INTERNATIONAL MARITIME ORGANIZATION

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SUB-COMMITTEE ON STABILITY AND LOAD LINES AND ON FISHING VESSELS SAFETY
50th session
Agenda item 19

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REPORT TO THE MARITIME SAFETY COMMITTEE

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LIST OF ANNEXES

1 GENERAL

1.1 The Sub-Committee held its fiftieth session from 30 April to 4 May 2007 under the chairmanship of Mr. R. Gehling (Australia). The Vice-Chairman, Mr. Z. Szozda (Poland), was also present.

1.2 The session was attended by delegations from the following Member Governments:

ALGERIA
ANGOLA
ARGENTINA
AUSTRALIA
BAHAMAS
BELIZE
BOLIVIA
BRAZIL
CANADA
CHILE
CHINA
COLOMBIA
CROATIA
CUBA
CYPRUS
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA
DENMARK
DOMINICAN REPUBLIC
ECUADOR
EGYPT
FINLAND
FRANCE
GERMANY
GREECE
ICELAND
INDONESIA
IRAN (ISLAMIC REPUBLIC OF)
IRELAND
ISRAEL
ITALY
JAPAN
KENYA
LATVIA
LIBERIA
MALAYSIA
MALTA
MARSHALL ISLANDS
MEXICO
MOROCCO
NETHERLANDS
NIGERIA
NORWAY
PANAMA
PAPUA NEW GUINEA
PERU
PHILIPPINES
POLAND
PORTUGAL
REPUBLIC OF KOREA
RUSSIAN FEDERATION
SAINT KITTS AND NEVIS
SAUDI ARABIA
SINGAPORE
SOUTH AFRICA
SPAIN
SWEDEN
SYRIAN ARAB REPUBLIC
TURKEY
TUVALU
UNITED KINGDOM
UNITED STATES
URUGUAY
VENEZUELA

and the following Associate Member of IMO:

HONG KONG, CHINA

1.3 The session was also attended by representatives from the following United Nations specialized agencies:

INTERNATIONAL LABOUR ORGANIZATION (ILO)
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO)

1.4 The session was also attended by an observer from the following intergovernmental organization:

EUROPEAN COMMISSION (EC)

1.5 The session was also attended by observers from the following non-governmental organizations:

INTERNATIONAL CHAMBER OF SHIPPING (ICS)
INTERNATIONAL UNION OF MARINE INSURANCE (IUMI)
INTERNATIONAL CONFEDERATION OF FREE TRADE UNIONS (ICFTU)
INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES (IACS)
OIL COMPANIES INTERNATIONAL MARINE FORUM (OCIMF)
INTERNATIONAL ASSOCIATION OF DRILLING CONTRACTORS (IADC)
INTERNATIONAL FEDERATION OF SHIPMASTERS' ASSOCIATIONS (IFSMA)
INTERNATIONAL ASSOCIATION OF INDEPENDENT TANKER OWNERS (INTERTANKO)
CRUISE LINES INTERNATIONAL ASSOCIATION (CLIA)
INTERNATIONAL MARINE CONTRACTORS ASSOCIATION (IMCA)
THE ROYAL INSTITUTION OF NAVAL ARCHITECTS (RINA)
INTERNATIONAL TOWING TANK CONFERENCE (ITTC)

Opening address

1.6 In welcoming the participants, the Secretary-General, in marking the fiftieth session, recalled that the SLF Sub-Committee was the amalgamation of the Sub-Committee on Tonnage Measurement (TM), the Sub-Committee on Subdivision and Stability Problems (STAB) and the Panel of Experts on Stability of Fishing Vessels (PFV), and paid tribute to its remarkable achievements during the long period of its existence. He stated that Members should be pleased at the progress the Sub-Committee had since made and the quality of the output of the Sub-Committee, which had contributed significantly to the achievement of the objectives of the Organization.

In recalling the many advances in the field of stability, load lines, tonnage measurement and fishing vessel safety made over these years, the Secretary-General highlighted, in particular, the comprehensive Intact Stability Code; the subdivision and damage stability requirements, including harmonization of requirements for passenger ships and cargo ships using the probabilistic method; the 1966 Load Lines Convention and, later on, the 1988 Load Lines Protocol relating thereto; the 1969 Tonnage Measurement Convention; the 1977 Torremolinos Convention and its 1993 Protocol; the Code of Safety and Voluntary Guidelines for fishermen and fishing vessels, prepared in co-operation with FAO and ILO.

