. Where the form at the lower part of the midship section is of a hollow character, or where thick garboards are fitted, the distance is measured from the point where the line of the flat of the bottom continued inwards cuts the side of the keel. In ships having rounded gunwales, the moulded depth should be measured to the point of intersection of the moulded lines of the deck and side shell plating, the lines extending as though the gunwale were of angular design. Where the freeboard deck is stepped and the raised part of the deck extends over the point at which the moulded depth is to be determined, the moulded depth should be measured to a line of reference extending from the lower part of the deck along a line parallel with the raised part.

2.15 *Near-coastal voyage* means a voyage in the vicinity of the coast of a State as defined by the Administration of that State.

2.16 *Pontoon* is considered to be normally:

.1 non self-propelled;

.2 unmanned;

.3 carrying only deck cargo;

.4 having a block coefficient of 0.9 or greater;

.5 having a breadth/depth ratio of greater than 3; and

.6 having no hatchways in the deck except small manholes closed with gasketed covers.

2.17 *Timber* means sawn wood or lumber, cants, logs, poles, pulpwood and all other types of timber in loose or packaged forms. The term does not include wood pulp or similar cargo.

2.18 *Timber deck cargo* means a cargo of timber carried on an uncovered part of a freeboard or superstructure deck. The term does not include wood pulp or similar cargo.

2.19 *Timber load line* means a special load line assigned to ships complying with certain conditions related to their construction set out in the International Convention on Load Lines, 1966, or the Protocol of 1988, as amended, and used when the cargo complies with the stowage and securing conditions of the Code of Safe Practice for Ships Carrying Timber Deck Cargoes, 1991 (resolution A.715(17)).

2.20 *Certification of the inclining test weights* is the verification of the weight marked on a test weight. Test weights should be certified using a certificated scale. The weighing should be performed close enough in time to the inclining test to ensure the measured weight is accurate.

2.21 *Draught* is the vertical distance from the moulded baseline to the waterline.

2.22 The *inclining test* involves moving a series of known weights, normally in the transverse direction, and then measuring the resulting change in the equilibrium heel angle of the ship. By using this information and applying basic naval architecture principles, the ship's vertical centre of gravity (VCG) is determined.

2.23 *Lightship condition* is a ship complete in all respects, but without consumables, stores, cargo, crew and effects, and without any liquids on board except that machinery and piping fluids, such as lubricants and hydraulics, are at operating levels.

2.24 *Lightweight survey* involves taking an audit of all items which should be added, deducted or relocated on the ship at the time of the inclining test so that the observed condition of the ship can be adjusted to the lightship condition. The mass, longitudinal, transverse and vertical location of each item should be accurately determined and recorded. Using this information, the static waterline of the ship at the time of the inclining test as determined from measuring the freeboard or verified draught marks of the ship, the ship's hydrostatic data, and the sea water density, the lightship displacement and longitudinal centre of gravity (LCG) can be obtained. The transverse centre of gravity (TCG) may also be determined for mobile offshore drilling units (MODUs) and other ships which are asymmetrical about the centreline or whose internal arrangement or outfitting is such that an inherent list may develop from off-centre mass.

2.25 *In-service inclining test* means an inclining test which is performed in order to verify the pre-calculated *GM* and the deadweight's centre of gravity of an actual loading condition.

2.26 *Stability instrument* is an instrument installed on board a particular ship by means of which it can be ascertained that stability requirements specified for the ship in the Stability Booklet are met in any operational loading condition. The stability instrument comprises hardware and software.

PART A

MANDATORY CRITERIA

CHAPTER 1 – GENERAL

1.1 Application

1.1.1 The criteria stated under chapter 2 of this part present a set of minimum requirements that shall apply to cargo and passenger ships of 24 m in length and over.

1.1.2 The criteria stated under chapter 3 are special criteria for certain types of ships. For the purpose of part A the definitions given in the Introduction apply.

1.2 Dynamic stability phenomena in waves

Administrations shall be aware that some ships are more at risk of encountering critical stability situations in waves. Necessary precautionary provisions may need to be taken in the design to address the severity of such phenomena. The phenomena in seaways which may cause large roll angles and/or accelerations have been identified hereunder.

Having regard to the phenomena described in this section, the Administration may for a particular ship or group of ships apply criteria demonstrating that the safety of the ship is sufficient. Any Administration which applies such criteria should communicate to the Organization particulars thereof. It is recognized by the Organization that performance oriented criteria for the identified phenomena listed in this section need to be developed and implemented to ensure a uniform international level of safety.

1.2.1 *Righting lever variation*

Any ship exhibiting large righting lever variations between wave trough and wave crest condition may experience parametric roll or pure loss of stability or combinations thereof.

1.2.2 *Resonant roll in dead ship condition*

Ships without propulsion or steering ability may be endangered by resonant roll while drifting freely.

1.2.3 *Broaching and other manoeuvring related phenomena*

Ships in following and quartering seas may not be able to keep constant course despite maximum steering efforts which may lead to extreme angles of heel.

CHAPTER 2 – GENERAL CRITERIA

2.1 General

2.1.1 All criteria shall be applied for all conditions of loading as set out in part B, 3.3 and 3.4.

2.1.2 Free surface effects (part B, 3.1) shall be accounted for in all conditions of loading as set out in part B, 3.3 and 3.4.

2.1.3 Where anti-rolling devices are installed in a ship, the Administration shall be satisfied that the criteria can be maintained when the devices are in operation and that failure of power supply or the failure of the device(s) will not result in the vessel being unable to meet the relevant provisions of this Code.

2.1.4 A number of influences such as icing of topsides, water trapped on deck, etc., adversely affect stability and the Administration is advised to take these into account, so far as is deemed necessary.

2.1.5 Provisions shall be made for a safe margin of stability at all stages of the voyage, regard being given to additions of weight, such as those due to absorption of water and icing (details regarding ice accretion are given in part B, chapter 6 – Icing considerations) and to losses of weight such as those due to consumption of fuel and stores.

2.1.6 Each ship shall be provided with a stability booklet, approved by the Administration, which contains sufficient information (see part B, 3.6) to enable the master to operate the ship in compliance with the applicable requirements contained in the Code. If a stability instrument is used as a supplement to the stability booklet for the purpose of determining compliance with the relevant stability criteria such instrument shall be subject to the approval by the Administration (see part B, chapter 4 – Stability calculations performed by stability instruments).

2.1.7 If curves or tables of minimum operational metacentric height (GM) or maximum centre of gravity (VCG) are used to ensure compliance with the relevant intact stability criteria those limiting curves shall extend over the full range of operational trims, unless the Administration agrees that trim effects are not significant. When curves or tables of minimum operational metacentric height (GM) or maximum centre of gravity (VCG) versus draught covering the operational trims are not available, the master must verify that the operating condition does not deviate from a studied loading condition, or verify by calculation that the stability criteria are satisfied for this loading condition taking into account trim effects.

2.2 Criteria regarding righting lever curve properties

2.2.1 The area under the righting lever curve (GZ curve) shall not be less than 0.055 metre-radians up to φ = 30° angle of heel and not less than 0.09 metre-radians up to φ = 40° or the angle of down-flooding φ_f if this angle is less than 40°. Additionally, the area under the righting lever curve (GZ curve) between the angles of heel of 30° and 40° or between 30° and φ_f, if this angle is less than 40°, shall not be less than 0.03 metre-radians.

2.2.2 The righting lever GZ shall be at least 0.2 m at an angle of heel equal to or greater than 30°.

2.2.3 The maximum righting lever shall occur at an angle of heel not less than 25°. If this is not practicable, alternative criteria, based on an equivalent level of safety, may be applied subject to the approval of the Administration.

2.2.4 The initial metacentric height GM_0 shall not be less than 0.15 m.

2.3 Severe wind and rolling criterion (weather criterion)

2.3.1 The ability of a ship to withstand the combined effects of beam wind and rolling shall be demonstrated, with reference to figure 2.3.1 as follows:

.1 the ship is subjected to a steady wind pressure acting perpendicular to the ship's centreline which results in a steady wind heeling lever (l_{w1});

.2 from the resultant angle of equilibrium (φ_0), the ship is assumed to roll owing to wave action to an angle of roll (φ_1) to windward. The angle of heel under action of steady wind (φ_0) should not exceed 16° or 80% of the angle of deck edge immersion, whichever is less;

.3 the ship is then subjected to a gust wind pressure which results in a gust wind heeling lever (l_{w2}); and

.4 under these circumstances, area *b* shall be equal to or greater than area *a*, as indicated in figure 2.3.1 below:

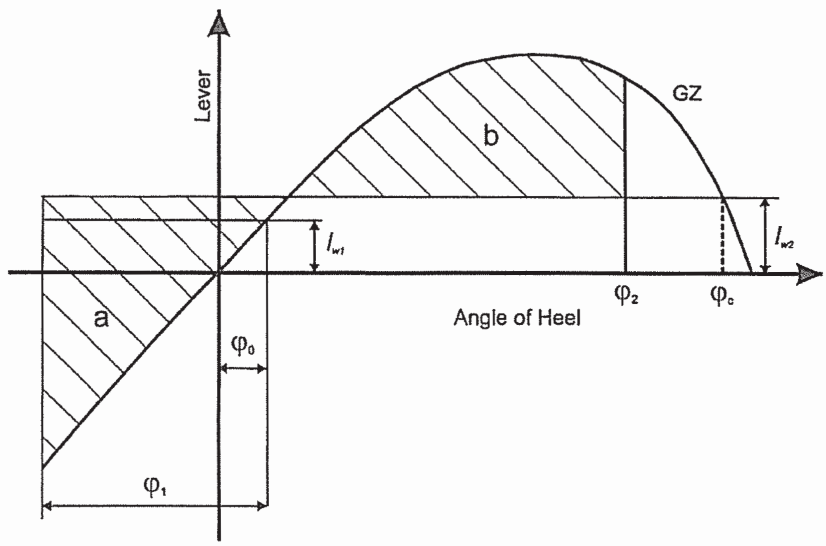


Figure 2.3.1 – Severe wind and rolling

where the angles in figure 2.3.1 are defined as follows:

φ_0 = angle of heel under action of steady wind

φ_1 = angle of roll to windward due to wave action (see 2.3.1.2, 2.3.4)

φ_2 = angle of down-flooding (φ_f) or 50° or φ_c, whichever is less,

where:

φ_f = angle of heel at which openings in the hull, superstructures or deckhouses which cannot be closed weathertight immerse. In applying this criterion, small openings through which progressive flooding cannot take place need not be considered as open

φ_c = angle of second intercept between wind heeling lever l_{w2} and GZ curves.

2.3.2 The wind heeling levers l_{w1} and l_{w2} referred to in 2.3.1.1 and 2.3.1.3 are constant values at all angles of inclination and shall be calculated as follows:

$$l_{w_1} = \frac{P * A * Z}{1000 * g * \Delta} \quad (m) \quad \text{and}$$

$$l_{w_2} = 1.5 * l_{w_1} \quad (m)$$

where:

P = wind pressure of 504 Pa. The value of P used for ships in restricted service may be reduced subject to the approval of the Administration

A = projected lateral area of the portion of the ship and deck cargo above the waterline (m^2)

Z = vertical distance from the centre of A to the centre of the underwater lateral area or approximately to a point at one half the mean draught (m)

Δ = displacement (t)

g = gravitational acceleration of 9.81 m/s^2.

2.3.3 Alternative means for determining the wind heeling lever (l_{w1}) may be accepted, to the satisfaction of the Administration, as an equivalent to calculation in 2.3.2. When such alternative tests are carried out, reference shall be made based on the Guidelines developed by the Organization. The wind velocity used in the tests shall be 26 m/s in full scale with uniform velocity profile. The value of wind velocity used for ships in restricted services may be reduced to the satisfaction of the Administration.

2.3.4 The angle of roll (φ_1) referred to in 2.3.1.2 shall be calculated as follows:

$$\varphi_1 = 109 * k * X_1 * X_2 * \sqrt{r * s} \quad (degrees)$$

where:

X_1 = factor as shown in table 2.3.4-1

X_2 = factor as shown in table 2.3.4-2

k = factor as follows:

k = 1.0 for round-bilged ship having no bilge or bar keels

k = 0.7 for a ship having sharp bilges

k = as shown in table 2.3.4-3 for a ship having bilge keels, a bar keel or both

r = $0.73 + 0.6\ OG/d$

with:

OG = KG – d

d = mean moulded draught of the ship (m)

s = factor as shown in table 2.3.4-4, where T is the ship roll natural period. In absence of sufficient information, the following approximate formula can be used:

Rolling period $$T = \frac{2 * C * B}{\sqrt{GM}} \ (s)$$

where:

$$C = 0.373 + 0.023(B/d) - 0.043(L_{wl}/100).$$

The symbols in tables 2.3.4-1, 2.3.4-2, 2.3.4-3 and 2.3.4-4 and the formula for the rolling period are defined as follows:

L_{wl} = length of the ship at waterline (m)

B = moulded breadth of the ship (m)

d = mean moulded draught of the ship (m)

C_B = block coefficient (-)

A_k = total overall area of bilge keels, or area of the lateral projection of the bar keel, or sum of these areas (m^2)

GM = metacentric height corrected for free surface effect (m).

Table 2.3.4-1 – Values of factor X_1

B/d	X_1
≤ 2.4	1.0
2.5	0.98
2.6	0.96
2.7	0.95
2.8	0.93
2.9	0.91
3.0	0.90
3.1	0.88
3.2	0.86
3.4	0.82
≥ 3.5	0.80

Table 2.3.4-2 – Values of factor X_2

C_B	X_2
≤ 0.45	0.75
0.50	0.82
0.55	0.89
0.60	0.95
0.65	0.97
≥ 0.70	1.00

Table 2.3.4-3 – Values of factor k

$\frac{A_k \times 100}{L_{WL} \times B}$	k
0	1.0
1.0	0.98
1.5	0.95
2.0	0.88
2.5	0.79
3.0	0.74
3.5	0.72
≥ 4.0	0.70

Table 2.3.4-4 – Values of factor s

T	s
≤ 6	0.100
7	0.098
8	0.093
12	0.065
14	0.053
16	0.044
18	0.038
≥ 20	0.035

(Intermediate values in these tables shall be obtained by linear interpolation)

2.3.5 The tables and formulae described in 2.3.4 are based on data from ships having:

.1 *B/d* smaller than 3.5;

.2 *(KG/d-1)* between - 0.3 and 0.5; and

.3 *T* smaller than 20 s.

For ships with parameters outside of the above limits the angle of roll (φ_1) may be determined with model experiments of a subject ship with the procedure described in MSC.1/Circ.1200 as the alternative. In addition, the Administration may accept such alternative determinations for any ship, if deemed appropriate.

CHAPTER 3 – SPECIAL CRITERIA FOR CERTAIN TYPES OF SHIPS

3.1 Passenger ships

Passenger ships shall comply with the requirements of 2.2 and 2.3.

3.1.1 In addition, the angle of heel on account of crowding of passengers to one side as defined below shall not exceed 10°.

3.1.1.1 A minimum weight of 75 kg shall be assumed for each passenger except that this value may be increased subject to the approval of the Administration. In addition, the mass and distribution of the luggage shall be approved by the Administration.

3.1.1.2 The height of the centre of gravity for passengers shall be assumed equal to:

.1 1 m above deck level for passengers standing upright. Account may be taken, if necessary, of camber and sheer of deck; and

.2 0.3 m above the seat in respect of seated passengers.

3.1.1.3 Passengers and luggage shall be considered to be in the spaces normally at their disposal, when assessing compliance with the criteria given in 2.2.1 to 2.2.4.

3.1.1.4 Passengers without luggage shall be considered as distributed to produce the most unfavourable combination of passenger heeling moment and/or initial metacentric height, which may be obtained in practice, when assessing compliance with the criteria given in 3.1.1 and 3.1.2, respectively. In this connection, a value higher than four persons per square metre is not necessary.

3.1.2 In addition, the angle of heel on account of turning shall not exceed 10° when calculated using the following formula:

$$M_R = 0.200 * \frac{v_0^2}{L_{WL}} * \Delta * \left(KG - \frac{d}{2} \right)$$

where:

M_R = heeling moment (kNm)

v_o = service speed (m/s)

L_{WL} = length of ship at waterline (m)

Δ = displacement (t)

d = mean draught (m)

KG = height of centre of gravity above baseline (m).

3.2 Oil tankers of 5,000 tonnes deadweight and above

Oil tankers, as defined in section 2 (Definitions) of the Introduction, shall comply with regulation 27 of Annex I to MARPOL 73/78.

3.3 Cargo ships carrying timber deck cargoes

Cargo ships carrying timber deck cargoes shall comply with the requirements of 2.2 and 2.3 unless the Administration is satisfied with the application of alternative provision 3.3.2.

3.3.1 *Scope*

The provisions given hereunder apply to all ships of 24 m in length and over engaged in the carriage of timber deck cargoes. Ships that are provided with, and make use of, their timber load line shall also comply with the requirements of regulations 41 to 45 of the 1966 Load Lines Convention and the Protocol of 1988 relating thereto.

3.3.2 *Alternative stability criteria*

For ships loaded with timber deck cargoes and provided that the cargo extends longitudinally between superstructures (where there is no limiting superstructure at the after end, the timber deck cargo shall extend at least to the after end of the aftermost hatchway) transversely for the full beam of ship, after due allowance for a rounded gunwale, not exceeding 4% of the breadth of the ship and/or securing the supporting uprights and which remains securely fixed at large angles of heel may be:

3.3.2.1 The area under the righting lever curve (GZ curve) shall not be less than 0.08 metre-radians up to $\varphi = 40°$ or the angle of flooding if this angle is less than 40°.

3.3.2.2 The maximum value of the righting lever (GZ) shall be at least 0.25 m.

3.3.2.3 At all times during a voyage, the metacentric height GM shall not be less than 0.1 m, taking into account the absorption of water by the deck cargo and/or ice accretion on the exposed surfaces (details regarding ice accretion are given in part B, chapter 6 (Icing considerations)).

3.3.2.4 When determining the ability of the ship to withstand the combined effects of beam wind and rolling according to 2.3, the 16° limiting angle of heel under action of steady wind shall be complied with, but the additional criterion of 80% of the angle of deck edge immersion may be ignored.

3.4 Cargo ships carrying grain in bulk

The intact stability of ships engaged in the carriage of grain shall comply with the requirements of the International Code for the Safe Carriage of Grain in Bulk adopted by resolution MSC.23(59).

3.5 High-speed craft

High-speed craft, as defined in section 2 (Definitions) of the Introduction, constructed on or after 1 January 1996 but before 1 July 2002, to which chapter X of the 1974 SOLAS Convention applies, shall comply with stability requirements of the 1994 HSC Code (resolution MSC.36(63)). Any high-speed craft to which chapter X of the 1974 SOLAS Convention applies, irrespective of its date of construction, which has undergone repairs, alterations or modifications of a major character; and a high-speed craft constructed on or after 1 July 2002, shall comply with stability requirements of the 2000 HSC Code (resolution MSC.97(73)).

PART B

RECOMMENDATIONS FOR CERTAIN TYPES OF SHIPS AND ADDITIONAL GUIDELINES

CHAPTER 1 – GENERAL

1.1 Purpose

The purpose of this part of the Code is to:

.1 recommend stability criteria and other measures for ensuring the safe operation of certain types of ships to minimize the risk to such ships, to the personnel on board and to the environment; and

.2 provide guidelines for stability information, operational provisions against capsizing, icing considerations, considerations for watertight integrity and the determination of lightship parameters.

1.2 Application

1.2.1 This part of the Code contains recommended intact stability criteria for certain types of ships and other marine vehicles not included in part A or intended to supplement those of part A in particular cases regarding size or operation.

1.2.2 Administrations may impose additional requirements regarding the design aspects of ships of novel design or ships not otherwise covered by the Code.

1.2.3 The criteria stated in this part should give guidance to Administrations if no national requirements are applied.

CHAPTER 2 – RECOMMENDED DESIGN CRITERIA FOR CERTAIN TYPES OF SHIPS

2.1 Fishing vessels

2.1.1 *Scope*

The provisions given hereunder apply to decked seagoing fishing vessels as defined in section 2 (Definitions) of the Introduction. The stability criteria given in 2.1.3 and 2.1.4 below should be complied with for all conditions of loading as specified in 3.4.1.6, unless the Administration is satisfied that operating experience justifies departures therefrom.

2.1.2 *General precautions against capsizing*

Apart from general precautions referred to in part B, 5.1, 5.2 and 5.3, the following measures should be considered as preliminary guidance on matters influencing safety as related to stability:

.1 all fishing gear and other heavy material should be properly stowed and placed as low in the vessel as possible;

.2 particular care should be taken when pull from fishing gear might have a negative effect on stability, e.g., when nets are hauled by power-block or the trawl catches obstructions on the sea-bed. The pull of the fishing gear should be from as low a point on the vessel, above the waterline, as possible;

.3 gear for releasing the deck load in fishing vessels which carry the catch on deck, e.g., herring, should be kept in good working condition;

.4 when the main deck is prepared for carrying deck load by dividing it with pound boards, there should be slots between them of suitable size to allow easy flow of water to freeing ports, thus preventing trapping of water;

.5 to prevent a shift of the fish load carried in bulk, portable divisions in the holds should be properly installed;

.6 reliance on automatic steering may be dangerous as this prevents changes to course which may be needed in bad weather;

.7 necessary care should be taken to maintain adequate freeboard in all loading conditions, and where load line regulations are applicable they should be strictly adhered to at all times; and

.8 particular care should be taken when the pull from fishing gear results in dangerous heel angles. This may occur when fishing gear fastens onto an underwater obstacle or when handling fishing gear, particularly on purse seiners, or when one of the trawl wires tears off. The heel angles caused by the fishing gear in these situations may be eliminated by employing devices which can relieve or remove excessive forces applied through the fishing gear. Such devices should not impose a danger to the vessel through operating in circumstances other than those for which they were intended.

2.1.3 ***Recommended general criteria***

2.1.3.1 The general intact stability criteria given in part A, 2.2.1 to 2.2.3 should apply to fishing vessels having a length of 24 m and over, with the exception of requirements on the initial metacentric height GM (part A, 2.2.4), which, for fishing vessels, should not be less than 0.35 m for single-deck vessels. In vessels with complete superstructure or vessels of 70 m in length and over the metacentric height may be reduced to the satisfaction of the Administration but in no case should be less than 0.15 m.

2.1.3.2 The adoption by individual countries of simplified criteria which apply such basic stability values to their own types and classes of vessels is recognized as a practical and valuable method of economically judging the stability.

2.1.3.3 Where arrangements other than bilge keels are provided to limit the angle of roll, the Administration should be satisfied that the stability criteria referred to in 2.1.3.1 are maintained in all operating conditions.

2.1.4 ***Severe wind and rolling criterion (weather criterion) for fishing vessels***

2.1.4.1 The Administration may apply the provisions of part A, 2.3 to fishing vessels of 45 m length and over.

2.1.4.2 For fishing vessels in the length range between 24 m and 45 m, the Administration may apply the provisions of part A, 2.3. Alternatively the values of wind pressure (see part A, 2.3.2) may be taken from the following table:

h (m)	1	2	3	4	5	6 and over
P (Pa)	316	386	429	460	485	504

where *h* is the vertical distance from the centre of the projected vertical area of the vessel above the waterline, to the waterline.

2.1.5 ***Recommendation for an interim simplified stability criterion for decked fishing vessels under 30 m in length***

2.1.5.1 For decked vessels with a length less than 30 m, the following approximate formula for the minimum metacentric height GM_{min} (in metres) for all operating conditions should be used as the criterion:

$$GM_{\min} = 0.53 + 2B\left[0.075 - 0.37\left(\frac{f}{B}\right) + 0.82\left(\frac{f}{B}\right)^2 - 0.014\left(\frac{B}{D}\right) - 0.032\left(\frac{l_s}{L}\right)\right]$$

where:

L is the length of the vessel on the waterline in maximum load condition (m)

l_s is the actual length of enclosed superstructure extending from side to side of the vessel (m)

B is the extreme breadth of the vessel on the waterline in maximum load condition (m)

D is the depth of the vessel measured vertically amidships from the base line to the top of the upper deck at side (m)

f is the smallest freeboard measured vertically from the top of the upper deck at side to the actual waterline (m).

The formula is applicable for vessels having:

.1 f/B between 0.02 and 0.2;

.2 l_s/L smaller than 0.6;

.3 B/D between 1.75 and 2.15;

.4 sheer fore and aft at least equal to or exceeding the standard sheer prescribed in regulation 38(8) of the International Convention on Load Lines, 1966 or the Protocol of 1988 as amended, as applicable; and

.5 height of superstructure included in the calculation is not less than 1.8 m.

For ships with parameters outside the above limits the formula should be applied with special care.

2.1.5.2 The above formula is not intended as a replacement for the basic criteria given in 2.1.3 and 2.1.4 but is to be used only if circumstances are such that cross curves of stability, KM curve and subsequent GZ curves are not and cannot be made available for judging a particular vessel's stability.

2.1.5.3 The calculated value of GM, should be compared with actual GM values of the vessel in all loading conditions. If an inclining experiment based on estimated displacement, or another approximate method of determining the actual GM is used, a safety margin should be added to the calculated GM_{min}.

2.2 Pontoons

2.2.1 *Application*

The provisions given hereunder apply to seagoing pontoons. A pontoon is considered to be normally:

.1 non self-propelled;

.2 unmanned;

.3 carrying only deck cargo;

.4 having a block coefficient of 0.9 or greater;

.5 having a breadth/depth ratio of greater than 3; and

.6 having no hatchways in the deck except small manholes closed with gasketed covers.

2.2.2 ***Stability drawings and calculations***

The following information is typical of that required to be submitted to the Administration for approval:

.1 lines drawing;

.2 hydrostatic curves;

.3 cross curves of stability;

.4 report of draught and density readings and calculation of lightship displacement and longitudinal centre of gravity;

.5 statement of justification of assumed vertical centre of gravity; and

.6 simplified stability guidance such as a loading diagram, so that the pontoon may be loaded in compliance with the stability criteria.

2.2.3 ***Concerning the performance of calculations***

The following guidance is suggested:

.1 no account should be taken of the buoyancy of deck cargo (except buoyancy credit for adequately secured timber);

.2 consideration should be given to such factors as water absorption (e.g., timber), trapped water in cargo (e.g., pipes) and ice accretion;

.3 in performing wind heel calculations:

.3.1 the wind pressure should be constant and for general operations be considered to act on a solid mass extending over the length of the cargo deck and to an assumed height above the deck;

.3.2 the centre of gravity of the cargo should be assumed at a point mid-height of the cargo; and

.3.3 the wind lever should be taken from the centre of the deck cargo to a point at one half the mean draught;

.4 calculations should be performed covering the full range of operating draughts; and

.5 the down-flooding angle should be taken as the angle at which an opening through which progressive flooding may take place is immersed. This would not be an opening closed by a watertight manhole cover or a vent fitted with an automatic closure.

2.2.4 ***Intact stability criteria***

2.2.4.1 The area under the righting lever curve up to the angle of maximum righting lever should not be less than 0.08 metre-radians.

2.2.4.2 The static angle of heel due to a uniformly distributed wind load of 540 Pa (wind speed 30 m/s) should not exceed an angle corresponding to half the freeboard for the relevant loading condition, where the lever of wind heeling moment is measured from the centroid of the windage area to half the draught.

2.2.4.3 The minimum range of stability should be:

for $L \leq 100$ m:	20°;
for $L \geq 150$ m:	15°;
for intermediate length:	by interpolation.

2.3 Containerships greater than 100 m

2.3.1 ***Application***

These requirements apply to containerships greater than 100 m in length as defined in section 2 (Definitions) of the Introduction. They may also be applied to other cargo ships in this length range with considerable flare or large water plane areas. The Administration may apply the following criteria instead of those in part A, 2.2.

2.3.2 ***Intact stability***

2.3.2.1 The area under the righting lever curve (GZ curve) should not be less than $0.009/C$ metre-radians up to $\varphi = 30°$ angle of heel, and not less than $0.016/C$ metre-radians up to $\varphi = 40°$ or the angle of flooding φ_f (as defined in part A, 2.2) if this angle is less than 40°.

2.3.2.2 Additionally, the area under the righting lever curve (GZ curve) between the angles of heel of 30° and 40° or between 30° and φ_f, if this angle is less than 40°, should not be less than $0.006/C$ metre-radians.

2.3.2.3 The righting lever GZ should be at least $0.033/C$ m at an angle of heel equal or greater than 30°.

2.3.2.4 The maximum righting lever GZ should be at least $0.042/C$ m.

2.3.2.5 The total area under the righting lever curve (GZ curve) up to the angle of flooding φ_f should not be less than $0.029/C$ metre-radians.

2.3.2.6 In the above criteria the form factor C should be calculated using the formula and figure 2.3-1:

$$C = \frac{d\,D'}{B_m^2}\sqrt{\frac{d}{KG}}\left(\frac{C_B}{C_W}\right)^2\sqrt{\frac{100}{L}}$$

where:

d = mean draught (m)

D' = moulded depth of the ship, corrected for defined parts of volumes within the hatch coamings according to the formula:

$$D' = D + h\left(\frac{2b - B_D}{B_D}\right)\left(\frac{2\Sigma l_H}{L}\right),$$ as defined in figure 2.3-1;

D = moulded depth of the ship (m);

B_D = moulded breadth of the ship (m);

KG = height of the centre of mass above base, corrected for free surface effect, not be taken as less than d (m);

C_B = block coefficient;

C_W = water plane coefficient;

l_H = length of each hatch coaming within L/4 forward and aft from amidships (m) (see figure 2.3-1);

b = mean width of hatch coamings within L/4 forward and aft from amidships (m) (see figure 2.3-1);

h = mean height of hatch coamings within L/4 forward and aft from amidships (m) (see figure 2.3-1);

L = length of the ship (m);

B = breadth of the ship on the waterline (m);

B_m = breadth of the ship on the waterline at half mean draught (m).

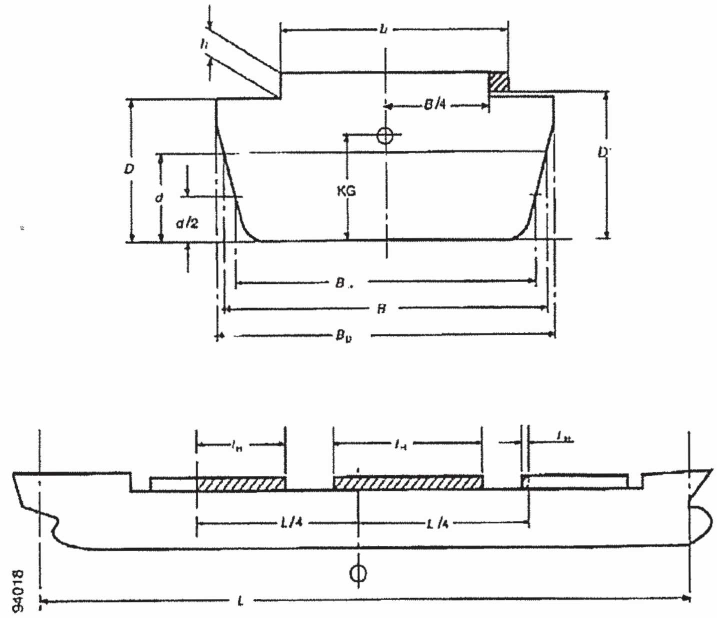


Figure 2.3-1

The shaded areas in figure 2.3-1 represent partial volumes within the hatch coamings considered contributing to resistance against capsizing at large heeling angles when the ship is on a wave crest.

2.3.2.7 The use of electronic loading and stability instrument is encouraged in determining the ship's trim and stability during different operational conditions.

2.4 Offshore supply vessels

2.4.1 *Application*

2.4.1.1 The provisions given hereunder apply to offshore supply vessels, as defined in section 2 (Definitions) of the Introduction, of 24 m in length and over. The alternative stability criteria contained in 2.4.5 apply to vessels of not more than 100 m in length.

2.4.1.2 For a vessel engaged in near-coastal voyages, as defined in section "Definitions", the principles given in 2.4.2 should guide the Administration in the development of its national standards. Relaxations from the requirements of the Code may be permitted by an Administration for vessels engaged in near-coastal voyages off its own coasts provided the operating conditions are, in the opinion of that Administration, such as to render compliance with the provisions of the Code unreasonable or unnecessary.

2.4.1.3 Where a ship other than an offshore supply vessel, as defined in section "Definitions", is employed on a similar service, the Administration should determine the extent to which compliance with the provisions of the Code is required.

2.4.2 *Principles governing near-coastal voyages*

2.4.2.1 The Administration defining near-coastal voyages for the purpose of the present Code should not impose design and construction standards for a vessel entitled to fly the flag of another State and engaged in such voyages in a manner resulting in a more stringent standard for such a vessel than for a vessel entitled to fly its own flag. In no case should the Administration impose, in respect of a vessel entitled to fly the flag of another State, standards in excess of the Code for a vessel not engaged in near-coastal voyages.

2.4.2.2 With respect to a vessel regularly engaged in near-coastal voyages off the coast of another State the Administration should prescribe design and construction standards for such a vessel at least equal to those prescribed by the Government of the State off whose coast the vessel is engaged, provided such standards do not exceed the Code in respect of a vessel not engaged in near-coastal voyages.

2.4.2.3 A vessel which extends its voyages beyond a near-coastal voyage should comply with the present Code.

2.4.3 ***Constructional precautions against capsizing***

2.4.3.1 Access to the machinery space should, if possible, be arranged within the forecastle. Any access to the machinery space from the exposed cargo deck should be provided with two weathertight closures. Access to spaces below the exposed cargo deck should preferably be from a position within or above the superstructure deck.

2.4.3.2 The area of freeing ports in the side bulwarks of the cargo deck should at least meet the requirements of regulation 24 of the International Convention on Load Lines, 1966 or the Protocol of 1988 relating thereto, as amended, as applicable. The disposition of the freeing ports should be carefully considered to ensure the most effective drainage of water trapped in pipe deck cargoes or in recesses at the after end of the forecastle. In vessels operating in areas where icing is likely to occur, no shutters should be fitted in the freeing ports.

2.4.3.3 The Administration should give special attention to adequate drainage of pipe stowage positions having regard to the individual characteristics of the vessel. However, the area provided for drainage of the pipe stowage positions should be in excess of the required freeing port area in the cargo deck bulwarks and should not be fitted with shutters.

2.4.3.4 A vessel engaged in towing operations should be provided with means for quick release of the towing hawser.

2.4.4 ***Operational procedures against capsizing***

2.4.4.1 The arrangement of cargo stowed on deck should be such as to avoid any obstruction of the freeing ports or of the areas necessary for the drainage of pipe stowage positions to the freeing ports.

2.4.4.2 A minimum freeboard at the stern of at least 0.005 L should be maintained in all operating conditions.

2.4.5 ***Stability criteria***

2.4.5.1 The stability criteria given in part A, 2.2 should apply to all offshore supply vessels except those having characteristics which render compliance with part A, 2.2 impracticable.

2.4.5.2 The following equivalent criteria should be applied where a vessel's characteristics render compliance with part A, 2.2 impracticable:

.1 the area under the curve of righting levers (GZ curve) should not be less than 0.07 metre-radians up to an angle of 15° when the maximum righting lever (GZ) occurs at 15° and 0.055 metre-radians up to an angle of 30° when the maximum righting lever (GZ) occurs at 30° or above. Where the maximum righting lever (GZ) occurs at angles of between 15° and 30°, the corresponding area under the righting lever curve should be:

$$0.055 + 0.001\,(30° - \varphi_{max})\ \text{metre-radians};$$

.2 the area under the righting lever curve (GZ curve) between the angles of heel of 30° and 40°, or between 30° and φ_f if this angle is less than 40°, should be not less than 0.03 metre-radians;

.3 the righting lever (GZ) should be at least 0.2 m at an angle of heel equal to or greater than 30°;

.4 the maximum righting lever (GZ) should occur at an angle of heel not less than 15°;

.5 the initial transverse metacentric height (GM_o) should not be less than 0.15 m; and

.6 reference is made also to part A, 2.1.3 to 2.1.5 and part B, 5.1.

2.5 Special purpose ships

2.5.1 *Application*

The provisions given hereunder apply to special purpose ships, as defined in section 2 (Definitions) of the Introduction, of not less than 500 gross tonnage. The Administration may also apply these provisions as far as reasonable and practicable to special purpose ships of less than 500 gross tonnage.

2.5.2 *Stability criteria*

The intact stability of special purpose ships should comply with the provisions given in part A, 2.2 except that the alternative criteria given in part B, 2.4.5 which apply to offshore supply vessels may be used for special purpose ships of less than 100 m in length of similar design and characteristics.

2.6 Mobile offshore drilling units (MODUs)

2.6.1 *Application*

2.6.1.1 The provisions given hereunder apply to mobile offshore drilling units as defined in section 2 (Definitions) of the Introduction, the keels of which are laid or which are at a similar stage of construction on or after 1 May 1991. For MODUs constructed before that date, the corresponding provisions of chapter 3 of resolution A.414(XI) should apply.

2.6.1.2 The coastal State may permit any unit designed to a lesser standard than that of this chapter to engage in operations, having taken account of the local environmental conditions. Any such unit should, however, comply with safety requirements which in the opinion of the coastal State are adequate for the intended operation and ensure the overall safety of the unit and the personnel on board.

2.6.2 *Righting moment and wind heeling moment curves*

2.6.2.1 Curves of righting moments and of wind heeling moments similar to figure 2.6-1 with supporting calculations should be prepared covering the full range of operating draughts, including those in transit conditions, taking into account the maximum deck cargo and equipment in the most unfavourable position applicable. The righting moment curves and wind heeling moment curves should be related to the most critical axes. Account should be taken of the free surface of liquids in tanks.

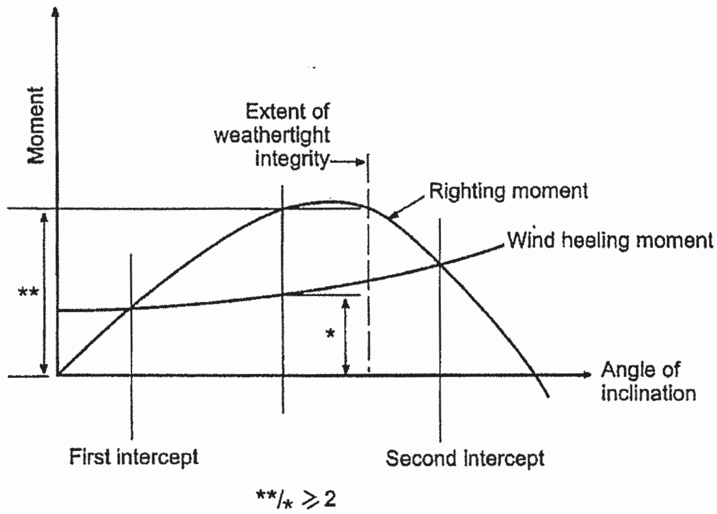


Figure 2.6-1 – Righting moment and wind heeling moment curves

2.6.2.2 Where equipment is of such a nature that it can be lowered and stowed, additional wind heeling moment curves may be required and such data should clearly indicate the position of such equipment.

2.6.2.3 The curves of wind heeling moment should be drawn for wind forces calculated by the following formula:

$$F = 0.5 * C_S * C_H * \rho * V^2 * A$$

where:

F	is the wind force (N)
C_S	is the shape coefficient depending on the shape of the structural member exposed to the wind (see table 2.6.2.3-1)
C_H	is the height coefficient depending on the height above sea level of the structural member exposed to wind (see table 2.6.2.3-2)
ρ	is the air mass density (1.222 kg/m³)
V	is the wind velocity (m/s)
A	is the projected area of all exposed surfaces in either the upright or the heeled condition (m²).

Table 2.6.2.3-1 – Values of the coefficient C_S

Shape	C_S
Spherical	0.40
Cylindrical	0.50
Large flat surface (hull, deck-house, smooth under-deck areas)	1.00
Drilling derrick	1.25
Wires	1.20
Exposed beams and girders under deck	1.30
Small parts	1.40
Isolated shapes (crane, beam, etc.)	1.50
Clustered deck-houses or similar structures	1.10

Table 2.6.2.3-2 – Values of the coefficient C_H

Height above sea level (m)	C_H
0 – 15.3	1
15.3 – 30.5	1.1
30.5 – 46	1.2
46.0 – 61	1.3
61.0 – 76	1.37
76.0 – 91.5	1.43
91.5 – 106.5	1.48
106.5 – 122	1.52
122.0 – 137	1.56
137.0 – 152.5	1.6
152.5 – 167.5	1.63
167.5 – 183	1.67
183.0 – 198	1.7
198.0 – 213.5	1.72
213.5 – 228.5	1.75
228.5 – 244	1.77
244.0 – 256	1.79
Above 256	1.8

2.6.2.4 Wind forces should be considered from any direction relative to the unit and the value of the wind velocity should be as follows:

.1 in general, a minimum wind velocity of 36 m/s (70 knots) for offshore service should be used for normal operating conditions and a minimum wind velocity of 51.5 m/s (100 knots) should be used for the severe storm conditions; and

.2 where a unit is to be limited in operation to sheltered locations (protected inland waters such as lakes, bays, swamps, rivers, etc.), consideration should be given to a reduced wind velocity of not less than 25.8 m/s (50 knots) for normal operating conditions.

2.6.2.5 In calculating the projected areas to the vertical plane, the area of surfaces exposed to wind due to heel or trim, such as under decks, etc., should be included, using the appropriate shape factor. Open truss work may be approximated by taking 30% of the projected block area of both the front and back section, i.e. 60% of the projected area of one side.

2.6.2.6 In calculating the wind heeling moments, the lever of the wind overturning force should be taken vertically from the centre of pressure of all surfaces exposed to the wind to the centre of lateral resistance of the underwater body of the unit. The unit is to be assumed floating free of mooring restraint.

2.6.2.7 The wind heeling moment curve should be calculated for a sufficient number of heel angles to define the curve. For ship-shaped hulls the curve may be assumed to vary as the cosine function of ship heel.

2.6.2.8 Wind heeling moments derived from wind-tunnel tests on a representative model of the unit may be considered as alternatives to the method given in 2.6.2.3 to 2.6.2.7. Such heeling moment determination should include lift and drag effects at various applicable heel angles.

2.6.3 *Intact stability criteria*

2.6.3.1 The stability of a unit in each mode of operation should meet the following criteria (see also figure 2.6-2):

.1 for surface and self-elevating units the area under the righting moment curve to the second intercept or down-flooding angle, whichever is less, should be not less than 40% in excess of the area under the wind heeling moment curve to the same limiting angle;

.2 for column-stabilized units the area under the righting moment curve to the angle of down-flooding should be not less than 30% in excess of the area under the wind heeling moment curve to the same limiting angle; and

.3 the righting moment curve should be positive over the entire range of angles from upright to the second intercept.