The Secretary-General took the opportunity to pay a special tribute to all the Chairmen who have led the Sub-Committee, for their committed service: Prof. Prohaska and Mr. Bache (Denmark), Mr. Wood, Capt. Price and Mr. Middleton (United States), Mr. Smith and Mr. Allan (United Kingdom), Mr. Bardarson (Iceland), Dr. Dorin (Russian Federation), Mr. Christiansen and Mr. Manum (Norway), Mr. Hormann (Germany), Mr. Carcantzós (Greece) and the current Chairman Mr. Gehling (Australia). He also praised and thanked the Sub-Committee's Secretaries and other officers involved in its work such as Mr. Sanderson, Mr. Nakayama, Mr. Nadeinski, Mr. Sasamura, Mr. Jens, Mr. Mitschka, Mr. Kobylinski, Mr. Petrov, Mr. Semenov, Mr. Palomares and, more recently, Mr. Yamada for their painstaking and dedicated services.

Referring to this year's theme for World Maritime Day "IMO's response to current environmental challenges", the Secretary-General pointed out that this theme provided an opportunity to show that the maritime sector did care about the environment and was, indeed, at the forefront of this challenge. In this context, he emphasized that IMO had adopted a wide range of measures to prevent and control any pollution caused by ships which were all positive proof of the firm determination of Governments and the industry to reduce to the barest minimum the impact that shipping might have on the fragile environment.

Turning to the important items on the agenda, the Secretary-General, having recalled that requirements for damage stability and subdivision under the revised SOLAS chapter II-1, were expected to enter into force on 1 January 2009, highlighted that the work on the development of definitive Explanatory Notes to the aforementioned requirements would assist SOLAS Contracting Governments and the industry with the implementation of the revised chapter II-1 in an effective and uniform manner. He stated that, moreover and for the same purpose, the Sub-Committee would commence work on guidance on the impact of open watertight doors on existing and new ship survivability and on the interpretation of alterations and modifications of a major character under the revised SOLAS chapter II-1.

In relation to the passenger ship safety initiative, particularly in the context of the new SOLAS regulation II-1/8-1, the Secretary-General noted that the Sub-Committee would give preliminary consideration to the stability and seakeeping characteristics of damaged passenger ships and to time-dependent survivability of passenger ships in damaged condition, and stressed that the Sub-Committee's contribution to these crucial issues of the Committee's proactive work on passenger ship safety was of the utmost importance.

Referring to the comprehensive revision of the Intact Stability Code, the Secretary-General observed that the Sub-Committee had almost finalized its work on this topic, including the Code's restructuring so as to make it mandatory, and would now embark on the development of performance-based stability criteria. He emphasized that this salutary trend towards performance-based criteria would allow technological developments and innovative solutions to emerge, whilst continuing efforts to produce the highest practicable standards in all the areas of IMO's concern, and he looked forward to further progress on the matter.

Concerning work on the safety of small fishing vessels, aiming at developing safety recommendations for decked fishing vessels of less than 12 metres in length and undecked fishing vessels, the Secretary-General recalled that, when addressing the 27th session of the Committee on Fisheries (COFI) of the Food and Agriculture Organization, he had urged the Ministers and other Government representatives attending that meeting to promote, in their respective countries, the earliest possible acceptance of the 1993 Torremolinos Protocol and the 1995 STCW-F Convention and emphasized the great importance of the work on the safety of small fishing vessels.

Referring to the development of options to improve the effect on ship design and safety of the 1969 Tonnage Measurement (TM) Convention, the Secretary-General pointed out that the Committee had assigned this new work item to the Sub-Committee, after noting the possible adverse effect on the design and safety of ships of the use of total enclosed volume as the basis for gross tonnage. In this regard, he noted that developing options to improve safety from the design stage of ships might lead to necessary amendments to the 1969 TM Convention and encouraged the Sub-Committee to give a thorough and meticulous consideration to this matter.

In concluding, the Secretary-General, on the issue of security, stressed that there should be no complacency about security at any of the various venues where IMO meetings were scheduled to be held during the refurbishment period and appealed to all to abide by the security rules in place and any other *ad hoc* measures that may be necessary; and, with regard to the implementation of the Voluntary IMO Member State Audit Scheme in accordance with resolution A.974(24), updated the Sub-Committee on the audits conducted so far, and requested the support and co-operation of all Member States to the wide and effective implementation of the Scheme.

Chairman's remarks

1.7 In responding, the Chairman thanked the Secretary-General and stated that his words of encouragement as well as advice and requests would be given every consideration in the deliberations of the Sub-Committee and its working and drafting groups.