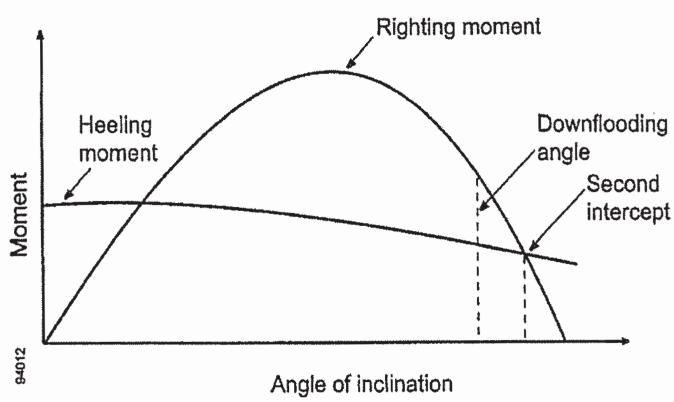


Figure 2.6-2 – Righting moment and heeling moment curves

2.6.3.2 Each unit should be capable of attaining a severe storm condition in a period of time consistent with the meteorological conditions. The procedures recommended and the approximate length of time required, considering both operating conditions and transit conditions, should be contained in the operating manual, as referred to in 3.6.2. It should be possible to achieve the severe storm condition without the removal or relocation of solid consumables or other variable load. However, the Administration may permit loading a unit past the point at which solid consumables would have to be removed or relocated to go to severe storm condition under the following conditions, provided the allowable KG requirement is not exceeded:

.1 in a geographic location where weather conditions annually or seasonally do not become sufficiently severe to require a unit to go to severe storm condition; or

.2 where a unit is required to support extra deckload for a short period of time that is well within the bounds of a favourable weather forecast.

The geographic locations and weather conditions and loading conditions when this is permitted should be identified in the operating manual.

2.6.3.3 Alternative stability criteria may be considered by the Administration provided an equivalent level of safety is maintained and if they are demonstrated to afford adequate positive initial stability. In determining the acceptability of such criteria, the Administration should consider at least the following and take into account as appropriate:

.1 environmental conditions representing realistic winds (including gusts) and waves appropriate for world-wide service in various modes of operation;

.2 dynamic response of a unit. Analysis should include the results of wind-tunnel tests, wave tank model tests, and non-linear simulation, where appropriate. Any wind and wave spectra used should cover sufficient frequency ranges to ensure that critical motion responses are obtained;

.3 potential for flooding taking into account dynamic responses in a seaway;

.4 susceptibility to capsizing considering the unit's restoration energy and the static inclination due to the mean wind speed and the maximum dynamic response; and

.5 an adequate safety margin to account for uncertainties.

An example of alternative criteria for twin-pontoon column-stabilized semi-submersible units is given in section 2.6.4.

2.6.4 *An example of alternative intact stability criteria for twin-pontoon column-stabilized semi-submersible units*

2.6.4.1 The criteria given below apply only to twin-pontoon column-stabilized semi-submersible units in severe storm conditions which fall within the following ranges of parameters:

V_p/V_t	is between 0.48 and 0.58
$A_{wp}/(V_c)^{2/3}$	is between 0.72 and 1.00
$I_{wp}/[V_c * (L_{ptn}/2)]$	is between 0.40 and 0.70

The parameters used in the above equations are defined in paragraph 2.6.4.3.

2.6.4.2 Intact stability criteria

The stability of a unit in the survival mode of operation should meet the following criteria.

2.6.4.2.1 Capsize criteria

These criteria are based on the wind heeling moment and righting moment curves calculated as shown in section 2.6.2 of the Code at the survival draught. The reserve energy area 'B' should be equal to or greater than 10% of the dynamic response area 'A' as shown in figure 2.6-3.

Area 'B'/Area 'A' $\geq$ 0.10

where:

Area 'A' is the area under the righting moment curve measured from φ_1 to $(\varphi_1 + 1.15 * \varphi_{dyn})$

Area 'B' is the area under the righting moment curve measured from $(\varphi_1 + 1.15 * \varphi_{dyn})$ to φ_2

φ_1 is the first intercept with the 100 knot wind moment curve

φ_2 is the second intercept with the 100 knot wind moment curve

φ_{dyn} is the dynamic response angle due to waves and fluctuating wind

$$\varphi_{dyn} = (10.3 + 17.8 * C)/(1 + GM/(1.46 + 0.28 * BM))$$

$$C = (L_{ptn}^{5/3} * VCP_{wl} * A_w * V_p * V_c^{1/3})/(I_{wp}^{5/3} * V_t)$$

Parameters used in the above equations are defined in paragraph 2.6.4.3.

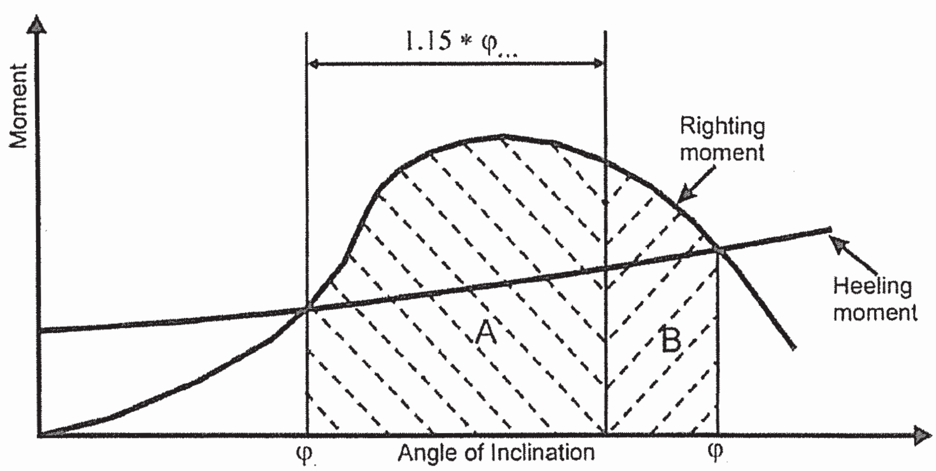


Figure 2.6-3 – Righting moment and heeling moment curves

2.6.4.2.2 Down-flooding criteria

These criteria are based on the physical dimensions of the unit and the relative motion of the unit about a static inclination due to a 75 knot wind measured at the survival draught. The initial down-flooding distance (DFD_0) should be greater than the reduction in down-flooding distance at the survival draught as shown in figure 2.6-4.

DFD_0 - RDFD > 0.0

where:

DFD_0 is the initial down-flooding distance to D_m (m)

RDFD is the reduction in down-flooding distance (m) equal to SF (k * QSD_1 + RMW)

SF is equal to 1.1, which is a safety factor to account for uncertainties in the analysis, such as non-linear effects

k (correlation factor) is equal to 0.55 + 0.08 * (a - 4) + 0.056 * (1.52 - GM);
(GM cannot be taken to be greater than 2.44 m)

a is equal to $(FBD_0/D_m)*(S_{ptn} * L_{cc})/A_{wp}$
(a cannot be taken to be less than 4)

QSD_1 is equal to DFD_0 minus quasi-static down-flooding distance at φ_1 (m), but not to be taken less than 3 m

RMW is the relative motion due to waves about φ_1 (m), equal to 9.3 + 0.11 * (X - 12.19)

X is equal to $D_m *(V_t/V_p)*(A_{wp}^2/I_{wp})*(L_{ccc}/L_{ptn})$
(X cannot be taken to be less than 12.19 m).

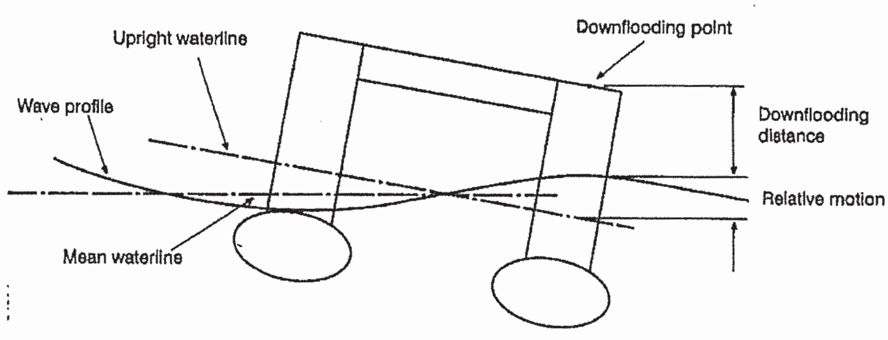


Figure 2.6-4 – Definition of down-flooding distance and relative motion

The parameters used in the above equations are defined in paragraph 2.6.4.3.

2.6.4.3 Geometric parameters

A_{wp} is the waterplane area at the survival draught, including the effects of bracing members as applicable (m^2).

A_w is the effective wind area with the unit in the upright position (i.e. the product of projected area, shape coefficient and height coefficient) (m^2).

BM is the vertical distance from the metacentre to the centre of buoyancy with the unit in the upright position (m).

D_m is the initial survival draught (m).

FBD_0 is the vertical distance from D_m, to the top of the upper exposed weathertight deck at the side (m).

GM for paragraph 2.6.4.2.1, GM is the metacentric height measured about the roll or diagonal axis, whichever gives the minimum reserve energy ratio, 'B'/'A'. This axis is usually the diagonal axis as it possesses a characteristically larger projected wind area which influences the three characteristic angles mentioned above (m).

GM for paragraph 2.6.4.2.2, GM is the metacentric height measured about the axis which gives the minimum down-flooding distance margin (i.e. generally the direction that gives the largest QSD_1) (m).

I_{wp} is the water plane second moment of inertia at the survival draught, including the effects of bracing members as applicable (m^4).

L_{ccc} is the longitudinal distance between centres of the corner columns (m).

L_{ptn} is the length of each pontoon (m).

S_{ptn} is the transverse distance between the centrelines of the pontoons (m).

V_c is the total volume of all columns from the top of the pontoons to the top of the column structure, except for any volume included in the upper deck (m^3).

V_p is the total combined volume of both pontoons (m^3).

V_t is the total volume of the structures (pontoons, columns and bracings) contributing to the buoyancy of the unit, from its baseline to the top of the column structure, except for any volume included in the upper deck (m^3).

VCP_{w1} is the vertical centre of wind pressure above D_m (m).

2.6.4.4 Capsize criteria assessment form

Input data

GM	....	=	m
BM	....	=	m
VCP_{w1}	....	=	m
A_w	....	=	m^2
V_t	....	=	m^3
V_c	....	=	m^3
V_p	....	=	m^3
I_{wp}	....	=	m^4
L_{ptn}	....	=	m

Determine

φ_1	....	=	deg
φ_2	....	=	deg
C =	$(L_{ptn}^{5/3} * VCP_{w1} * A_w * V_p * V_c^{1/3})/(I_{wp}^{5/3} * V_t)$ ...	=	m^{-1}
φ_{dyn} =	$(10.3 + 17.8C)/(1 + GM/(1.46 + 0.28BM))$	=	deg
Area 'A'	....	=	m-deg
Area 'B'	....	=	m-deg

Results Reserve energy ratio:

'B'/'A' = ... (minimum = 0.1)

GM = ... m (KG = ... m)

Note: The minimum GM is that which produces a 'B'/'A' ratio = 0.1

2.6.4.5 Down-flooding criteria assessment form

Input data

DFD_0	....	=	m
FBD_0	....	=	m
GM	....	=	m
D_m	....	=	m
V_t	....	=	m^3
V_p	....	=	m^3
A_{wp}	....	=	m^2
I_{wp}	....	=	m^4
L_{ccc}	....	=	m
L_{ptn}	....	=	m
S_{ptn}	....	=	m
SF	....	= 1.1	

Determine

φ_1		....	= .... deg
DFD_1		....	= .... m
QSD_1	=	$DFD_0 - DFD_1$	= .... m
a	=	$(FBD_0/D_m)*(S_{ptn} * L_{ccc})/A_{wp}$	= .... ($a_{min} = 4$)
k	=	$0.55 + 0.08*(a - 4) + 0.056*(1.52 - GM)$	= .... m ($GM_{max} = 2.44$ m)
X	=	$D_m*(V_t/V_p)*(A_{wp}^2 /I_{wp}))(L_{ccc}/L_{ptn})$	= .... m ($X_{min} = 12.19$ m)
RMW	=	$9.3 + 0.11*(X - 12.19)$	= .... m
RDFD	=	$SF*(k * QSD_1 + RMW)$	= .... m

Results Down-flooding margin:

DFD_0 - RDFD = ... (minimum = 0.0 m)

GM = ... m (KG = ... m)

Note: The minimum GM is that which produces a down-flooding margin = 0.0 m.

CHAPTER 3 – GUIDANCE IN PREPARING STABILITY INFORMATION

3.1 Effect of free surfaces of liquids in tanks

3.1.1 For all loading conditions, the initial metacentric height and the righting lever curve should be corrected for the effect of free surfaces of liquids in tanks.

3.1.2 Free surface effects should be considered whenever the filling level in a tank is less than 98% of full condition. Free surface effects need not be considered where a tank is nominally full, i.e. filling level is 98% or above. Free surface effects for small tanks may be ignored under condition specified in 3.1.12.

But nominally full cargo tanks should be corrected for free surface effects at 98% filling level. In doing so, the correction to initial metacentric height should be based on the inertia moment of liquid surface at 5° of heeling angle divided by displacement, and the correction to righting lever is suggested to be on the basis of real shifting moment of cargo liquids.

3.1.3 Tanks which are taken into consideration when determining the free surface correction may be in one of two categories:

.1 tanks with filling levels fixed (e.g., liquid cargo, water ballast). The free surface correction should be defined for the actual filling level to be used in each tank; or

.2 tanks with filling levels variable (e.g., consumable liquids such as fuel oil, diesel oil and fresh water, and also liquid cargo and water ballast during liquid transfer operations). Except as permitted in 3.1.5 and 3.1.6, the free surface correction should be the maximum value attainable between the filling limits envisaged for each tank, consistent with any operating instructions.

3.1.4 In calculating the free surface effects in tanks containing consumable liquids, it should be assumed that for each type of liquid at least one transverse pair or a single centreline tank has a free surface and the tank or combination of tanks taken into account should be those where the effect of free surfaces is the greatest.

3.1.5 Where water ballast tanks, including anti-rolling tanks and anti-heeling tanks, are to be filled or discharged during the course of a voyage, the free surface effects should be calculated to take account of the most onerous transitory stage relating to such operations.

3.1.6 For ships engaged in liquid transfer operations, the free surface corrections at any stage of the liquid transfer operations may be determined in accordance with the filling level in each tank at that stage of the transfer operation.

3.1.7 The corrections to the initial metacentric height and to the righting lever curve should be addressed separately as follows.

3.1.8 In determining the correction to initial metacentric height, the transverse moments of inertia of the tanks should be calculated at 0° angle of heel according to the categories indicated in 3.1.3.

3.1.9 The righting lever curve may be corrected by any of the following methods subject to the agreement of the Administration:

.1 correction based on the actual moment of fluid transfer for each angle of heel calculated; or

.2 correction based on the moment of inertia, calculated at 0° angle of heel, modified at each angle of heel calculated.

3.1.10 Corrections may be calculated according to the categories indicated in 3.1.2.

3.1.11 Whichever method is selected for correcting the righting lever curve, only that method should be presented in the ship's stability booklet. However, where an alternative method is described for use in manually calculated loading conditions, an explanation of the differences which may be found in the results, as well as an example correction for each alternative, should be included.

3.1.12 Small tanks which satisfy the following condition corresponding to an angle of inclination of 30°, need not be included in the correction:

$M_{fs} / \Delta_{min} < 0.01$ m

where:

M_{fs} free surface moment (mt)

Δ_{min} is the minimum ship displacement calculated at d_{min} (t)

d_{min} is the minimum mean service draught of the ship without cargo, with 10% stores and minimum water ballast, if required (m).

3.1.13 The usual remainder of liquids in empty tanks need not be taken into account in calculating the corrections, provided that the total of such residual liquids does not constitute a significant free surface effect.

3.2 Permanent ballast

If used, permanent ballast should be located in accordance with a plan approved by the Administration and in a manner that prevents shifting of position. Permanent ballast should not be removed from the ship or relocated within the ship without the approval of the Administration. Permanent ballast particulars should be noted in the ship's stability booklet.

3.3 Assessment of compliance with stability criteria

3.3.1 Except as otherwise required by this Code, for the purpose of assessing in general whether the stability criteria are met, stability curves using the assumptions given in this Code should be drawn for the loading conditions intended by the owner in respect of the ship's operations.

3.3.2 If the owner of the ship does not supply sufficiently detailed information regarding such loading conditions, calculations should be made for the standard loading conditions.

3.4 Standard conditions of loading to be examined

3.4.1 *Loading conditions*

The standard loading conditions referred to in the text of the present Code are as follows.

3.4.1.1 For a passenger ship:

.1 ship in the fully loaded departure condition with cargo, full stores and fuel and with the full number of passengers with their luggage;

.2 ship in the fully loaded arrival condition, with cargo, the full number of passengers and their luggage but with only 10% stores and fuel remaining;

.3 ship without cargo, but with full stores and fuel and the full number of passengers and their luggage; and

.4 ship in the same condition as at .3 above with only 10% stores and fuel remaining.

3.4.1.2 For a cargo ship:

.1 ship in the fully loaded departure condition, with cargo homogeneously distributed throughout all cargo spaces and with full stores and fuel;

.2 ship in the fully loaded arrival condition with cargo homogeneously distributed throughout all cargo spaces and with 10% stores and fuel remaining;

.3 ship in ballast in the departure condition, without cargo but with full stores and fuel; and

.4 ship in ballast in the arrival condition, without cargo and with 10% stores and fuel remaining.

3.4.1.3 For a cargo ship intended to carry deck cargoes:

.1 ship in the fully loaded departure condition with cargo homogeneously distributed in the holds and with cargo specified in extension and mass on deck, with full stores and fuel; and

.2 ship in the fully loaded arrival condition with cargo homogeneously distributed in holds and with a cargo specified in extension and mass on deck, with 10% stores and fuel.

3.4.1.4 For a ship intended to carry timber deck cargoes:

The loading conditions which should be considered for ships carrying timber deck cargoes are specified in 3.4.1.3. The stowage of timber deck cargoes should comply with the provisions of chapter 3 of the Code of Safe Practice for Ships Carrying Timber Deck Cargoes, 1991 (resolution A.715(17)).

3.4.1.5 For an offshore supply vessel the standard loading conditions should be as follows:

.1 vessel in fully loaded departure condition with cargo distributed below deck and with cargo specified by position and weight on deck, with full stores and fuel, corresponding to the worst service condition in which all the relevant stability criteria are met;

.2 vessel in fully loaded arrival condition with cargo as specified in 3.4.1.5.1, but with 10% stores and fuel;

.3 vessel in ballast departure condition, without cargo but with full stores and fuel;

.4 vessel in ballast arrival condition, without cargo and with 10% stores and fuel remaining; and

.5 vessel in the worst anticipated operating condition.

3.4.1.6 For fishing vessels the standard loading conditions referred to in 2.1.1 are as follows:

.1 departure conditions for the fishing grounds with full fuel, stores, ice, fishing gear, etc.;

.2 departure from the fishing grounds with full catch and a percentage of stores, fuel, etc., as agreed by the Administration;

.3 arrival at home port with 10% stores, fuel, etc. remaining and full catch; and

.4 arrival at home port with 10% stores, fuel, etc. and a minimum catch, which should normally be 20% of full catch but may be up to 40% provided the Administration is satisfied that operating patterns justify such a value.

3.4.2 ***Assumptions for calculating loading conditions***

3.4.2.1 For the fully loaded conditions mentioned in 3.4.1.2.1, 3.4.1.2.2, 3.4.1.3.1 and 3.4.1.3.2 if a dry cargo ship has tanks for liquid cargo, the effective deadweight in the loading conditions therein described should be distributed according to two assumptions, i.e. with cargo tanks full, and with cargo tanks empty.

3.4.2.2 In the conditions mentioned in 3.4.1.1.1, 3.4.1.2.1 and 3.4.1.3.1 it should be assumed that the ship is loaded to its subdivision load line or summer load line or if intended to carry a timber deck cargo, to the summer timber load line with water ballast tanks empty.

3.4.2.3 If in any loading condition water ballast is necessary, additional diagrams should be calculated taking into account the water ballast. Its quantity and disposition should be stated.

3.4.2.4 In all cases, the cargo in holds is assumed to be fully homogeneous unless this condition is inconsistent with the practical service of the ship.

3.4.2.5 In all cases, when deck cargo is carried, a realistic stowage mass should be assumed and stated, including the height of the cargo.

3.4.2.6 Considering timber deck cargo the following assumptions should be made for calculating the loading conditions referred to in 3.4.1.4:

.1 the amount of cargo and ballast should correspond to the worst service condition in which all the relevant stability criteria of part A 2.2 or the optional criteria given in part A 3.3.2, are met. In the arrival condition, it should be assumed that the weight of the deck cargo has increased by 10% owing to water absorption.

3.4.2.7 For offshore supply vessels, the assumptions for calculating loading conditions should be as follows:

.1 if a vessel is fitted with cargo tanks, the fully loaded conditions of 3.4.1.5.1 and 3.4.1.5.2 should be modified, assuming first the cargo tanks full and then the cargo tanks empty;

.2 if in any loading condition water ballast is necessary, additional diagrams should be calculated, taking into account the water ballast, the quantity and disposition of which should be stated in the stability information;

.3 in all cases when deck cargo is carried a realistic stowage weight should be assumed and stated in the stability information, including the height of the cargo and its centre of gravity;

.4 where pipes are carried on deck, a quantity of trapped water equal to a certain percentage of the net volume of the pipe deck cargo should be assumed in and around the pipes. The net volume should be taken as the internal volume of the pipes, plus the volume between the pipes. This percentage should be 30 if the freeboard amidships is equal to or less than 0.015 L and 10 if the freeboard amidships is equal to or greater than 0.03 L. For intermediate values of the freeboard amidships the percentage may be obtained by linear interpolation. In assessing the quantity of trapped water, the Administration may take into account positive or negative sheer aft, actual trim and area of operation; or

.5 if a vessel operates in zones where ice accretion is likely to occur, allowance for icing should be made in accordance with the provisions of chapter 6 (Icing considerations).

3.4.2.8 For fishing vessels the assumptions for calculating loading conditions should be as follows:

.1 allowance should be made for the weight of the wet fishing nets and tackle, etc., on deck;

.2 allowance for icing, where this is anticipated to occur, should be made in accordance with the provisions of 6.3;

.3 in all cases the cargo should be assumed to be homogeneous unless this is inconsistent with practice;

.4 in conditions referred to in 3.4.1.6.2 and 3.4.1.6.3 deck cargo should be included if such a practice is anticipated;

.5 water ballast should normally only be included if carried in tanks which are specially provided for this purpose.

3.5 Calculation of stability curves

3.5.1 *General*

Hydrostatic and stability curves should be prepared for the trim range of operating loading conditions taking into account the change in trim due to heel (free trim hydrostatic calculation). The calculations should take into account the volume to the upper surface of the deck sheathing. Furthermore, appendages and sea chests need to be considered when calculating hydrostatics and cross curves of stability. In the presence of port-starboard asymmetry, the most unfavourable righting lever curve should be used.

3.5.2 *Superstructures, deckhouses, etc., which may be taken into account*

3.5.2.1 Enclosed superstructures complying with regulation 3(10)(b) of the 1966 Load Line Convention and the Protocol of 1988 relating thereto, as amended, may be taken into account.

3.5.2.2 Additional tiers of similarly enclosed superstructures may also be taken into account. As guidance windows (pane and frame) that are considered without deadlights in additional tiers above the second tier if considered buoyant should be designed with strength to sustain a safety margin with regard to the required strength of the surrounding structure.

3.5.2.3 Deckhouses on the freeboard deck may be taken into account, provided that they comply with the conditions for enclosed superstructures laid down in regulation 3(10)(b) of the 1966 Load Line Convention and the Protocol of 1988 relating thereto, as amended.

3.5.2.4 Where deckhouses comply with the above conditions, except that no additional exit is provided to a deck above, such deckhouses should not be taken into account; however, any deck openings inside such deckhouses should be considered as closed even where no means of closure are provided.

3.5.2.5 Deckhouses, the doors of which do not comply with the requirements of regulation 12 of the 1966 Load Line Convention and the Protocol of 1988 relating thereto, as amended, should not be taken into account; however, any deck openings inside the deckhouse are regarded as closed where their means of closure comply with the requirements of regulations 15, 17 or 18 of the 1966 Load Line Convention and the Protocol of 1988 relating thereto, as amended.

3.5.2.6 Deckhouses on decks above the freeboard deck should not be taken into account, but openings within them may be regarded as closed.

3.5.2.7 Superstructures and deckhouses not regarded as enclosed can, however, be taken into account in stability calculations up to the angle at which their openings are flooded (at this angle, the static stability curve should show one or more steps, and in subsequent computations the flooded space should be considered non-existent).

3.5.2.8 In cases where the ship would sink due to flooding through any openings, the stability curve should be cut short at the corresponding angle of flooding and the ship should be considered to have entirely lost its stability.

3.5.2.9 Small openings such as those for passing wires or chains, tackle and anchors, and also holes of scuppers, discharge and sanitary pipes should not be considered as open if they submerge at an angle of inclination more than 30°. If they submerge at an angle of 30° or less, these openings should be assumed open if the Administration considers this to be a source of significant flooding.

3.5.2.10 Trunks may be taken into account. Hatchways may also be taken into account having regard to the effectiveness of their closures.

3.5.3 *Calculation of stability curves for ships carrying timber deck cargoes*

In addition to the provisions given above, the Administration may allow account to be taken of the buoyancy of the deck cargo assuming that such cargo has a permeability of 25% of the volume occupied by the cargo. Additional curves of stability may be required if the Administration considers it necessary to investigate the influence of different permeabilities and/or assumed effective height of the deck cargo.

3.6 Stability booklet

3.6.1 Stability data and associated plans should be drawn up in the working language of the ship and any other language the Administration may require. Reference is also made to the International Safety Management (ISM) Code, adopted by the Organization by resolution A.741(18). All translations of the stability booklet should be approved.

3.6.2 Each ship should be provided with a stability booklet, approved by the Administration, which contains sufficient information to enable the master to operate the ship in compliance with the applicable requirements contained in the Code. The Administration may have additional requirements. On a mobile offshore drilling unit, the stability booklet may be referred to as an operating manual. The stability booklet may include information on longitudinal strength. This Code addresses only the stability-related contents of the booklet.

3.6.3 For ships carrying timber deck cargoes:

.1 comprehensive stability information should be supplied which takes into account timber deck cargo. Such information should enable the master, rapidly and simply, to obtain accurate guidance as to the stability of the ship under varying conditions of service. Comprehensive rolling period tables or diagrams have proved to be very useful aids in verifying the actual stability conditions;

.2 the Administration may deem it necessary that the master be given information setting out the changes in deck cargo from that shown in the loading conditions, when the permeability of the deck cargo is significantly different from 25% (refer to 3.5.3); and

.3 conditions should be shown indicating the maximum permissible amount of deck cargo having regard to the lightest stowage rate likely to be met in service.

3.6.4 The format of the stability booklet and the information included will vary dependent on the ship type and operation. In developing the stability booklet, consideration should be given to including the following information:

.1 a general description of the ship;

.2 instructions on the use of the booklet;

.3 general arrangement plans showing watertight compartments, closures, vents, downflooding angles, permanent ballast, allowable deck loadings and freeboard diagrams;

.4 hydrostatic curves or tables and cross curves of stability calculated on a free-trimming basis, for the ranges of displacement and trim anticipated in normal operating conditions;

.5 capacity plan or tables showing capacities and centres of gravity for each cargo stowage space;

.6 tank sounding tables showing capacities, centres of gravity, and free surface data for each tank;

.7 information on loading restrictions, such as maximum KG or minimum GM curve or table that can be used to determine compliance with the applicable stability criteria;

.8 standard operating conditions and examples for developing other acceptable loading conditions using the information contained in the stability booklet;

.9 a brief description of the stability calculations done including assumptions;

.10 general precautions for preventing unintentional flooding;

.11 information concerning the use of any special cross-flooding fittings with descriptions of damage conditions which may require cross-flooding;

.12 any other necessary guidance for the safe operation of the ship under normal and emergency conditions;

.13 a table of contents and index for each booklet;

.14 inclining test report for the ship, or:

.14.1 where the stability data is based on a sister ship, the inclining test report of that sister ship along with the lightship measurement report for the ship in question; or

.14.2 where lightship particulars are determined by other methods than from inclining of the ship or its sister, a summary of the method used to determine those particulars;

.15 recommendation for determination of ship's stability by means of an in-service inclining test.

3.6.5 As an alternative to the stability booklet mentioned in 3.6.1, a simplified booklet in an approved form containing sufficient information to enable the master to operate the ship in compliance with the applicable provisions of the Code as may be provided at the discretion of the Administration concerned.

3.7 Operational measures for ships carrying timber deck cargoes

3.7.1 The stability of the ship at all times, including during the process of loading and unloading timber deck cargo, should be positive and to a standard acceptable to the Administration. It should be calculated having regard to:

.1 the increased weight of the timber deck cargo due to:

.1.1 absorption of water in dried or seasoned timber, and

.1.2 ice accretion, if applicable (chapter 6 (Icing considerations));

.2 variations in consumables;

.3 the free surface effect of liquid in tanks; and

.4 weight of water trapped in broken spaces within the timber deck cargo and especially logs.

3.7.2 The master should:

.1 cease all loading operations if a list develops for which there is no satisfactory explanation and it would be imprudent to continue loading;

.2 before proceeding to sea, ensure that:

.2.1 the ship is upright;

.2.2 the ship has an adequate metacentric height; and

.2.3 the ship meets the required stability criteria.

3.7.3 The masters of ships having a length less than 100 m should also:

.1 exercise good judgement to ensure that a ship which carries stowed logs on deck has sufficient additional buoyancy so as to avoid overloading and loss of stability at sea;

.2 be aware that the calculated GM_0 in the departure condition may decrease continuously owing to water absorption by the deck cargo of logs, consumption of fuel, water and stores and ensure that the ship has adequate GM_0 throughout the voyage; and

.3 be aware that ballasting after departure may cause the ship's operating draught to exceed the timber load line. Ballasting and deballasting should be carried out in accordance with the guidance provided in the Code of Safe Practice for Ships Carrying Timber Deck Cargoes, 1991 (resolution A.715(17)).

3.7.4 Ships carrying timber deck cargoes should operate, as far as possible, with a safe margin of stability and with a metacentric height which is consistent with safety requirements but such metacentric height should not be allowed to fall below the recommended minimum, as specified in part A, 3.3.2.

3.7.5 However, excessive initial stability should be avoided as it will result in rapid and violent motion in heavy seas which will impose large sliding and racking forces on the cargo causing high stresses on the lashings. Operational experience indicates that metacentric height should preferably not exceed 3% of the breadth in order to prevent excessive accelerations in rolling provided that the relevant stability criteria given in part A, 3.3.2 are satisfied. This recommendation may not apply to all ships and the master should take into consideration the stability information obtained from the ship's stability booklet.

3.8 Operating booklets for certain ships

3.8.1 Special purpose ships and novel craft, should be provided with additional information in the stability booklet such as design limitations, maximum speed, worst intended weather conditions or other information regarding the handling of the craft that the master needs to operate the ship safely.

3.8.2 For double hull oil tankers of single cargo tank across design, an operation manual for loading and unloading cargo oil should be provided, including operational procedures of loading and unloading cargo oil and detailed data of the initial metacentric height of the oil tanker and that of free surface correction of liquids in cargo oil tanks and ballast tanks during loading and unloading cargo oil (including ballasting and discharging) and cargo oil washing of tanks.

3.8.3 The stability booklet of ro-ro passenger ships should contain information concerning the importance of securing and maintaining all closures watertight due to the rapid loss of stability which may result when water enters the vehicle deck and the fact that capsize can rapidly follow.

CHAPTER 4 – STABILITY CALCULATIONS PERFORMED BY STABILITY INSTRUMENTS

4.1 Stability instruments

A stability instrument installed onboard should cover all stability requirements applicable to the ship. The software is subject to approval by the Administration. Active and passive systems are defined in 4.1.2. These requirements cover passive systems and the off-line operation mode of active systems only.

4.1.1 *General*

4.1.1.1 The scope of stability calculation software should be in accordance with the approved stability booklet and should at least include all information and perform all calculations or checks as necessary to ensure compliance with the applicable stability requirements.

4.1.1.2 An approved stability instrument is not a substitute for the approved stability booklet, and is used as a supplement to the approved stability booklet to facilitate stability calculations.

4.1.1.3 The input/output information should be easily comparable with the approved stability booklet so as to avoid confusion and possible misinterpretation by the operator.

4.1.1.4 An operation manual should be provided for the stability instrument.

4.1.1.5 The language in which the stability calculation results are displayed and printed out as well as the operation manual is written should be the same as used in the ship's approved stability booklet. A translation into a language considered appropriate may be required.

4.1.1.6 The stability instrument is ship specific equipment and the results of the calculations are only applicable to the ship for which it has been approved.

4.1.1.7 In case of modifications of the ship which cause alterations in the stability booklet, the specific approval of any original stability calculation software is no longer valid. The software should be modified accordingly and re-approved.

4.1.1.8 Any change in software version related to the stability calculation should be reported to and be approved by the Administration.

4.1.2 *Data entry system*

4.1.2.1 A passive system requires manual data entry.

4.1.2.2 An active system replaces partly the manual entry with sensors reading and entering the contents of tanks, etc.

4.1.2.3 Any integrated system which controls or initiates actions based on the sensor-supplied inputs is not within the scope of this Code except the part calculating the stability.

4.1.3 *Types of stability software*

Three types of calculations performed by stability software are acceptable depending upon a vessel's stability requirements:

Type 1

Software calculating intact stability only (for vessels not required to meet a damage stability criterion).

Type 2

Software calculating intact stability and checking damage stability on basis of a limit curve (e.g., for vessels applicable to SOLAS chapter II-1, part B-1 damage stability calculations, etc.) or previously approved loading conditions.

Type 3

Software calculating intact stability and damage stability by direct application of pre-programmed damage cases for each loading condition (for some tankers, etc.). The results of the direct calculations performed by the stability instrument could be accepted by the Administration even if they differ from the required minimum GM or maximum VCG stated in the approved stability booklet.

Such deviations could be accepted under the condition that all relevant stability requirements will be complied with by the results of the direct calculations.

4.1.4 *Functional requirements*

4.1.4.1 The stability instrument should present relevant parameters of each loading condition in order to assist the master in his judgement on whether the ship is loaded within the approved limits. The following parameters should be presented for a given loading condition:

.1 detailed deadweight data items including centre of gravity and free surfaces, if applicable;

.2 trim, list;

.3 draught at the draught marks and perpendiculars;

.4 summary of loading condition displacement, VCG, LCG, TCG, VCB, LCB, TCB, LCF, GM and GM_L;

.5 table showing the righting lever versus heeling angle including trim and draught;

.6 down-flooding angle and corresponding down-flooding opening; and

.7 compliance with stability criteria: Listings of all calculated stability criteria, the limit values, the obtained values and the conclusions (criteria fulfilled or not fulfilled).

4.1.4.2 If direct damage stability calculations are performed, the relevant damage cases according to the applicable rules should be pre-defined for automatic check of a given loading condition.

4.1.4.3 A clear warning should be given on screen and in hard copy printout if any of the limitations are not complied with.

4.1.4.4 The data should be presented on screen and in hard copy printout in a clear unambiguous manner.

4.1.4.5 The date and time of a saved calculation should be part of the screen display and hard copy printout.

4.1.4.6 Each hard copy printout should contain identification of the calculation program including version number.

4.1.4.7 Units of measurement should be clearly identified and used consistently within a loading calculation.

4.1.5 ***Acceptable tolerances***

Depending on the type and scope of programs, the acceptable tolerances should be determined differently, according to 4.1.5.1 or 4.1.5.2. Deviation from these tolerances should not be accepted unless the Administration considers that there is a satisfactory explanation for the difference and that there will be no adverse effect on the safety of the ship.

The accuracy of the results should be determined using an independent program or the approved stability booklet with identical input.

4.1.5.1 Programs which use only pre-programmed data from the approved stability booklet as the basis for stability calculations should have zero tolerances for the printouts of input data.

Output data tolerances should be close to zero, however, small differences associated with calculation rounding or abridged input data are acceptable. Additionally differences associated with the use of hydrostatic and stability data for trims and the method calculating free surface moments that differ from those in the approved stability booklet are acceptable subject to review by the Administration.

4.1.5.2 Programs which use hull form models as their basis for stability calculations should have tolerances for the printouts of basic calculated data established against either data from the approved stability booklet or data obtained using the Administration's approval model.

4.1.6 ***Approval procedure***

4.1.6.1 Conditions of approval of the stability instrument

The software approval includes:

.1 verification of type approval, if any;

.2 verification that the data used is consistent with the current condition of the ship (refer to 4.1.6.2);

.3 verification and approval of the test conditions; and

.4 verification that the software is appropriate for the type of ship and stability calculations required.

The satisfactory operation of the stability instrument is to be verified by testing upon installation (refer to 4.1.8). A copy of the approved test conditions and the operation manual for the stability instrument are to be available on board.

4.1.6.2 Specific approval

4.1.6.2.1 The accuracy of the computational results and actual ship data used by the calculation program for the particular ship on which the program will be installed should be to the satisfaction of the Administration.

4.1.6.2.2 Upon application for data verification, minimum of four loading conditions should be taken from the ship's approved stability booklet, which should be used as the test conditions. For ships carrying liquids in bulk, at least one of the conditions should include partially filled tanks. For ships carrying grain in bulk, one of the grain loading conditions should include a partially filled grain compartment. Within the test conditions each compartment should be loaded at least once. The test conditions normally should cover the range of load draughts from the deepest envisaged loaded condition to the light ballast condition and should include at least one departure and one arrival condition.

4.1.6.2.3 The following data, submitted by the applicant, should be consistent with arrangements and most recently approved lightship characteristics of the ship according to current plans and documentation on file, subject to possible further verification on board:

.1 identification of the calculation program including version number. Main dimensions, hydrostatic particulars and, if applicable, the ship's profile;

.2 the position of the forward and aft perpendiculars, and if appropriate, the calculation method to derive the forward and aft draughts at the actual position of the ship's draught marks;

.3 ship's lightweight and centre of gravity derived from the most recently approved inclining experiment or light weight survey;

.4 lines plan, offset tables or other suitable presentation of hull form data including all relevant appendages, if necessary to model the ship;

.5 compartment definitions, including frame spacing, and centres of volume, together with capacity tables (sounding/ullage tables), free surface corrections, if appropriate; and

.6 cargo and consumables distribution for each loading condition.

Verification by the Administration does not absolve the shipowner of responsibility for ensuring that the information programmed into the stability instrument is consistent with the current condition of the ship and approved stability booklet.

4.1.7 *User manual*

A simple and straightforward user manual written in the same language as the stability booklet should be provided, containing descriptions and instructions, as appropriate, for at least the following:

.1 installation;

.2 function keys;

.3 menu displays;

.4 input and output data;

.5 required minimum hardware to operate the software;

.6 use of the test loading conditions;

.7 computer-guided dialogue steps; and

.8 list of warnings.

A user manual in electronic format may be provided in addition to the written manual.

4.1.8 *Installation testing*

4.1.8.1 To ensure correct working of the stability instrument after the final or updated software has been installed, it is the responsibility of the ship's master to have test calculations carried out according to the following pattern in the presence of an Administration's surveyor. From the approved test conditions at least one load case (other than light ship) should be calculated.

Note: Actual loading condition results are not suitable for checking the correct working of the stability instrument.

4.1.8.2 Normally, the test conditions are permanently stored in the stability instrument. Steps to be performed:

.1 retrieve the test load case and start a calculation run; compare the stability results with those in the documentation;

.2 change several items of deadweight (tank weights and the cargo weight) sufficiently to change the draught or displacement by at least 10%. The results should be reviewed to ensure that they differ in a logical way from those of the approved test condition;

.3 revise the above modified load condition to restore the initial test condition and compare the results. The relevant input and output data of the approved test condition should be replicated; and

.4 alternatively, one or more test conditions should be selected and the test calculations performed by entering all deadweight data for each selected test condition into the program as if it were a proposed loading. The results should be verified as identical to the results in the approved copy of the test conditions.

4.1.9 ***Periodical testing***

4.1.9.1 It is the responsibility of the ship's master to check the accuracy of the stability instrument at each annual survey by applying at least one approved test condition. If an Administration's representative is not present for the stability instrument check, a copy of the test condition results obtained by this check should be retained on board as documentation of satisfactory testing for the Administration's representative's verification.

4.1.9.2 At each renewal survey this checking for all approved test loading conditions should be done in the presence of the Administration's representative.

4.1.9.3 The testing procedure should be carried out in accordance with paragraph 4.1.8.

4.1.10 ***Other requirements***

4.1.10.1 Protection against unintentional or unauthorized modification of programs and data should be provided.

4.1.10.2 The program should monitor operation and activate an alarm when the program is incorrectly or abnormally used.

4.1.10.3 The program and any data stored in the system should be protected from corruption by loss of power.

4.1.10.4 Error messages with regard to limitations such as filling a compartment beyond capacity or more than once, or exceeding the assigned load line, etc., should be included.

4.1.10.5 If any software related to stability measures such as sea keeping abilities of the vessel, evaluation of in-service inclining experiments and processing the results for further calculation, as well as the evaluation of roll period measurements is installed on board, such software should be reported to the Administration for consideration.

4.1.10.6 Program functionalities should include mass and moment calculations with numerical and graphical presentation of the results, such as initial stability values, righting lever curve, areas under the righting lever curve and range of stability.

4.1.10.7 All input data from automatically measuring sensors, such as gauging devices or draught reading systems should be presented to the user for verification. The user should have the possibility to override faulty readings manually.

CHAPTER 5 – OPERATIONAL PROVISIONS AGAINST CAPSIZING

5.1 General precautions against capsizing

5.1.1 Compliance with the stability criteria does not ensure immunity against capsizing, regardless of the circumstances, or absolve the master from his responsibilities. Masters should therefore exercise prudence and good seamanship having regard to the season of the year, weather forecasts and the navigational zone and should take the appropriate action as to speed and course warranted by the prevailing circumstances.

5.1.2 Care should be taken that the cargo allocated to the ship is capable of being stowed so that compliance with the criteria can be achieved. If necessary, the amount should be limited to the extent that ballast weight may be required.

5.1.3 Before a voyage commences, care should be taken to ensure that the cargo, cargo handling cranes and sizeable pieces of equipment have been properly stowed or lashed so as to minimize the possibility of both longitudinal and lateral shifting, while at sea, under the effect of acceleration caused by rolling and pitching.