Adoption of the agenda

1.8 The Sub-Committee adopted the agenda (SLF 50/1/Rev.1) and agreed, in general, to be guided in its work by the annotations to the provisional agenda contained in document SLF 50/1/1. The agenda, as adopted, with the list of documents considered under each agenda item, is set out in document SLF 50/INF.5.

2 DECISIONS OF OTHER IMO BODIES

General

2.1 The Sub-Committee noted the decisions and comments pertaining to its work made by DSC 11, MEPC 55, MSC 82, FP 51 and DE 50, as reported in documents SLF 50/2 and SLF 50/2/1, and took them into account in its deliberations when dealing with relevant agenda items.

2.2 The Sub-Committee agreed to consider matters related to the draft amendments to the MODU Code, as summarized in paragraph 3 of document SLF 50/2/1, under agenda item 18 (Any other business).

Application of the Committee's Guidelines

2.3 The Sub-Committee noted that MSC 82 had approved amendments to the Guidelines on the organization and method of work of the MSC and the MEPC and their subsidiary bodies, which were incorporated in the revised Guidelines disseminated by means of MSC-MEPC.1/Circ.1, superseding the existing Guidelines (MSC/Circ.1099 – MEPC/Circ.405).

3 DEVELOPMENT OF EXPLANATORY NOTES FOR HARMONIZED SOLAS CHAPTER II-1

General

3.1 The Sub-Committee recalled that MSC 82 had approved the Interim Explanatory Notes to the SOLAS chapter II-1 subdivision and damage stability regulations (MSC.1/Circ.1226), as prepared by SLF 49.

3.2 The Sub-Committee also recalled that SLF 49 had established the SDS Correspondence Group to develop additions and improvements to the Interim Explanatory Notes; to identify any regulations that need future improvement; to develop a draft MSC circular on Guidelines for damage control plans and information to the master; and to prepare guidelines for flooding detection systems required by new SOLAS regulation II-1/22-1.

3.3 The Sub-Committee had for its consideration the report of the SDS Correspondence Group (SLF 50/3) submitted by Sweden and the United States; and documents submitted by Germany (SLF 50/3/2), Japan (SLF 50/3/4), Norway (SLF 50/3/3) and the Secretariat (SLF 50/3/1 and SLF 50/3/5).

Report of the correspondence group

3.4 The Sub-Committee considered the report of the correspondence group (SLF 50/3), containing draft additions and improvements to the Explanatory Notes for the harmonized SOLAS chapter II-1, the list of regulations of SOLAS chapter II-1 that need future improvement, draft guidelines for damage control plans and information to the master and a report on guidelines for flooding detection systems required by new SOLAS regulation II-1/22-1, together with document SLF 50/3/2, providing a study on calculated survivability of passenger ships after damage for the use of these values by the master for decision-making.

3.5 Following the discussion, the Sub-Committee approved the report in general and, having noted the views expressed on the draft Explanatory Notes, in particular that there were some support for development of a single minimum GM curve and trim limits curves (revised SOLAS regulations II-1/5-1.4 and II-1/7.2); the draft guidelines for damage control plans and information to the master; and the guidelines for flooding detection systems required by new SOLAS regulation II-1/22-1, agreed to refer documents SLF 50/3 and SLF 50/3/2 to the SDS Working Group for further consideration.

Outcome of MSC 82

New SOLAS regulation II-1/8-1

3.6 The Sub-Committee recalled that MSC 82 had instructed it to include, in the Explanatory Notes, guidance on the term “any single watertight compartment” used in the new SOLAS regulation II-1/8-1 and, having considered documents SLF 50/3/3 (Norway) and SLF 50/3/4 (Japan), containing comments and proposals on the matter, agreed that the draft text contained in the annex to document SLF 50/3/3 should be used as a basis for the guidance to be developed. The Sub-Committee further agreed that the working group should also take document SLF 50/3/4 into account during its discussions on the matter.

Unfavourable conditions of trim and list

3.7 The Sub-Committee considered the outcomes of MSC 82 (SLF 50/3/1) and DE 50 (SLF 50/3/5) on matters related to the draft SOLAS chapter III definition for the term “unfavourable conditions of trim and list” and, having noted that probabilistic requirements of revised SOLAS chapter II-1 (annex 2 to SLF 50/3/1) had been deleted from the aforementioned definition by DE 50, agreed to refer this matter together with the 20° list and 10° trim values of the revised definition by DE 50 to the SDS Working Group for further consideration, with a view to referral of the outcome of SLF 50 to the LSA Correspondence Group established by DE 50.

Reduced degree of hazard

3.8 In considering the request from DE 50 to include, in the Explanatory Notes, the term "reduced degree of hazard" contained in the revised SOLAS regulation II-1/6.2.4 (SLF 50/3/5), the Sub-Committee agreed to refer the matter to the SDS Working Group for further consideration and action as appropriate.

Application of the B/5 value

3.9 With regard to the application of the term "B/5" to the subdivision standards, the Sub-Committee noted that DE 50 had agreed that no change is needed to the application of the term "B/5".

Establishment of the working group

3.10 The Sub-Committee established the Working Group on Subdivision and Damage Stability, and instructed it, taking into account relevant comments made and decisions taken in plenary, to:

.1 further develop additions and improvements to the Interim Explanatory Notes to the SOLAS chapter II-1 subdivision and damage stability regulations, including the issue of "any single watertight compartment" and the term "reduced degree of hazard", based on MSC.1/Circ.1226 and document SLF 50/3 (annex 1), taking into account documents SLF 50/3/3, SLF 50/3/4 and SLF 50/3/5;

.2 further consider the SOLAS chapter II-1 regulations identified by the correspondence group as needing future improvement (SLF 50/3, annex 2) and advise the Sub-Committee accordingly;

.3 finalize the draft MSC circular on Guidelines for damage control plans and information to the master, based on document SLF 50/3 (annex 3), taking into account document SLF 50/3/2;

.4 prepare draft Guidelines for flooding detection systems required by new SOLAS regulation II-1/22-1, taking into account document SLF 50/3;

.5 consider the definition of the term "unfavourable conditions of trim and list", taking into account the outcome of DE 50 (SLF 50/3/5) and the draft amendments to SOLAS and the LSA Code referred to in annex 2 to document SLF 50/3/1, and make relevant recommendations to the Sub-Committee; and

.6 consider whether it is necessary to re-establish the correspondence group and, if so, prepare draft terms of reference for the group, for consideration by plenary.

Report of the working group

3.11 Having received the report of the working group (SLF 50/WP.1), the Sub-Committee approved it in general and took action as outlined in the following paragraphs.

Explanatory Notes for SOLAS chapter II-1

Any single watertight compartment

3.12 Concerning the term "any single watertight compartment", the Sub-Committee agreed on the following text for inclusion in the Explanatory Notes:

> "**Regulation 8-1 – System capabilities after a flooding casualty on passenger ships**
>
> ***Paragraph 2***
>
> In the context of this regulation, 'compartment' has the same meaning as defined under regulation 7-1 of these Notes (i.e., an onboard space within watertight boundaries).
>
> The purpose of the paragraph is to prevent any flooding of limited extent from immobilizing the ship. This principle should be applied regardless of how the flooding might occur. Only flooding below the bulkhead deck need be considered."

3.13 The Sub-Committee noted that regulation 8-1 was established only for redundancy of the system capabilities and, in this connection, the placement of regulation 8-1 in the revised chapter II-1, part B-1 (Stability), is at present not logical. However, the Sub-Committee recalled that stability requirements could be developed separately, pending the outcome of the work under the future agenda item on "Stability and sea-keeping characteristics of damaged passenger ships in a seaway when returning to port by own power or under tow".

Reduced degree of hazard

3.14 The Sub-Committee considered the following interpretation of the term "reduced degree of hazard" in the revised SOLAS regulation II-1/6.2.4, referred to the Sub-Committee by DE 50 for inclusion in the Explanatory Notes (SLF 50/3/5):

> "A lesser value of N, but in no case less than N = N1 + N2, may be allowed at the discretion of the Administration for passenger ships, which, in the course of their voyages, do not proceed more than 20 miles from the nearest land",

and agreed that the interpretation should be included in the Explanatory Notes to SOLAS chapter II-1.