5.1.4 A ship, when engaged in towing operations, should possess an adequate reserve of stability to withstand the anticipated heeling moment arising from the tow line without endangering the towing ship. Deck cargo on board the towing ship should be so positioned as not to endanger the safe working of the crew on deck or impede the proper functioning of the towing equipment and be properly secured. Tow line arrangements should include towing springs and a method of quick release of the tow.

5.1.5 The number of partially filled or slack tanks should be kept to a minimum because of their adverse effect on stability. The negative effect on stability of filled pool tanks should be taken into consideration.

5.1.6 The stability criteria contained in part A chapter 2 set minimum values, but no maximum values are recommended. It is advisable to avoid excessive values of metacentric height, since these might lead to acceleration forces which could be prejudicial to the ship, its complement, its equipment and to safe carriage of the cargo. Slack tanks may, in exceptional cases, be used as a means of reducing excessive values of metacentric height. In such cases, due consideration should be given to sloshing effects.

5.1.7 Regard should be paid to the possible adverse effects on stability where certain bulk cargoes are carried. In this connection, attention should be paid to the IMO Code of Safe Practice for Solid Bulk Cargoes.

5.2 Operational precautions in heavy weather

5.2.1 All doorways and other openings, through which water can enter into the hull or deckhouses, forecastle, etc., should be suitably closed in adverse weather conditions and accordingly all appliances for this purpose should be maintained on board and in good condition.

5.2.2 Weathertight and watertight hatches, doors, etc., should be kept closed during navigation, except when necessarily opened for the working of the ship and should always be ready for immediate closure and be clearly marked to indicate that these fittings are to be kept closed except for access. Hatch covers and flush deck scuttles in fishing vessels should be kept properly secured when not in use during fishing operations. All portable deadlights should be maintained in good condition and securely closed in bad weather.

5.2.3 Any closing devices provided for vent pipes to fuel tanks should be secured in bad weather.

5.2.4 Fish should never be carried in bulk without first being sure that the portable divisions in the holds are properly installed.

5.3 Ship handling in heavy weather

5.3.1 In all conditions of loading necessary care should be taken to maintain a seaworthy freeboard.

5.3.2 In severe weather, the speed of the ship should be reduced if propeller emergence, shipping of water on deck or heavy slamming occurs.

5.3.3 Special attention should be paid when a ship is sailing in following, quartering or head seas because dangerous phenomena such as parametric resonance, broaching to, reduction of stability on the wave crest, and excessive rolling may occur singularly, in sequence or simultaneously in a multiple combination, creating a threat of capsize. A ship's speed and/or course should be altered appropriately to avoid the above-mentioned phenomena.

5.3.4 Reliance on automatic steering may be dangerous as this prevents ready changes to course which may be needed in bad weather.

5.3.5 Water trapping in deck wells should be avoided. If freeing ports are not sufficient for the drainage of the well, the speed of the ship should be reduced or the course changed, or both. Freeing ports provided with closing appliances should always be capable of functioning and are not to be locked.

5.3.6 Masters should be aware that steep or breaking waves may occur in certain areas, or in certain wind and current combinations (river estuaries, shallow water areas, funnel shaped bays, etc.). These waves are particularly dangerous, especially for small ships.

5.3.7 In severe weather, the lateral wind pressure may cause a considerable angle of heel. If anti-heeling measures (e.g., ballasting, use of anti-heeling devices, etc.) are used to compensate for heeling due to wind, changes of the ship's course relative to the wind direction may lead to dangerous angles of heel or capsizing. Therefore, heeling caused by the wind should not be compensated with anti-heeling measures, unless, subject to the approval by the Administration, the vessel has been proven by calculation to have sufficient stability in worst case conditions (i.e. improper or incorrect use, mechanism failure, unintended course change, etc.). Guidance on the use of anti-heeling measures should be provided in the stability booklet.

5.3.8 Use of operational guidelines for avoiding dangerous situations in severe weather conditions or an onboard computer based system is recommended. The method should be simple to use.

5.3.9 High-speed craft should not be intentionally operated outside the worst intended conditions and limitations specified in the relevant certificates, or in documents referred to therein.

CHAPTER 6 – ICING CONSIDERATIONS

6.1 General

6.1.1 For any ship operating in areas where ice accretion is likely to occur, adversely affecting a ship's stability, icing allowances should be included in the analysis of conditions of loading.

6.1.2 Administrations are advised to take icing into account and are permitted to apply national standards where environmental conditions are considered to warrant a higher standard than those recommended in the following sections.

6.2 Cargo ships carrying timber deck cargoes

6.2.1 The master should establish or verify the stability of his ship for the worst service condition, having regard to the increased weight of deck cargo due to water absorption and/or ice accretion and to variations in consumables.

6.2.2 When timber deck cargoes are carried and it is anticipated that some formation of ice will take place, an allowance should be made in the arrival condition for the additional weight.

6.3 Fishing vessels

The calculations of loading conditions for fishing vessels (refer to 3.4.2.8) should, where appropriate, include allowance for ice accretion, in accordance with the following provisions.

6.3.1 *Allowance for ice accretion*

For vessels operating in areas where ice accretion is likely to occur, the following icing allowance should be made in the stability calculations:

.1 30 kg per square metre on exposed weather decks and gangways;

.2 7.5 kg per square metre for projected lateral area of each side of the vessel above the water plane;

.3 the projected lateral area of discontinuous surfaces of rail, sundry booms, spars (except masts) and rigging of vessels having no sails and the projected lateral area of other small objects should be computed by increasing the total projected area of continuous surfaces by 5% and the static moments of this area by 10%.

Vessels intended for operation in areas where ice is known to occur should be:

.4 designed to minimize the accretion of ice; and

.5 equipped with such means for removing ice as the Administration may require; for example, electrical and pneumatic devices, and/or special tools such as axes or wooden clubs for removing ice from bulwarks, rails and erections.

6.3.2 *Guidance relating to ice accretion*

In the application of the above standards, the following icing areas should apply:

.1 the area north of latitude 65° 30′ N, between longitude 28° W and the west coast of Iceland; north of the north coast of Iceland; north of the rhumb line running from latitude 66° N, longitude 15° W to latitude 73° 30′ N, longitude 15° E, north of latitude 73° 30′ N between longitude 15° E and 35° E, and east of longitude 35° E, as well as north of latitude 56° N in the Baltic Sea;

.2 the area north of latitude 43° N bounded in the west by the North American coast and the east by the rhumb line running from latitude 43° N, longitude 48° W to latitude 63° N, longitude 28° W and thence along longitude 28° W;

.3 all sea areas north of the North American Continent, west of the areas defined in 6.3.2.1 and 6.3.2.2;

.4 the Bering and Okhotsk Seas and the Tartary Strait during the icing season; and

.5 south of latitude 60° S.

A chart to illustrate the areas is attached at the end of this chapter.

For vessels operating in areas where ice accretion may be expected:

.6 within the areas defined in 6.3.2.1, 6.3.2.3, 6.3.2.4 and 6.3.2.5 known to having icing conditions significantly different from those described in 6.3.1, ice accretion requirements of one half to twice the required allowance may be applied; and

.7 within the area defined in 6.3.2.2, where ice accretion in excess of twice the allowance required by 6.3.1 may be expected, more severe requirements than those given in 6.3.1 may be applied.

6.3.3 *Brief survey of the causes of ice formation and its influence upon the seaworthiness of the vessel*

6.3.3.1 The skipper of a fishing vessel should bear in mind that ice formation is a complicated process which depends upon meteorological conditions, condition of loading and behaviour of the vessel in stormy weather as well as on the size and location of superstructures and rigging. The most common cause of ice formation is the deposit of water droplets on the vessel's structure. These droplets come from spray driven from wave crests and from ship-generated spray.

6.3.3.2 Ice formation may also occur in conditions of snowfall, sea fog (including arctic sea smoke), a drastic fall in ambient temperature, as well as from the freezing of drops of rain on impact with the vessel's structure.

6.3.3.3 Ice formation may sometimes be caused or accentuated by water shipped on board and retained on deck.

6.3.3.4 Intensive ice formation generally occurs on stem, bulwark and bulwark rail, front walls of superstructures and deck-houses, hawse holes, anchors, deck gear, forecastle deck and upper deck, freeing ports, aerials, stays, shrouds, masts and spars.

6.3.3.5 It should be borne in mind that the most dangerous areas as far as ice formation is concerned are the sub-Arctic regions.

6.3.3.6 The most intensive ice formation takes place when wind and sea come from ahead. In beam and quartering winds, ice accumulates quicker on the windward side of the vessel, thus leading to a constant list which is extremely dangerous.

6.3.3.7 Listed below are meteorological conditions causing the most common type of ice formation due to spraying of a vessel. Examples of the weight of ice formation on a typical fishing vessel of displacement in the range 100 t to 500 t are also given. For larger vessels the weight will be correspondingly greater.

6.3.3.8 Slow accumulations of ice take place:

.1 at ambient temperature from -1°C to -3°C and any wind force;

.2 at ambient temperature -4°C and lower and wind force from 0 m/s to 9 m/s; and

.3 under the conditions of precipitation, fog or sea mist followed by a drastic fall of the ambient temperature.

Under all these conditions the intensity of ice accumulation may not exceed 1.5 t/h.

6.3.3.9 At ambient temperature of -4°C to -8°C and wind force 10 m/s to 15 m/s, rapid accumulation of ice takes place. Under these conditions the intensity of ice accumulation can lie within the range 1.5 t/h to 4 t/h.

6.3.3.10 Very fast accumulation of ice takes place:

.1 at ambient temperature of -4°C and lower and wind forces of 16 m/s and over; and

.2 at ambient temperature -9°C and lower and wind force 10 m/s to 15 m/s.

Under these conditions the intensity of ice accumulation can exceed 4 t/h.

6.3.3.11 The skipper should bear in mind that ice formation adversely affects the seaworthiness of the vessel as ice formation leads to:

.1 an increase in the weight of the vessel due to accumulation of ice on the vessel's surfaces which causes the reduction of freeboard and buoyancy;

.2 a rise of the vessel's centre of gravity due to the high location of ice on the vessel's structures with corresponding reduction in the level of stability;

.3 an increase of windage area due to ice formation on the upper parts of the vessel and hence an increase in the heeling moment due to the action of the wind;

.4 a change of trim due to uneven distribution of ice along the vessel's length;

.5 the development of a constant list due to uneven distribution of ice across the breadth of the vessel; and

.6 impairment of the manoeuvrability and reduction of the speed of the vessel.

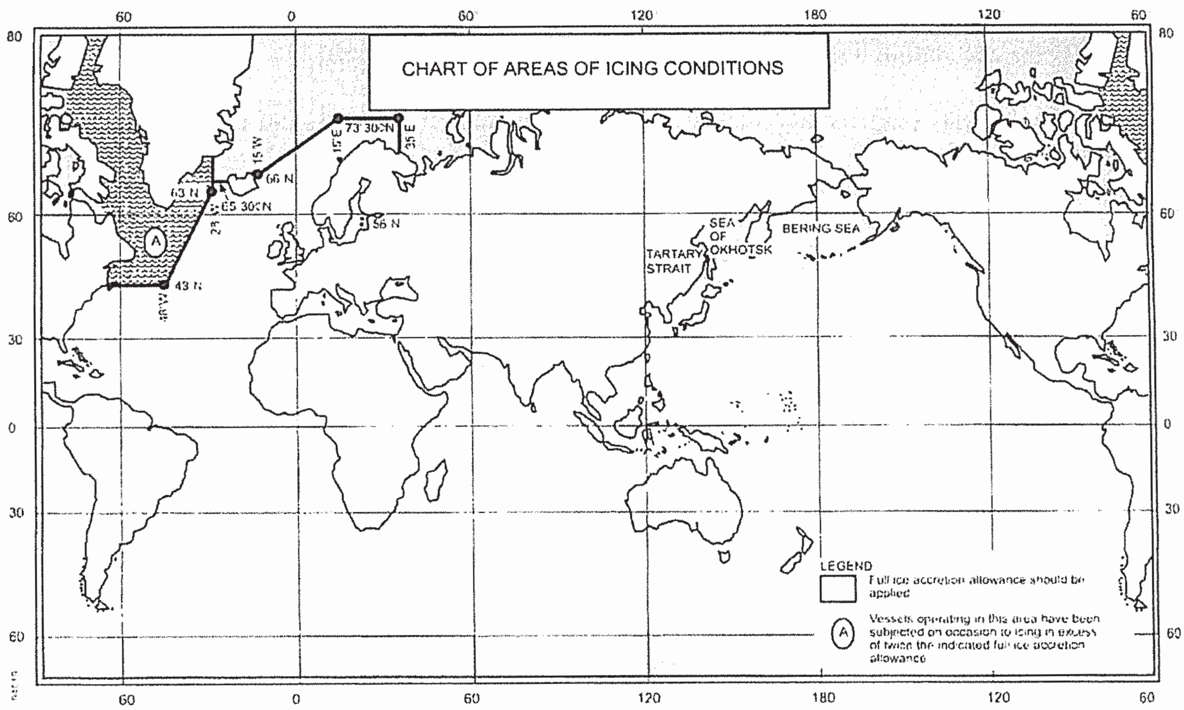
6.3.4 Operational procedures related to ensuring a fishing vessel's endurance in conditions of ice formation are given in annex 2 (Recommendations for skippers of fishing vessels on ensuring a vessel's endurance in conditions of ice formation).

6.4 Offshore supply vessels 24 m to 100 m in length

For vessels operating in areas where ice accretion is likely to occur:

.1 no shutters should be fitted in the freeing ports; and

.2 with regard to operational precautions against capsizing, reference is made to the recommendations for skippers of fishing vessels on ensuring a vessel's endurance in conditions of ice formation, as given in paragraph 6.3.3 and in annex 2 (Recommendations for skippers of fishing vessels on ensuring a vessel's endurance in conditions of ice formation).



CHAPTER 7 – CONSIDERATIONS FOR WATERTIGHT AND WEATHERTIGHT INTEGRITY

7.1 Hatchways

7.1.1 Cargo and other hatchways in ships to which the International Convention on Load Lines, 1966 and the Protocol of 1988 relating thereto, as amended, applies should comply with regulations 13, 14, 15, 16 and 26(5) of this Convention and the Protocol.

7.1.2 Hatchways in fishing vessels to which the 1993 Torremolinos Protocol applies should comply with regulations II/5 and II/6 of the Protocol.

7.1.3 In decked fishing vessels of 12 m in length and over but less than 24 m in length hatchways should comply with the following:

7.1.3.1 All hatchways should be provided with covers and those which may be opened during fishing operations should normally be arranged near to the vessel's centreline.

7.1.3.2 For the purpose of strength calculations it should be assumed that hatchway covers other than wood are subject to static load of 10 kN/m^2 or the weight of cargo intended to be carried on them, whichever is the greater.

7.1.3.3 Where covers are constructed of mild steel, the maximum stress according to 7.1.3.2 multiplied by 4.25 should not exceed the minimum ultimate strength of the material. Under these loads the deflections should not be more than 0.0028 times the span.

7.1.3.4 Covers made of materials other than mild steel or wood should be at least of equivalent strength to those made of mild steel and their construction should be of sufficient stiffness to ensure weathertightness under the loads specified in 7.1.3.2.

7.1.3.5 Covers should be fitted with clamping devices and gaskets or other equivalent arrangements sufficient to ensure weathertightness.

7.1.3.6 The use of wooden hatchway covers is generally not recommended in view of the difficulty of rapidly securing their weathertightness. However, where fitted they should be capable of being secured weathertight.

7.1.3.7 The finished thickness of wood hatchway covers should include an allowance for abrasion due to rough handling. In any case, the finished thickness of these covers should be at least 4 mm for each 100 mm of unsupported span subject to a minimum of 40 mm and the width of their bearing surfaces should be at least 65 mm.

7.1.3.8 The height above deck of hatchway coamings on exposed parts of the working deck should be at least 300 mm for vessels of 12 m in length and at least 600 mm for vessels of 24 m in length. For vessels of intermediate length the minimum height should be obtained by linear interpolation. The height above deck of hatchway coamings on exposed parts of the superstructure deck should be at least 300 mm.

7.1.3.9 Where operating experience has shown justification and on approval of the competent authority the height of hatchway coamings, except those which give direct access to machinery spaces may be reduced from the height as specified in 7.1.3.8 or the coamings may be omitted entirely, provided that efficient watertight hatch covers other than wood are fitted. Such hatchways should be kept as small as practicable and the covers should be permanently attached by hinges or equivalent means and be capable of being rapidly closed or battened down.

7.2 Machinery space openings

7.2.1 In ships to which the International Convention on Load Lines, 1966 or the Protocol of 1988 relating thereto as amended, as applicable, applies, machinery space openings should comply with regulation 17.

7.2.2 In fishing vessels to which the 1993 Torremolinos Protocol applies and in new decked fishing vessels of 12 m in length and over, but less than 24 m in length, the following requirements of regulation II/7 of this Protocol should be met:

.1 machinery space openings should be framed and enclosed by casings of a strength equivalent to the adjacent superstructure. External access openings therein should be fitted with doors complying with the requirements of regulation II/4 of the Protocol or, in vessels less than 24 m in length, with hatch covers other than wood complying with the requirements of 7.1.3 of this chapter; and

.2 openings other than access openings should be fitted with covers of equivalent strength to the unpierced structure, permanently attached thereto and capable of being closed weathertight.

7.2.3 In offshore supply vessels, access to the machinery space should, if possible, be arranged within the forecastle. Any access to the machinery space from the exposed cargo deck should be provided with two weathertight closures. Access to spaces below the exposed cargo deck should preferably be from a position within or above the superstructure deck.

7.3 Doors

7.3.1 In passenger ships to which the International Convention for the Safety of Life at Sea, 1974, applies, doors should comply with regulations II-1/13 and 16 of this Convention.

7.3.2 In ships to which the International Convention on Load Lines, 1966 or the Protocol of 1988 relating thereto, as amended, as applicable, applies, doors should comply with regulation 12 of this Convention.

7.3.3 In fishing vessels to which the 1993 Torremolinos Protocol applies, doors should comply with regulation II/2 and regulation II/4 of this Protocol.

7.3.4 In decked fishing vessels of 12 m in length and over but less than 24 m in length:

.1 Watertight doors may be of the hinged type and should be capable of being operated locally from each side of the door. A notice should be attached to the door on each side stating that the door should be kept closed at sea.

.2 All access openings in bulkheads of enclosed deck erections, through which water could enter and endanger the vessel, should be fitted with doors permanently attached to the bulkhead, framed and stiffened so that the whole structure is of equivalent strength to the unpierced structure, and weathertight when closed, and means should be provided so that they can be operated from each side of the bulkhead.

.3 The height above deck of sills in those doorways, companionways, deck erections and machinery casings situated on the working deck and on superstructure decks which give direct access to parts of that deck exposed to the weather and sea should be at least equal to the height of hatchway coamings as specified in 7.1.3.8.

.4 Where operating experience has shown justification and on approval of the competent authority, the height above deck of sills in the doorways specified in 7.3.4.3 except those giving direct access to machinery spaces, may be reduced to not less than 150 mm on superstructure decks and not less than 380 mm on the working deck for vessels 24 m in length, or not less than 150 mm on the working deck for vessels of 12 m in length. For vessels of intermediate length the minimum acceptable reduced height for sills in doorways on the working deck should be obtained by linear interpolation.

7.4 Cargo ports and other similar openings

7.4.1 Cargo ports and other similar openings in ships to which the International Convention on Load Lines, 1966 or the Protocol of 1988 relating thereto, as amended, as applicable, applies should comply with regulation 21 of this Convention.

7.4.2 Openings through which water can enter the vessel and fish flaps on stern trawlers in fishing vessels to which the 1993 Torremolinos Protocol applies should comply with regulation II/3 of this Protocol.

7.4.3 Cargo port and other similar openings in passenger ships to which the International Convention for the Safety of Life at Sea, 1974 applies should comply with regulations II-1/15, 17 and 22 of this Convention. In addition, such openings in ro-ro passenger ships to which this Convention applies, should comply with regulation II-1/17-1 of this Convention.

7.4.4 Cargo port and other similar openings in cargo ships to which the International Convention for the Safety of Life at Sea, 1974 applies should comply with regulation II-1/15-1 of this Convention.

7.5 Sidescuttles, window scuppers, inlets and discharges

7.5.1 In passenger ships to which the International Convention for the Safety of Life at Sea, 1974 applies, openings in shell plating below the bulkhead deck should comply with regulation II-1/15 of this Convention.

Watertight integrity above the bulkhead deck should comply with regulation II-1/17 of this Convention.

In addition, in ro-ro passenger ships, watertight integrity below the bulkhead deck should comply with regulation II-1/23 and integrity of the hull and superstructure should comply with regulation II-1/17-1 of this Convention.

7.5.2 In ships to which the International Convention on Load Lines, 1966 or the Protocol of 1988 relating thereto, as amended, as applicable, applies, scuppers, inlets and discharges should comply with regulation 22 and sidescuttles should comply with regulation 23 of this Convention.

7.5.3 In fishing vessels to which the 1993 Torremolinos Protocol applies, sidescuttles and windows should comply with regulation II/12 and inlets and discharges should comply with regulation II/13 of this Protocol.

7.5.4 In decked fishing vessels of 12 m in length and over but less than 24 m in length, sidescuttles, windows and other openings and inlets and discharges should comply with the following:

.1 sidescuttles to spaces below the working deck and to enclosed spaces on the working deck should be fitted with hinged deadlights capable of being closed watertight;

.2 sidescuttles should be fitted in a position such that their sills are above a line drawn parallel to the working deck at side having its lowest point 500 mm above the deepest operating waterline;

.3 sidescuttles, together with their glasses and deadlights, should be of substantial construction to the satisfaction of the competent authority;

.4 skylights leading to spaces below the working deck should be of substantial construction and capable of being closed and secured weathertight, and with provision for adequate means of closing in the event of damage to the inserts. Skylights leading to machinery spaces should be avoided as far as practicable;

.5 toughened safety glass or suitable permanently transparent material of equivalent strength should be fitted in all wheelhouse windows exposed to the weather. The means of securing windows and the width of the bearing surfaces should be adequate, having regard to the window material used. Openings leading to spaces below deck from a wheelhouse whose windows are not provided with the protection required by .6 should be fitted with a weathertight closing appliance;

.6 deadlights or a suitable number of storm shutters should be provided where there is no other method of preventing water from entering the hull through a broken window or sidescuttle;

.7 the competent authority may accept sidescuttles and windows without deadlights in side or aft bulkheads of deck erections located on or above the working deck if satisfied that the safety of the vessel will not be impaired;

.8 the number of openings in the sides of the vessel below the working deck should be the minimum compatible with the design and proper working of the vessel and such openings should be provided with closing arrangements of adequate strength to ensure watertightness and the structural integrity of the surrounding structure;

.9 discharges led through the shell either from spaces below the working deck or from spaces within deck erections should be fitted with efficient and accessible means for preventing water from passing inboard. Normally each separate discharge should have an automatic non-return valve with a positive means of closing it from a readily accessible position. Such a valve is not required if the competent authority considers that the entry of water into the vessel through the opening is not likely to lead to dangerous flooding and that the thickness of the pipe is sufficient. The means for operating the valve with a positive means of closing should be provided with an indicator showing whether the valve is open or closed. The open inboard end of any discharge system should be above the deepest operating waterline at an angle of heel satisfactory to the competent authority;

.10 in machinery spaces main and auxiliary sea inlets and discharges essential for the operation of machinery should be controlled locally. Controls should be readily accessible and should be provided with indicators showing whether the valves are open or closed. Suitable warning devices should be incorporated to indicate leakage of water into the space; and

.11 fittings attached to the shell and all valves should be of steel, bronze or other ductile material. All pipes between the shell and valves should be of steel, except that in vessels constructed of material other than steel, other suitable materials may be used.

7.5.5 In cargo ships to which the International Convention for the Safety of Life at Sea, 1974 applies, external openings should comply with regulation II-1/15-1 of this Convention.

7.6 Other deck openings

7.6.1 Miscellaneous openings in freeboard and superstructure decks in ships to which the International Convention on Load Lines, 1966 or the Protocol of 1988 relating thereto, as amended, as applicable, applies should comply with regulation 18 of this Convention.

7.6.2 In decked fishing vessels of 12 m and over where it is essential for fishing operations, flush deck scuttles of the screw, bayonet or equivalent type and manholes may be fitted provided these are capable of being closed watertight and such devices should be permanently attached to the adjacent structure. Having regard to the size and disposition of the openings and the design of the closing devices, metal-to-metal closures may be fitted if they are effectively watertight. Openings other than hatchways, machinery space openings, manholes and flush scuttles in the working or superstructure deck should be protected by enclosed structures fitted with weathertight doors or their equivalent. Companionways should be situated as close as practicable to the centreline of the vessel.

7.7 Ventilators, air pipes and sounding devices

7.7.1 Ventilators in ships to which the International Convention on Load Lines, 1966 or the Protocol of 1988 relating thereto, as amended, as applicable, applies should comply with regulation 19 and air pipes should comply with regulation 20 of this Convention.

7.7.2 Ventilators in fishing vessels to which the 1993 Torremolinos Protocol applies should comply with regulation II/9 and air pipes should comply with regulation II/10 of this Protocol. Sounding devices should comply with regulation II/11 of this Protocol.

7.7.3 Ventilators and air pipes in fishing vessels of 12 m in length and over but less than 24 m in length should comply with the following:

.1 ventilators should have coamings of substantial construction and should be capable of being closed weathertight by devices permanently attached to the ventilator or adjacent structure. Ventilators should be arranged as close to the vessel's centreline as possible and, where practicable, should extend through the top of a deck erection or companionway;

.2 the coamings of ventilators should be as high as practicable. On the working deck the height above deck of coamings of ventilators, other than machinery space ventilators, should be not less than 760 mm and on superstructure decks not less than 450 mm. When the height of such ventilators may interfere with the working of the vessel their coaming heights may be reduced to the satisfaction of the competent authority. The height above deck of machinery space ventilator openings should be to the satisfaction of the competent authority;

.3 closing appliances need not be fitted to ventilators the coamings of which extend more than 2.5 m above the working deck or more than 1.0 m above a deck-house top or superstructure deck;

.4 where air pipes to tanks or other spaces below deck extend above the working or superstructure decks the exposed parts of the pipes should be of substantial construction and, as far as is practicable, located close to the vessel's centreline and protected from damage by fishing or lifting gear. Openings of such pipes should be protected by efficient means of closing, permanently attached to the pipe or adjacent structure, except that where the competent authority is satisfied that they are protected against water trapped on deck, these means of closing may be omitted; and

.5 where air pipes are situated near the side of the vessel their height above deck to the point where water may have access below should be at least 760 mm on the working deck and at least 450 mm on the superstructure deck. The competent authority may accept reduction of the height of an air pipe to avoid interference with the fishing operations.

7.7.4 In offshore supply vessels air pipes and ventilators should comply with the following:

.1 air pipes and ventilators should be fitted in protected positions in order to avoid damage by cargo during operations and to minimize the possibility of flooding. Air pipes on the exposed cargo and forecastle decks should be fitted with automatic closing devices; and

.2 due regard should be given to the position of machinery space ventilators. Preferably they should be fitted in a position above the superstructure deck, or above an equivalent level if no superstructure deck is fitted.

7.8 Freeing ports

7.8.1 Where bulwarks on the weather portion of the freeboard or superstructure decks or, in fishing vessels, the working decks form wells, freeing ports should be arranged along the length of the bulwark as to ensure that the deck is freed of water most rapidly and effectively. Lower edges of freeing ports should be as near the deck as practicable.

7.8.2 In ships to which the International Convention on Load Lines, 1966 or the Protocol of 1988 relating thereto as amended, as applicable, applies, freeing ports should comply with regulation 24 of this Convention.

7.8.3 In decked fishing vessels of 12 m in length and over, freeing ports should comply with the following.

7.8.3.1 The minimum freeing port area A in m², on each side of the vessel for each well on the working deck, should be determined in relation to the length l and height of bulwark in the well as follows:

.1 $A = K * l$

where:

K = 0.07, for vessels of 24 m in length and over

K = 0.035, for vessels of 12 m in length;
for intermediate lengths the value of K should be obtained by linear interpolation (l need not be taken as greater than 70% of the vessel's length);

.2 where the bulwark is more than 1.2 m in average height, the required area should be increased by 0.004 m² per metre of length of well for each 0.1 m difference in height; and

.3 where the bulwark is less than 0.9 m in average height, the required area may be decreased by 0.004 m² per metre of length of well for each 0.1 m difference in height.

7.8.3.2 The freeing port area calculated according to 7.8.3.1 should be increased where the Administration or competent authority considers that the vessel's sheer is not sufficient to ensure rapid and effective freeing of the deck of water.

7.8.3.3 Subject to the approval of the Administration or competent authority, the minimum freeing port area for each well on the superstructure deck should be not less than one-half the area A given in 7.8.3.1 except that where the superstructure deck forms a working deck for fishing operations the minimum area on each side should be not less than 75% of the area A.

7.8.3.4 Freeing ports should be so arranged along the length of bulwarks as to provide the most rapid and effective freeing of the deck from water. Lower edges of freeing ports should be as near the deck as practicable.

7.8.3.5 Pound boards and means for stowage and working the fishing gear should be arranged so that the effectiveness of the freeing ports will not be impaired or water trapped on deck and prevented from easily reaching the freeing ports. Pound boards should be so constructed that they can be locked in position when in use and will not hamper the discharge of shipped water.

7.8.3.6 Freeing ports over 0.3 m in depth should be fitted with bars spaced not more than 0.23 m nor less than 0.15 m apart or provided with other suitable protective arrangements. Freeing port covers, if fitted, should be of approved construction. If devices are considered necessary for locking freeing port covers during fishing operations they should be to the satisfaction of the competent authority and easily operable from a readily accessible position.

7.8.3.7 In vessels intended to operate in areas subject to icing, covers and protective arrangements for freeing ports should be capable of being easily removed to restrict ice accumulation. Size of opening and means provided for removal of these protective arrangements should be to the satisfaction of the competent authority.

7.8.3.8 In addition, in fishing vessels of 12 m in length and above but less than 24 m in length where wells or cockpits are fitted in the working deck or superstructure deck with their bottoms above the deepest operating waterline, efficient non-return means of drainage overboard should be provided. Where bottoms of such wells or cockpits are below the deepest operating waterline, drainage to the bilges should be provided.

7.8.4 In offshore supply vessels, the Administration should give special attention to adequate drainage of pipe stowage positions, having regard to the individual characteristics of the vessel. However, the area provided for drainage of the pipe stowage positions should be in excess of the required freeing port area in the cargo deck bulwark and should not be fitted with shutters.

7.9 Miscellaneous

7.9.1 Ships engaged in towing operations should be provided with means for quick release of the towing hawser.

CHAPTER 8 – DETERMINATION OF LIGHTSHIP PARAMETERS

8.1 Application

8.1.1 Every passenger ship regardless of size and every cargo ship having a length, as defined in the International Convention on Load Lines, 1966 or the Protocol of 1988 relating thereto, as amended, as applicable, of 24 m and upwards, should be inclined upon its completion and the elements of its stability determined.

8.1.2 The Administration may allow the inclining test of an individual ship as required by paragraph 8.1.1 to be dispensed with provided basic stability data are available from the inclining test of a sister ship and it is shown to the satisfaction of the Administration that reliable stability information for the exempted ship can be obtained from such basic data.

To be dispensed from an inclining test, the deviation of lightship mass is not to exceed,

for $L < 50$ m:	2% of the lightship mass of the lead ship or as given in the information on stability;
for $L > 160$ m:	1% of the lightship mass of the lead ship or as given in the information on stability;
for intermediate L:	by linear interpolation,

and the deviation of the lightship's longitudinal centre of gravity (LCG) referred to L should not be greater than 0.5% of the lightship's LCG of the lead ship or as given in the information on stability regardless of the ship's length.

8.1.3 The Administration may allow the inclining test of an individual ship or class of ships especially designed for the carriage of liquids or ore in bulk to be dispensed with when reference to existing data for similar ships clearly indicates that due to the ship's proportions and arrangements more than sufficient metacentric height will be available in all probable loading conditions.

8.1.4 Where any alterations are made to a ship so as to materially affect the stability, the ship should be re-inclined.

8.1.5 At periodic intervals not exceeding five years, a lightweight survey should be carried out on all passenger ships to verify any changes in lightship displacement and longitudinal centre of gravity. The ship should be re-inclined whenever, in comparison with the approved stability information, a deviation from the lightship displacement exceeding 2% or a deviation of the longitudinal centre of gravity exceeding 1% of L is found, or anticipated.

8.1.6 The inclining test prescribed is adaptable for ships with a length below 24 m if special precautions are taken to ensure the accuracy of the test procedure.

8.2 Preparations for the inclining test

8.2.1 *Notification of the Administration*

Written notification of the inclining test should be sent to the Administration as it requires or in due time before the test. An Administration representative should be present to witness the inclining test and the test results be submitted for review.

The responsibility for making preparations, conducting the inclining test and lightweight survey, recording the data, and calculating the results rests with the shipyard, owner or naval architect. While compliance with the procedures outlined herein will facilitate an expeditious and accurate inclining test, it is recognized that alternative procedures or – arrangements may be equally efficient. However, to minimize risk of delay, it is recommended that all such variances be submitted to the Administration for review prior to the inclining test.

8.2.1.1 *Details of notification*

Written notification should provide the following information as the Administration may require:

.1 identification of the ship by name and shipyard hull number, if applicable;

.2 date, time, and location of the test;

.3 inclining weight data:

- .1 type;
- .2 amount (number of units and weight of each);
- .3 certification;
- .4 method of handling (i.e. sliding rail or crane);
- .5 anticipated maximum angle of heel to each side;

.4 measuring devices:

- .1 pendulums – approximate location and length;
- .2 U-tubes – approximate location and length;
- .3 inclinometers – location and details of approvals and calibrations;

.5 approximate trim;

.6 condition of tanks;

.7 estimated weights to deduct, to complete, and to relocate in order to place the ship in its true lightship condition;

.8 detailed description of any computer software to be used to aid in calculations during the inclining test; and

.9 name and telephone number of the person responsible for conducting the inclining test.

8.2.2 *General condition of the ship*

8.2.2.1 A ship should be as complete as possible at the time of the inclining test. The test should be scheduled to minimize the disruption in the ship's delivery date or its operational commitments.

8.2.2.2 The amount and type of work left to be completed (mass to be added) affect the accuracy of the lightship characteristics, so good judgement should be used. If the mass or centre of gravity of an item to be added cannot be determined with confidence, it is best to conduct the inclining test after the item is added.

8.2.2.3 Temporary material, tool boxes, staging, sand, debris, etc., on board should be reduced to absolute minimum before the inclining test. Excess crew or personnel not directly involved in the inclining test should be removed from on board the ship before the test.

8.2.2.4 Decks should be free of water. Water trapped on deck may shift and pocket in a fashion similar to liquids in a tank. Any rain, snow or ice accumulated on the ship should be removed prior to the test.

8.2.2.5 The anticipated liquid loading for the test should be included in the planning for the test. Preferably, all tanks should be empty and clean, or completely full. The number of slack tanks should be kept to an absolute minimum. The viscosity of the fluid, the depth of the fluid and the shape of the tank should be such that the free surface effect can be accurately determined.

8.2.2.6 The ship should be moored in a quiet, sheltered area free from extraneous forces such as propeller wash from passing vessels, or sudden discharges from shore side pumps. The tide conditions and the trim of the ship during the test should be considered. Prior to the test, the depth of water should be measured and recorded in as many locations as are necessary to ensure that the ship will not contact the bottom. The specific gravity of water should be accurately recorded. The ship should be moored in a manner to allow unrestricted heeling. The access ramps should be removed. Power lines, hoses, etc., connected to shore should be at a minimum, and kept slack at all times.

8.2.2.7 The ship should be as upright as possible; with inclining weights in the initial position, up to one-half degree of list is acceptable. The actual trim and deflection of keel, if practical, should be considered in the hydrostatic data. In order to avoid excessive errors caused by significant changes in the water plane area during heeling, hydrostatic data for the actual trim and the maximum anticipated heeling angles should be checked beforehand.

8.2.2.8 The total weight used should be sufficient to provide a minimum inclination of one degree and a maximum of four degrees of heel to each side. The Administration may, however, accept a smaller inclination angle for large ships provided that the requirements on pendulum deflection or U-tube difference in height in 8.2.2.9 are complied with. Test weights should be compact and of such a configuration that the vertical centre of gravity of the weights can be accurately determined. Each weight should be marked with an identification number and its mass. Re-certification of the test weights should be carried out prior to the incline. A crane of sufficient capacity and reach, or some other means, should be available during the inclining test to shift weights on the decking in an expeditious and safe manner. Water ballast transfer may be carried out, when it is impractical to incline using solid weights if acceptable to the Administration.

8.2.2.9 The use of three pendulums is recommended but a minimum of two should be used to allow identification of bad readings at any one pendulum station. They should each be located in an area protected from the wind. One or more pendulums may be substituted by other measuring devices (U-tubes or inclinometers) at the discretion of the Administration. Alternative measuring devices should not be used to reduce the minimum inclining angles recommended in 8.2.2.8.

The use of an inclinometer or U-tube should be considered in each separate case. It is recommended that inclinometers or other measuring devices only be used in conjunction with at least one pendulum.

8.2.2.10 Efficient two-way communications should be provided between central control and the weight handlers and between central control and each pendulum station. One person at a central control station should have complete control over all personnel involved in the test.

8.3 Plans required

The person in charge of the inclining test should have available a copy of the following plans at the time of the inclining test:

.1 lines plan;

.2 hydrostatic curves or hydrostatic data;

.3 general arrangement plan of decks, holds, inner bottoms, etc.;

.4 capacity plan showing capacities and vertical and longitudinal centres of gravity of cargo spaces, tanks, etc. When ballast water is used as inclining weight, the transverse and vertical centres of gravity for the applicable tanks for each angle of inclination, must be available;

.5 tank sounding tables;

.6 draught mark locations; and

.7 docking drawing with keel profile and draught mark corrections (if available).

8.4 Test procedure

8.4.1 Procedures followed in conducting the inclining test and lightweight survey should be in accordance with the recommendations laid out in annex 1 (Detailed guidance for the conduct of an inclining test) to this Code.

8.4.1.1 Freeboard/draught readings should be taken to establish the position of the waterline in order to determine the displacement of the ship at the time of the inclining test. It is recommended that at least five freeboard readings, approximately equally spaced, be taken on each side of the ship or that all draught marks (forward, midship and aft) be read on each side of the ship. Draught/freeboard readings should be read immediately before or immediately after the inclining test.

8.4.1.2 The standard test employs eight distinct weight movements. Movement No.8, a recheck of the zero point, may be omitted if a straight line plot is achieved after movement No.7. If a straight line plot is achieved after the initial zero and six weight movements, the inclining test is complete and the second check at zero may be omitted. If a straight line plot is not achieved, those weight movements that did not yield acceptable plotted points should be repeated or explained.

8.4.2 A copy of the inclining data should be forwarded to the Administration along with the calculated results of the inclining test in an acceptable report format, if required.

8.4.3 All calculations performed during the inclining test and in preparation of an inclining test report may be carried out by a suitable computer program. Output generated by such a program may be used for presentation of all or partial data and calculations included in the test report if it is clear, concise, well documented, and generally consistent in form and content with Administration requirements.

8.5 Inclining test for MODUs

8.5.1 An inclining test should be required for the first unit of a design, when as near to completion as possible, to determine accurately the lightship data (weight and position of centre of gravity).

8.5.2 For successive units which are identical by design, the lightship data of the first unit of the series may be accepted by the Administration in lieu of an inclining test, provided the difference in lightship displacement or position of centre of gravity due to weight changes for minor differences in machinery, outfitting or equipment, confirmed by the results of a deadweight survey, are less than 1% of the values of the lightship displacement and principal horizontal dimensions as determined for the first of the series. Extra care should be given to the detailed weight calculation and comparison with the original unit of a series of column-stabilized, semi-submersible types as these, even though identical by design, are recognized as being unlikely to attain an acceptable similarity of weight or centre of gravity to warrant a waiver of the inclining test.

8.5.3 The results of the inclining test, or deadweight survey and inclining experiment adjusted for weight differences, should be indicated in the Operating Manual.

8.5.4 A record of all changes to machinery, structure, outfit and equipment that affect the lightship data, should be maintained in the Operating Manual or a lightship data alterations log and be taken into account in daily operations.

8.5.5 For column-stabilized units, a deadweight survey should be conducted at intervals not exceeding five years. Where the deadweight survey indicates a change from the calculated lightship displacement in excess of 1% of the operating displacement, an inclining test should be conducted.

8.5.6 An inclining test or a deadweight survey should be carried out in the presence of an officer of the Administration, or a duly authorized person or representative of an approved organization.

8.6 Stability test for pontoons

An inclining experiment is not normally required for a pontoon, provided a conservative value of the lightship vertical centre of gravity (KG) is assumed for the stability calculations. The KG can be assumed at the level of the main deck although it is recognized that a lesser value could be acceptable if fully documented. The lightship displacement and longitudinal centre of gravity should be determined by calculation based on draught and density readings.

ANNEX 1

DETAILED GUIDANCE FOR THE CONDUCT OF AN INCLINING TEST

1 INTRODUCTION

This annex supplements the inclining standards put forth in part B, chapter 8 (Determination of lightship parameters) of this Code. This annex contains important detailed procedures for conducting an inclining test in order to ensure that valid results are obtained with maximum precision at a minimal cost to owners, shipyards and the Administration. A complete understanding of the correct procedures used to perform an inclining test is imperative in order to ensure that the test is conducted properly and so that results can be examined for accuracy as the inclining experiment is conducted.

2 PREPARATIONS FOR THE INCLINING TEST

2.1 Free surface and tankage

2.1.1 If there are liquids on board the ship when it is inclined, whether in the bilges or in the tanks, they will shift to the low side when the ship heels. This shift of liquids will exaggerate the heel of the ship. Unless the exact weight and distance of liquid shifted can be precisely calculated, the metacentric height (GM) calculated from the inclining test will be in error. Free surface should be minimized by emptying the tanks completely and making sure all bilges are dry; or by completely filling the tanks so that no shift of liquid is possible. The latter method is not the optimum because air pockets are difficult to remove from between structural members of a tank, and the weight and centre of the liquid in a full tank should be accurately determined in order to adjust the lightship values accordingly. When tanks must be left slack, it is desirable that the sides of the tanks be parallel vertical planes and the tanks be regular in shape (i.e. rectangular, trapezoidal, etc.) when viewed from above, so that the free surface moment of the liquid can be accurately determined. For example, the free surface moment of the liquid in a tank with parallel vertical sides can be readily calculated by the formula:

$$M_{fs} = l * b^3 * \rho_t / 12 \quad \text{(mt)}$$

where:

l = length of tank (m)

b = breadth of tank (m)

ρ_t = specific gravity of liquid in tank (t/m³)

$$Free\,surface\,correction = \frac{\sum_x M_{fs}(1) + M_{fs}(2) + ... + M_{fs}(x)}{\Delta} \quad \text{(m)}$$

where:

M_{fs} = free surface moment (mt)

Δ = displacement (t)

Free surface correction is independent of the height of the tank in the ship, location of the tank, and direction of heel. As the width of the tank increases, the value of free surface moment increases by the third power. The distance available for the liquid to shift is the predominant factor. This is why even the smallest amount of liquid in the bottom of a wide tank or bilge is normally unacceptable and should be removed prior to the inclining experiment. Insignificant amounts of liquids in V-shaped tanks or voids (e.g., a chain locker in the bow), where the potential shift is negligible, may remain if removal of the liquid would be difficult or would cause extensive delays.

When ballast water is used as inclining weight, the actual transverse and vertical movements of the liquid should be calculated taking into account the change of heel of the ship. Free surface corrections as defined in this paragraph should not apply to the inclining tanks.

2.1.2 ***Free surface and slack tanks***: The number of slack tanks should normally be limited to one port/starboard pair or one centreline tank of the following:

.1 fresh water reserve feed tanks;

.2 fuel/diesel oil storage tanks;

.3 fuel/diesel oil day tanks;

.4 lube oil tanks;

.5 sanitary tanks; or

.6 potable water tanks.

To avoid pocketing, slack tanks should normally be of regular (i.e. rectangular, trapezoidal, etc.) cross section and be 20% to 80% full if they are deep tanks and 40% to 60% full if they are double-bottom tanks. These levels ensure that the rate of shifting of liquid remains constant throughout the heel angles of the inclining test. If the trim changes as the ship is inclined, then consideration should also be given to longitudinal pocketing. Slack tanks containing liquids of sufficient viscosity to prevent free movement of the liquids, as the ship is inclined (such as bunker at low temperature), should be avoided since the free surface cannot be calculated accurately. A free surface correction for such tanks should not be used unless the tanks are heated to reduce viscosity. Communication between tanks should never be allowed. Cross-connections, including those via manifolds, should be closed. Equal liquid levels in slack tank pairs can be a warning sign of open cross connections. A bilge, ballast, and fuel oil piping plan can be referred to, when checking for cross connection closures.

2.1.3 ***Pressed-up tanks***: "Pressed up" means completely full with no voids caused by trim or inadequate venting. Anything less than 100% full, for example the 98% condition regarded as full for operational purposes, is not acceptable. Preferably, the ship should be rolled from side to side to eliminate entrapped air before taking the final sounding. Special care should be taken when pressing fuel oil tanks to prevent accidental pollution. An example of a tank that would appear "pressed up", but actually contains entrapped air, is shown in figure A1-2.1.3.

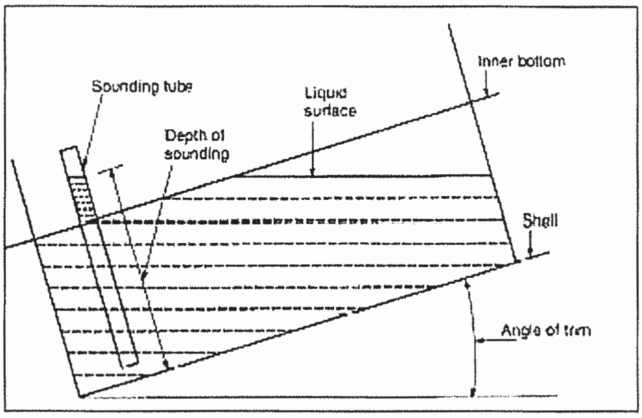


Figure A1-2.1.3

2.1.4 ***Empty tanks***: It is generally not sufficient to simply pump tanks until suction is lost. Enter the tank after pumping to determine if final stripping with portable pumps or by hand is necessary. The exceptions are very narrow tanks or tanks where there is a sharp deadrise, since free surface would be negligible. Since all empty tanks should be inspected, all manholes should be open and the tanks well ventilated and certified as safe for entry. A safe testing device should be on hand to test for sufficient oxygen and minimum toxic levels. A certified marine chemist's certificate certifying that all fuel oil and chemical tanks are safe for human entry should be available, if necessary.

2.2 Mooring arrangements

The importance of good mooring arrangements cannot be overemphasized. The arrangement selections will be dependent upon many factors. Among the most important are depth of water, wind and current effects. Whenever possible, the ship should be moored in a quiet, sheltered area free from extraneous forces such as propeller wash from passing ships, or sudden discharges from shore side pumps. The depth of water under the hull should be sufficient to ensure that the hull will be entirely free of the bottom. The tide conditions and the trim of the ship during the test should be considered. Prior to the test, the depth of water should be measured and recorded in as many locations as necessary to ensure the ship will not contact the bottom. If marginal, the test should be conducted during high tide or the ship moved to deeper water.

2.2.1 The mooring arrangement should ensure that the ship will be free to list without restraint for a sufficient period of time to allow a satisfactory reading of the heeling angle, due to each weight shift, to be recorded.

2.2.2 The ship should be held by lines at the bow and the stern, attached to bollards and/or cleats on the deck. If suitable restraint of the ship cannot be achieved using deck fittings, then temporary padeyes should be attached as close as possible to the centreline of the ship and as near the waterline as practical. Where the ship can be moored to one side only, it is good practice to supplement the bow and stern lines with two spring lines in order to maintain positive control of the ship, as shown in figure A1-2.2.2. The leads of the spring lines should be as long as practicable. Cylindrical camels should be provided between the ship and the dock. All lines should be slack, with the ship free of the pier and camels, when taking readings.

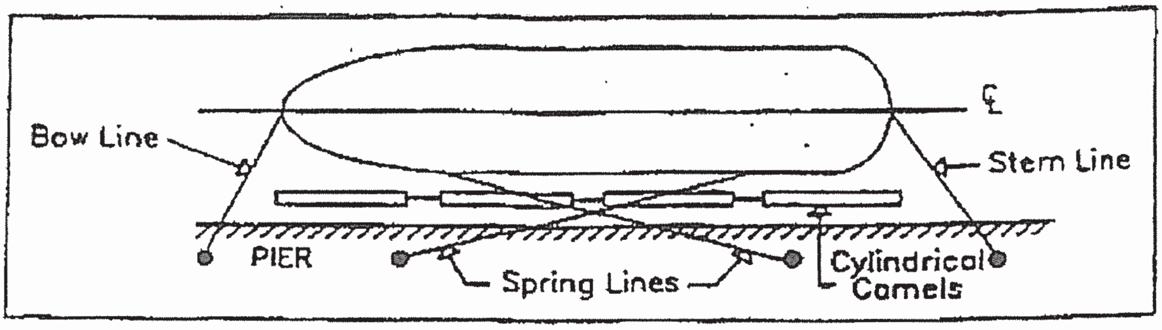


Figure A1-2.2.2

2.2.2.1 If the ship is held off the pier by the combined effect of the wind and current, a superimposed heeling moment will act on the ship throughout the test. For steady conditions this will not affect the results. Gusty winds or uniformly varying wind and/or current will cause these superimposed heeling moments to change, which may require additional test points to obtain a valid test. The need for additional test points can be determined by plotting test points as they are obtained.

2.2.2.2 If the ship is pressed against the fenders by wind and/or current, all lines should be slack. The cylindrical camels will prevent binding but there will be an additional superimposed heeling moment due to the ship bearing against the camels. This condition should be avoided where possible but, when used, consideration should be given to pulling the ship free of the dock and camels and letting the ship drift as readings are taken.

2.2.2.3 Another acceptable arrangement is where the combined wind and current are such that the ship may be controlled by only one line at either the bow or the stern. In this case, the control line should be led from on or near the centreline of the ship with all lines but the control line slack, the ship is free to veer with the wind and/or current as readings are taken. This can sometimes be troublesome because varying wind and/or current can cause distortion of the plot.

2.2.3 The mooring arrangement should be submitted to the approval authority for review prior to the test.

2.2.4 If a floating crane is used for handling inclining weights, it should not be moored to the ship.

2.3 Test weights

2.3.1 Weights, such as porous concrete, that can absorb significant amounts of moisture should only be used if they are weighed just prior to the inclining test or if recent weight certificates are presented. Each weight should be marked with an identification number and its weight. For small ships, drums completely filled with water may be used. Drums should normally be full and capped to allow accurate weight control. In such cases, the weight of the drums should be verified in the presence of the Administration representative using a recently calibrated scale.

2.3.2 Precautions should be taken to ensure that the decks are not overloaded during weight movements. If deck strength is questionable then a structural analysis should be performed to determine if existing framing can support the weight.

2.3.3 Generally, the test weights should be positioned as far outboard as possible on the upper deck. The test weights should be on board and in place prior to the scheduled time of the inclining test.

2.3.4 Where the use of solid weights to produce the inclining moment is demonstrated to be impracticable, the movement of ballast water may be permitted as an alternative method. This acceptance would be granted for a specific test only, and approval of the test procedure by the Administration is required. As a minimal prerequisite for acceptability, the following conditions should be required:

.1 inclining tanks should be wall-sided and free of large stringers or other internal members that create air pockets. Other tank geometries may be accepted at the discretion of the Administration;

.2 tanks should be directly opposite to maintain ship's trim;

.3 specific gravity of ballast water should be measured and recorded;

.4 pipelines to inclining tanks should be full. If the ship's piping layout is unsuitable for internal transfer, portable pumps and pipes/hoses may be used;

.5 blanks must be inserted in transfer manifolds to prevent the possibility of liquids being "leaked" during transfer. Continuous valve control must be maintained during the test;

.6 all inclining tanks must be manually sounded before and after each shift;

.7 vertical, longitudinal and transverse centres should be calculated for each movement;

.8 accurate sounding/ullage tables must be provided. The ship's initial heel angle should be established prior to the incline in order to produce accurate values for volumes and transverse and vertical centres of gravity for the inclining tanks at every angle of heel. The draught marks amidships (port and starboard) should be used when establishing the initial heel angle;

.9 verification of the quantity shifted may be achieved by a flow meter or similar device; and

.10 the time to conduct the inclining must be evaluated. If time requirements for transfer of liquids are considered too long, water may be unacceptable because of the possibility of wind shifts over long periods of time.

2.4 Pendulums

2.4.1 The pendulums should be long enough to give a measured deflection, to each side of upright, of at least 15 cm. Generally, this will require a pendulum length of at least 3 m. It is recommended that pendulum lengths of 4 to 6 m be used. Usually, the longer the pendulum the greater the accuracy of the test; however, if excessively long pendulums are used on a tender ship the pendulums may not settle down and the accuracy of the pendulums would then be questionable. On large ships with high GM, pendulum lengths in excess of the length recommended above may be required to obtain the minimum deflection. In such cases, the trough, as shown in figure A1-2.4.6, should be filled with high-viscosity oil. If the pendulums are of different lengths, the possibility of collusion between station recorders is avoided.

2.4.2 On smaller ships, where there is insufficient headroom to hang long pendulums, the 15 cm deflection should be obtained by increasing the test weight so as to increase the heel. On most ships the typical inclination is between one and four degrees.

2.4.3 The pendulum wire should be piano wire or other monofilament material. The top connection of the pendulum should afford unrestricted rotation of the pivot point. An example is that of a washer with the pendulum wire attached suspended from a nail.

2.4.4 A trough filled with a liquid should be provided to dampen oscillations of the pendulum after each weight movement. It should be deep enough to prevent the pendulum weight from touching the bottom. The use of a winged plumb bob at the end of the pendulum wire can also help to dampen the pendulum oscillations in the liquid.

2.4.5 The battens should be smooth, light-coloured wood, 1 to 2 cm thick, and should be securely fixed in position so that an inadvertent contact will not cause them to shift. The batten should be aligned close to the pendulum wire but not in contact with it.

2.4.6 A typical satisfactory arrangement is shown in figure A1-2.4.6. The pendulums may be placed in any location on the ship, longitudinally and transversely. The pendulums should be in place prior to the scheduled time of the inclining test.

2.4.7 It is recommended that inclinometers or other measuring devices only be used in conjunction with at least one pendulum. The Administration may approve an alternative arrangement when this is found impractical.

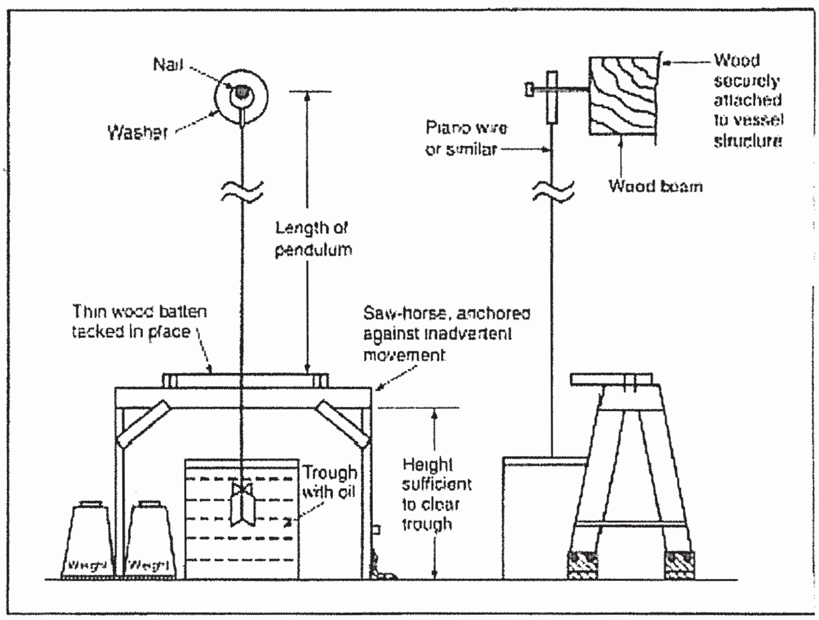


Figure A1-2.4.6

2.5 U-tubes

2.5.1 The legs of the device should be securely positioned as far as outboard as possible and should be parallel to the centreline plane of the ship. The distance between the legs should be measured perpendicular to the centreline plane. The legs should be vertical, as far as practical.

2.5.2 Arrangements should be made for recording all readings at both legs. For easy reading and checking for air pockets, clear plastic tube or hose should be used throughout. The U-tube should be pressure-tested prior to the inclining test to ensure watertightness.

2.5.3 The horizontal distance between the legs of the U-tube should be sufficient to obtain a level difference of at least 15 cm between the upright and the maximum inclination to each side.

2.5.4 Normally, water would be used as the liquid in the U-tube. Other low-viscosity liquids may also be considered.

2.5.5 The tube should be free of air pockets. Arrangements should be made to ensure that the free flow of the liquid in the tube is not obstructed.

2.5.6 Where a U-tube is used as a measuring device, due consideration should be given to the prevailing weather conditions (see 4.1.1.3):

.1 if the U-tube is exposed to direct sunlight, arrangements should be made to avoid temperature differences along the length of the tube;

.2 if temperatures below 0°C are expected, the liquid should be a mixture of water and an anti-freeze additive; and

.3 where heavy rain squalls can be expected, arrangements should be made to avoid additional water entering the U-tube.

2.6 Inclinometers

The use of inclinometers should be subject to at least the following recommendations:

.1 the accuracy should be equivalent to that of the pendulum;

.2 the sensitivity of the inclinometer should be such that the non-steady heeling angle of the ship can be recorded throughout the measurement;

.3 the recording period should be sufficient to accurately measure the inclination. The recording capacity should be generally sufficient for the whole test;

.4 the instrument should be able to plot or print the recorded inclination angles on paper;

.5 the instrument should have linear performance over the expected range of inclination angles;

.6 the instrument should be supplied with the manufacturer's instructions giving details of calibration, operating instructions, etc.; and

.7 it should be possible to demonstrate the required performance to the satisfaction of the Administration during the inclining test.

3 EQUIPMENT REQUIRED

Besides the physical equipment necessary such as the inclining weights, pendulums, small boat, etc., the following are necessary and should be provided by or made available to the person in charge of the inclining:

.1 engineering scales for measuring pendulum deflections (rules should be subdivided sufficiently to achieve the desired accuracy;

.2 sharp pencils for marking pendulum deflections;

.3 chalk for marking the various positions of the inclining weights;

.4 a sufficiently long measuring tape for measuring the movement of the weights and locating different items on board;

.5 a sufficiently long sounding tape for sounding tanks and taking freeboard readings;

.6 one or more well maintained specific gravity hydrometers with range sufficient to cover 0.999 to 1.030, to measure the specific gravity of the water in which the ship is floating (a hydrometer for measuring specific gravity of less than 1.000 may be needed in some locations);

.7 other hydrometers as necessary to measure the specific gravity of any liquids on board;

.8 graph paper to plot inclining moments versus tangents;

.9 a straight edge to draw the measured waterline on the lines drawing;

.10 a pad of paper to record data;

.11 an explosion-proof testing device to check for sufficient oxygen and absence of lethal gases in tanks and other closed spaces such as voids and cofferdams;

.12 a thermometer; and

.13 draught tubes (if necessary).

4 TEST PROCEDURE

The inclining experiment, the freeboard/draught readings and the survey may be conducted in any order and still achieve the same results. If the person conducting the inclining test is confident that the survey will show that the ship is in an acceptable condition and there is the possibility of the weather becoming unfavourable, then it is suggested that the inclining be performed first and the survey last. If the person conducting the test is doubtful that the ship is complete enough for the test, it is recommended that the survey be performed first since this could invalidate the entire test, regardless of the weather conditions. It is very important that all weights, the number of people on board, etc., remain constant throughout the test.

4.1 Initial walk-through and survey

The person responsible for conducting the inclining test should arrive on board the ship well in advance of the scheduled time of the test to ensure that the ship is properly prepared for the test. If the ship to be inclined is large, a preliminary walk through may need to be done the day preceding the actual incline. To ensure the safety of personnel conducting the walk through, and to improve the documentation of surveyed weights and deficiencies, at least two persons should make the initial walk through. Things to check include: all compartments are open, clean, and dry, tanks are well ventilated and gas-free, movable or suspended items are secured and their position documented, pendulums are in place, weights are on board and in place, a crane or other method for moving weights is available, and the necessary plans and equipment are available. Before beginning the inclining test, the person conducting the test should:

.1 consider the weather conditions. The combined adverse effect of wind, current and sea may result in difficulties or even an invalid test due to the following:

.1 inability to accurately record freeboards and draughts;

.2 excessive or irregular oscillations of the pendulums;

.3 variations in unavoidable superimposed heeling moments.

In some instances, unless conditions can be sufficiently improved by moving the ship to a better location, it may be necessary to delay or postpone the test. Any significant quantities of rain, snow, or ice should be removed from the ship before the test. If bad weather conditions are detected early enough and the weather forecast does not call for improving conditions, the Administration representative should be advised prior to departure from the office and an alternative date scheduled;

.2 make a quick overall survey of the ship to make sure the ship is complete enough to conduct the test and to ensure that all equipment is in place. An estimate of items which will be outstanding at the time of the inclining test should be included as part of any test procedure submitted to the Administration. This is required so that the Administration representative can advise the shipyard/naval architect if in their opinion the ship will not be sufficiently complete to conduct the incline and that it should be rescheduled. If the condition of the ship is not accurately depicted in the test procedure and at the time of the inclining test the Administration representative considers that the ship is in such condition that an accurate incline cannot be conducted, the representative may refuse to accept the incline and require that the incline be conducted at a later date;

.3 enter all empty tanks after it is determined that they are well ventilated and gas-free to ensure that they are dry and free of debris. Ensure that any pressed-up tanks are indeed full and free of air pockets. The anticipated liquid loading for the incline should be included in the procedure required to be submitted to the Administration;

.4 survey the entire ship to identify all items which need to be added to the ship, removed from the ship, or relocated on the ship to bring the ship to the lightship condition. Each item should be clearly identified by weight and vertical and longitudinal location. If necessary, the transverse location should also be recorded.

The inclining weights, the pendulums, any temporary equipment and dunnage, and the people on board during the inclining test are all among the weights to be removed to obtain the lightship condition. The person calculating the lightship characteristics from the data gathered during the incline and survey and/or the person reviewing the inclining test may not have been present during the test and should be able to determine the exact location of the items from the data recorded and the ship's drawings. Any tanks containing liquids should be accurately sounded and the soundings recorded;

.5 it is recognized that the weight of some items on board, or that are to be added, may have to be estimated. If this is necessary, it is in the best interest of safety to be on the safe side when estimating, so the following rules of thumb should be followed:

.1 when estimating weights to be added:

.1.1 estimate high for items to be added high in the ship; and

.1.2 estimate low for items to be added low in the ship;

.2 when estimating weights to be removed:

.2.1 estimate low for items to be removed from high in the ship; and

.2.2 estimate high for items to be removed from low in the ship;

.3 when estimating weights to be relocated:

.3.1 estimate high for items to be relocated to a higher point in the ship; and

.3.2 estimate low for items to be relocated to a lower point in the ship.

4.2 Freeboard/draught readings

4.2.1 Freeboard/draught readings should be taken to establish the position of the waterline in order to determine the displacement of the ship at the time of the inclining test. It is recommended that at least five freeboard readings, approximately equally spaced, be taken on each side of the ship or that all draught marks (forward, midship, and aft) be read on each side of the ship. Draught mark readings should be taken to assist in determining the waterline defined by freeboard readings, or to verify the vertical location of draught marks on ships where their location has not been confirmed. The locations for each freeboard reading should be clearly marked. The longitudinal location along the ship should be accurately determined and recorded since the (moulded) depth at each point will be obtained from the ship's lines. All freeboard measurements should include a reference note clarifying the inclusion of the coaming in the measurement and the coaming height.

4.2.2 Draught and freeboard readings should be read immediately before or immediately after the inclining test. Weights should be on board and in place and all personnel who will be on board during the test, including those who will be stationed to read the pendulums, should be on board and in location during these readings. This is particularly important on small ships. If readings are made after the test, the ship should be maintained in the same condition as during the test. For small ships, it may be necessary to counterbalance the list and trim effects of the freeboard measuring party. When possible, readings should be taken from a small boat.

4.2.3 A small boat should be available to aid in the taking of freeboard and draught mark readings. It should have low freeboard to permit accurate observation of the readings.

4.2.4 The specific gravity of the flotation water should be determined at this time. Samples should be taken from a sufficient depth of the water to ensure a true representation of the flotation water and not merely surface water, which could contain fresh water from run-off of rain. A hydrometer should be placed in a water sample and the specific gravity read and recorded. For large ships, it is recommended that samples of the flotation water be taken forward, midship, and aft and the readings averaged. For small ships, one sample taken from midships should be sufficient. The temperature of the water should be taken and the measured specific gravity corrected for deviation from the standard, if necessary. A correction to water specific gravity is not necessary if the specific gravity is determined at the inclining experiment site. Correction is necessary if specific gravity is measured when sample temperature differs from the temperature at the time of the inclining (e.g., if check of specific gravity is done at the office).

4.2.5 A draught mark reading may be substituted for a given freeboard reading at that longitudinal location if the height and location of the mark have been verified to be accurate by a keel survey while the ship was in dry dock.

4.2.6 A device, such as a draught tube, can be used to improve the accuracy of freeboard/draught readings by damping out wave action.

4.2.7 The dimensions given on a ship's lines drawing are normally moulded dimensions. In the case of depth, this means the distance from the inside of the bottom shell to the inside of the deck plate. In order to plot the ship's waterline on the lines drawing, the freeboard readings should be converted to moulded draughts. Similarly, the draught mark readings should be corrected from extreme (bottom of keel) to moulded (top of keel) before plotting. Any discrepancy between the freeboard/draught readings should be resolved.

4.2.8 The mean draught (average of port and starboard readings) should be calculated for each of the locations where freeboard/draught readings are taken and plotted on the ship's lines drawing or outboard profile to ensure that all readings are consistent and together define the correct waterline. The resulting plot should yield either a straight line or a waterline which is either hogged or sagged. If inconsistent readings are obtained, the freeboards/draughts should be retaken.

4.3 The incline

4.3.1 Prior to any weight movements the following should be checked:

.1 the mooring arrangement should be checked to ensure that the ship is floating freely (this should be done just prior to each reading of the pendulums);

.2 the pendulums should be measured and their lengths recorded. The pendulums should be aligned so that when the ship heels, the wire will be close enough to the batten to ensure an accurate reading but will not come into contact with the batten. The typical satisfactory arrangement is shown in figure A1-2.4.6;

.3 the initial position of the weights is marked on the deck. This can be done by tracing the outline of the weights on the deck;

.4 the communications arrangement is adequate; and

.5 all personnel are in place.

4.3.2 A plot should be run during the test to ensure that acceptable data are being obtained. Typically, the abscissa of the plot will be heeling moment W(x) (weight times distance x) and the ordinate will be the tangent of the heel angle (deflection of the pendulum divided by the length of the pendulum). This plotted line does not necessarily pass through the origin or any other particular point for no single point is more significant than any other point. A linear regression analysis is often used to fit the straight line. The weight movements shown in figure A1-4.3.2-1 give a good spread of points on the test plot.

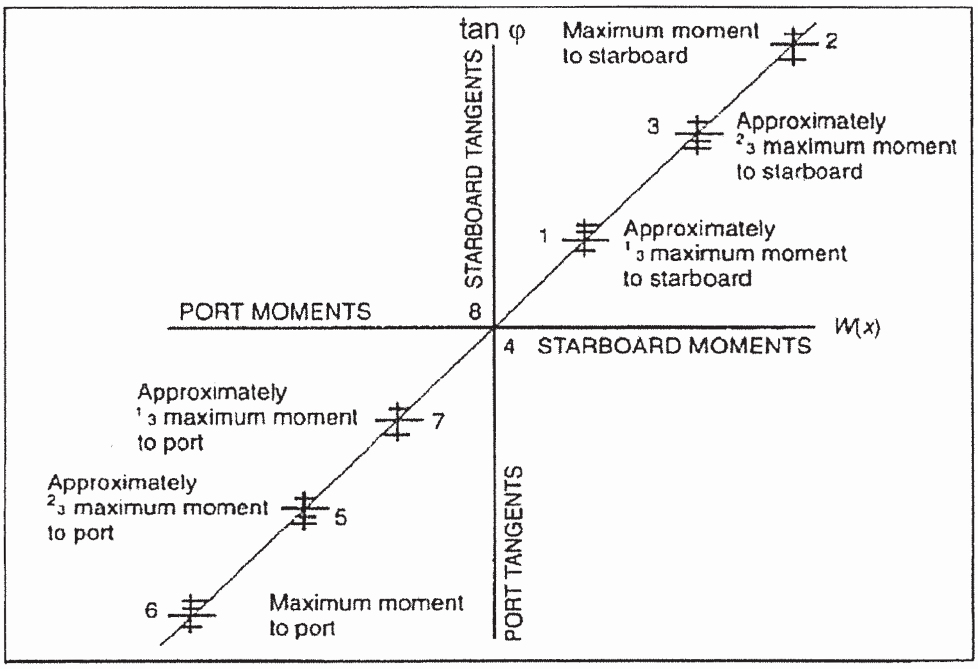
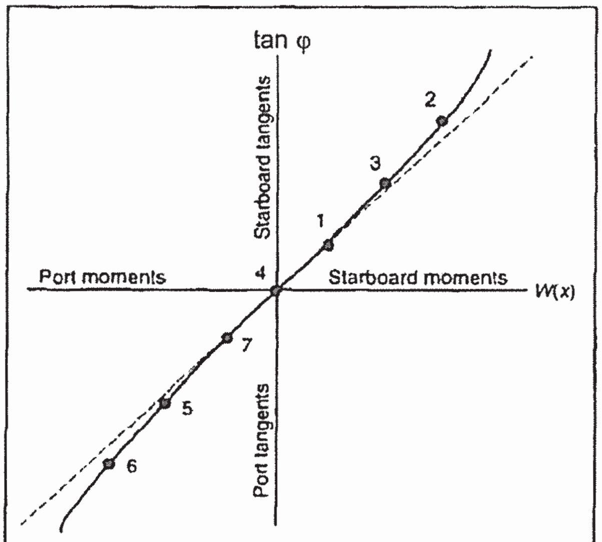


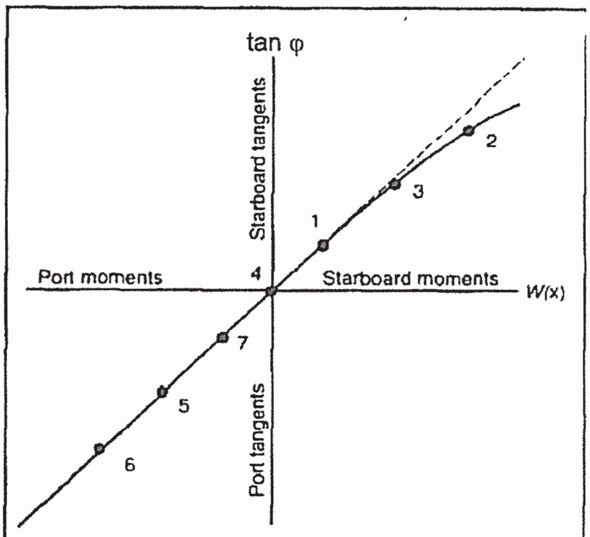
Figure A1-4.3.2-1

The plotting of all the readings for each of the pendulums during the inclining experiment aids in the discovery of bad readings. Since *W(x)/tan φ* should be constant, the plotted line should be straight. Deviations from a straight line are an indication that there were other moments acting on the ship during the inclining. These other moments should be identified, the cause corrected, and the weight movements repeated until a straight line is achieved. Figures A1-4.3.2-2 to A1-4.3.2-5 illustrate examples of how to detect some of these other moments during the inclining, and a recommended solution for each case. For simplicity, only the average of the readings is shown on the inclining plots.



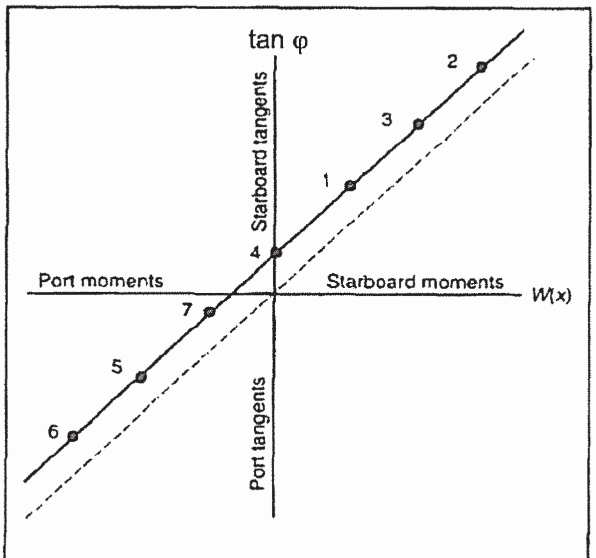
Excessive free liquids (re-check all tanks and voids and pump out as necessary: re-do all weight movements and re-check freeboard and draught readings)

Figure A1-4.3.2-2



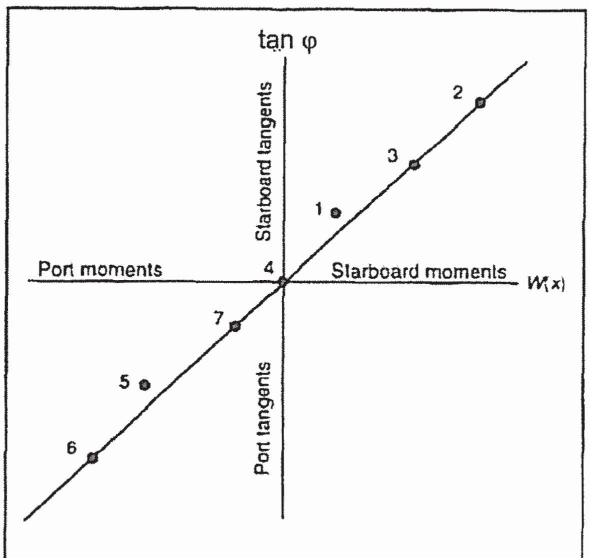
Ship touching bottom or restrained by mooring lines (take water soundings and check lines: re-do weight movements 2 and 3)

Figure A1-4.3.2-3



Steady wind from port side came up after initial zero point taken (plot acceptable)

Figure A1-4.3.2-4



Gusty wind from port side (re-do weight movements 1 and 5)

Figure A1-4.3.2-5

4.3.3 Once everything and everyone is in place, the zero position should be obtained and the remainder of the experiment conducted as quickly as possible, while maintaining accuracy and proper procedures, in order to minimize the possibility of a change in environmental conditions during the test.

4.3.4 Prior to each pendulum reading, each pendulum station should report to the control station when the pendulum has stopped swinging. Then, the control station will give a "standby" warning and then a "mark" command. When "mark" is given, the batten at each position should be marked at the location of the pendulum wire. If the wire was oscillating slightly, the centre of the oscillations should be taken as the mark. If any of the pendulum readers does not think the reading was a good one, the reader should advise the control station and the point should be retaken for all pendulum stations. Likewise, if the control station suspects the accuracy of a reading, it should be repeated for all the pendulum stations. Next to the mark on the batten should be written the number of the weight movement, such as zero for the initial position and one to seven for the weight movements.

4.3.5 Each weight movement should be made in the same direction, normally transversely, so as not to change the trim of the ship. After each weight movement, the distance the weight was moved (centre to centre) should be measured and the heeling moment calculated by multiplying the distance by the amount of weight moved. The tangent is calculated for each pendulum by dividing the deflection by the length of the pendulum. The resultant tangents are plotted on the graph. Provided there is good agreement among the pendulums with regard to the $tan\ \varphi$ value, the average of the pendulum readings may be graphed instead of plotting each of the readings.

4.3.6 Inclining data sheets should be used so that no data are forgotten and so that the data are clear, concise, and consistent in form and format. Prior to departing the ship, the person conducting the test and the Administration representative should initial each data sheet as an indication of their concurrence with the recorded data.

ANNEX 2

RECOMMENDATIONS FOR SKIPPERS OF FISHING VESSELS ON ENSURING A VESSEL'S ENDURANCE IN CONDITIONS OF ICE FORMATION

1 Prior to departure

1.1 Firstly, the skipper should, as in the case of any voyages in any season, ensure that the vessel is generally in a seaworthy condition, giving full attention to basic requirements such as:

.1 loading of the vessel within the limits prescribed for the season (paragraph 1.2.1 below);

.2 weathertightness and reliability of the devices for closing cargo and access hatches, outer doors and all other openings in the decks and superstructures of the vessel and the watertightness of the sidescuttles and of ports or similar openings in the sides below the freeboard deck to be checked;

.3 condition of the freeing ports and scuppers as well as operational reliability of their closures to be checked;

.4 emergency and life-saving appliances and their operational reliability;

.5 operational reliability of all external and internal communication equipment; and

.6 condition and operational reliability of the bilge and ballast pumping systems.

1.2 Further, with special regard to possible ice accretion, the skipper should:

.1 consider the most critical loading condition against approved stability documents with due regard to fuel and water consumption, distribution of supplies, cargoes and fishing gear and with allowance for possible ice accretion;

.2 be aware of the danger in having supplies and fishing gear stored on open weather deck spaces due to their large ice accretion surface and high centre of gravity;

.3 ensure that a complete set of warm clothing for all members of the crew is available on the vessel as well as a complete set of hand tools and other appliances for combating ice accretion, a typical list thereof for small vessels is shown in section 4 of this annex;

.4 ensure that the crew is acquainted with the location of means for combating ice accretion, as well as the use of such means, and that drills are carried out so that members of the crew know their respective duties and have the necessary practical skills to ensure the vessel's endurance under conditions of ice accretion;

.5 acquaint himself with the meteorological conditions in the region of fishing grounds and en route to the place of destination; study the synoptical maps of this region and weather forecasts; be aware of warm currents in the vicinity of the fishing grounds, of the nearest coastline relief, of the existence of protected bays and of the location of ice fields and their boundaries; and

.6 acquaint himself with the timetable of the radio stations transmitting weather forecasts and warnings of the possibility of ice accretion in the area of the relevant fishing grounds.

2 At sea

2.1 During the voyage and when the vessel is on the fishing grounds, the skipper should keep himself informed on all long-term and short-term weather forecasts and should arrange for the following systematic meteorological observations to be systematically recorded:

.1 temperatures of the air and of the sea surface;

.2 wind direction and force;

.3 direction and height of waves and sea state;

.4 atmospheric pressure, air humidity; and

.5 frequency of splashing per minute and the intensity of ice accumulation on different parts of the vessel per hour.

2.2 All observed data should be recorded in the vessel's log-book. The skipper should compare the weather forecasts and icing charts with actual meteorological conditions, and should estimate the probability of ice formation and its intensity.

2.3 When the danger of ice formation arises, the following measures should be taken without delay:

.1 all the means of combating ice formation should be ready for use;

.2 all the fishing operations should be stopped, the fishing gear should be taken on board and placed in the under-deck spaces. If this cannot be done all the gear should be fastened for storm conditions on its prescribed place. It is particularly dangerous to leave the fishing gear suspended since its surface for ice formation is large and the point of suspension is generally located high;

.3 barrels and containers with fish, packing, all gear and supplies located on deck as well as portable mechanisms should be placed in closed spaces as low as possible and firmly lashed;

.4 all cargoes in holds and other compartments should be placed as low as possible and firmly lashed;

.5 the cargo booms should be lowered and fastened;

.6 deck machinery, hawser reels and boats should be covered with duck covers;

.7 lifelines should be fastened on deck;

.8 freeing ports fitted with covers should be brought into operative condition, all objects located near scuppers and freeing ports and preventing water drainage from deck should be taken away;

.9 all cargo and companion hatches, manhole covers, weathertight outside doors in superstructures and deck-houses and portholes should be securely closed in order to ensure complete weathertightness of the vessel, access to the weather deck from inner compartments should be allowed only through the superstructure deck;

.10 a check should be carried out as to whether the amount of water ballast on board and its location is in accordance with that recommended in "Stability guidance to skippers"; if there is sufficient freeboard, all the empty bottom tanks fitted with ballast piping should be filled with seawater;

.11 all fire-fighting, emergency and life-saving equipment should be ready for use;

.12 all drainage systems should be checked for their effectiveness;

.13 deck lighting and searchlights should be checked;

.14 a check should be carried out to make sure that each member of the crew has warm clothing; and

.15 reliable two-way radio communication with both shore stations and other vessels should be established; radio calls should be arranged for set times.

2.4 The skipper should seek to take the vessel away from the dangerous area, keeping in mind that the lee edges of icefields, areas of warm currents and protected coastal areas are a good refuge for the vessel during weather when ice formation occurs.

2.5 Small fishing vessels on fishing grounds should keep nearer to each other and to larger vessels.

2.6 It should be remembered that the entry of the vessel into an icefield presents certain danger to the hull, especially when there is a high sea swell. Therefore the vessel should enter the icefield at a right angle to the icefield edge at low speed without inertia. It is less dangerous to enter an icefield bow to the wind. If a vessel must enter an icefield with the wind on the stern, the fact that the edge of the ice is more dense on the windward side should be taken into consideration. It is important to enter the icefield at the point where the ice floes are the smallest.

3 During ice formation

3.1 If in spite of all measures taken the vessel is unable to leave the dangerous area, all means available for removal of ice should be used as long as it is subjected to ice formation.

3.2 Depending on the type of vessel, all or many of the following ways of combating ice formation may be used:

.1 removal of ice by means of cold water under pressure;

.2 removal of ice with hot water and steam; and

.3 breaking up of ice with ice crows, axes, picks, scrapers, or wooden sledge-hammers and clearing it with shovels.

3.3 When ice formation begins, the skipper should take into account the recommendations listed below and ensure their strict fulfilment:

.1 report immediately ice formation to the shipowner and establish with him constant radio communication;

.2 establish radio communication with the nearest vessels and ensure that it is maintained;

.3 do not allow ice formation to accumulate on the vessel, immediately take steps to remove from the vessel's structures even the thinnest layer of ice and ice sludge from the upper deck;

.4 check constantly the vessel's stability by measuring the roll period of the vessel during ice formation. If the rolling period increases noticeably, immediately take all possible measures in order to increase the vessel's stability;

.5 ensure that each member of the crew working on the weather deck is warmly dressed and wears a safety line securely attached to the guardrail;

.6 bear in mind that the work of the crew on ice clearing entails the danger of frost-bite. For this reason it is necessary to make sure that members of the crew working on deck are replaced periodically;

.7 keep the following structures and gears of the vessel first free from ice:

.7.1 aerials;

.7.2 running and navigational lights;

.7.3 freeing ports and scuppers;

.7.4 lifesaving craft;

.7.5 stays, shrouds, masts and rigging;

.7.6 doors of superstructures and deck-houses; and

.7.7 windlass and hawse holes;

.8 remove the ice from large surfaces of the vessel, beginning with the upper structures (such as bridges, deck-houses, etc.), because even a small amount of ice on them causes a drastic worsening of the vessel's stability;

.9 when the distribution of ice is not symmetrical and a list develops, the ice must be cleared from the lower side first. Bear in mind that any correction of the list of the vessel by pumping fuel or water from one tank to another may reduce stability during the process when both tanks are slack;

.10 when a considerable amount of ice forms on the bow and a trim appears, ice must be quickly removed. Water ballast may be redistributed in order to decrease the trim;

.11 clear ice from the freeing ports and scuppers in due time in order to ensure free drainage of the water from the deck;

.12 check regularly for water accumulation inside the hull;

.13 avoid navigating in following seas since this may drastically worsen the vessel's stability;

.14 register in the vessel's log-book the duration, nature and intensity of ice formation, amount of ice on the vessel, measures taken to combat ice formation and their effectiveness; and

.15 if, in spite of all the measures taken to ensure the vessel's endurance in conditions of ice formation, the crew is forced to abandon the vessel and embark on life-saving craft (lifeboats, rafts) then, in order to preserve their lives, it is necessary to do all possible to provide all the crew with warm clothing or special bags as well as to have a sufficient number of lifelines and bailers for speedy bailing out of water from the life-saving craft.

4 List of equipment and hand tools

A typical list of equipment and hand tools required for combating ice formation:

.1 ice crows or crowbars;

.2 axes with long handles;

.3 picks;

.4 metal scrapers;

.5 metal shovels;

.6 wooden sledge-hammers;

.7 fore and aft lifelines to be rigged each side of the open deck fitted with travellers to which lizards can be attached.

Safety belts with spring hooks should be provided for no less than 50% of the members of the crew (but not less than 5 sets), which can be attached to the lizards.

Notes: 1 The number of hand tools and lifesaving appliances may be increased, at the shipowner's discretion.

2 Hoses which may be used for ice combating should be readily available on board.

二零一六年五月十二日於行政長官辦公室

辦公室主任 柯嵐

Gabinete do Chefe do Executivo, aos 12 de Maio de 2016. — A Chefe do Gabinete, *O Lam*.