Additions and improvements to the Interim Explanatory Notes to the SOLAS chapter II-1 subdivision and damage stability regulations (MSC.1/Circ.1226)

3.15 The Sub-Committee noted that the group had considered the additions and improvements to the Interim Explanatory Notes (MSC.1/Circ.1226) developed by the SDS Correspondence Group (SLF 50/3, annex 1) and had agreed on the following:

.1 clarification of definition of vertical extent of flooding – to be included in Explanatory Notes (EN) according to the proposal (regulation 2);

.2 application of regulation 19 to tankers – to be further discussed by the correspondence group (regulation 4);

.3 clarification that OBO in footnote of regulation 4 means combination carrier as defined in MARPOL Annex I, regulation 1 – to be included in EN (regulation 4);

.4 GM and KG limiting curves for different trims – to be further discussed and developed by the correspondence group (regulations 5-1 and 7);

.5 equipment adjacent to bulkheads (pipes, valves, etc.), including extent that may be allowed with same treatment as corrugated bulkheads – to be included in EN (regulations 7 and 7-1);

.6 valves outside the stiffening structure – a clarification to be included in EN, stating that this could be handled by introducing new zones (regulation 7-1);

.7 minor progressive flooding – restricted to pipes and with proposed limits on diameter or area to be included in EN, but not any references to leakage through weathertight closures (regulation 7.7);

.8 transverse penetration depth b – to be further discussed by the correspondence group (regulation 7-1);

.9 GZ_{max} to be taken up within the range – definitions in regulation 7-2.1 are sufficient and need no further EN (regulation 7-2);

.10 several ranges of positive levers – to be included in EN that only one continuous GZ curve is applicable to a specific stage of flooding, no combination of different stages in one curve; if a GZ curve includes several positive maxima within the allowable range, then any of these may be utilized for calculation of the criteria (regulation 7-2);

.11 instantaneous flooding/cross flooding/equalization – to be further discussed by the correspondence group, based on a simplified approach without specific calculation methods (regulation 7-2);

.12 horizontal evacuation routes – to be further developed by the correspondence group (regulation 7-2);

.13 permeability regarding timber deck cargo – reference to MSC/Circ.998 to be included, no clarification of alternative permeability needed (regulation 7-3);

.14 double bottoms in passenger ships and cargo ships other than tankers – to be included in EN (regulation 9);

.15 internal watertight integrity of passenger ships above the bulkhead deck – the "deterministic way" to be included, replacing the existing text, noting also that regulation 17 has been included in the list of SOLAS regulations to be further considered in the future (SLF 50/3, annex 2) (regulation 17); and

.16 bilge pumping arrangements – to be further developed by the correspondence group (regulation 35-1).

3.16 The Sub-Committee endorsed the view of the group that, since the target completion date for the item is 2008, additional items to be included to the Explanatory Notes should be kept to a minimum and consist of clear and concise text proposals.

SOLAS chapter II-1 regulations needing future improvement

3.17 The Sub-Committee noted that the group, having noted the list of SOLAS chapter II-1 regulations identified by the correspondence group as needing future improvement (SLF 50/3, annex 2), had not considered them in detail and agreed that the list should be kept updated and considered at an appropriate time in the future. The Sub-Committee further noted that the group had agreed that:

.1 it should be reconsidered whether regulation II-1/17.3 should be deleted or not; and

.2 a new item concerning regulation II-1/1.1.3.4, which is currently not in line with the principles of the proposed revision of MSC/Circ.650, should be included in the list.

MSC circular on Guidelines for damage control plans and information to the master

3.18 The Sub-Committee agreed to the Guidelines for damage control plans and information to the master and the associated draft MSC circular, set out in annex 1, for submission to MSC 83 for approval. In this connection, the Sub-Committee agreed that the relevant existing footnotes to SOLAS regulation II-1/19 publication should be modified accordingly (i.e., the two existing footnotes should be replaced by a single footnote with an asterisk to be inserted after the title of the regulation) and invited the Committee to request the Secretariat to act accordingly.

3.19 In the context of this item, the Sub-Committee, recalling the establishment of a correspondence group under agenda item 8 (see paragraph 8.7), also encouraged the correspondence group to consider how best to develop simple and easily understandable guidance for the master for cases involving flooding damage.

Guidelines for flooding detection systems required by new SOLAS regulation II-1/22-1

3.20 The Sub-Committee noted that the group had considered the development of draft Guidelines for flooding detection systems required by new SOLAS regulation II-1/22-1, taking into account document SLF 50/3, and concurred with the view of the group that there should be a lower limit for watertight spaces that are to be equipped with flooding detection systems according to the following:

.1 spaces that have a volume in m^3 less than the ship's moulded displacement per cm immersion at deepest subdivision draught; or

.2 30 m^3,

whichever is the highest value.

3.21 In considering the need for continuous flood level monitoring, the Sub-Committee agreed with the view of the group that it would be sufficient to have only water ingress detection, but that in spaces extending in height over more than one deck, there should be at least one detection system on each deck level. Furthermore, there should not be any requirements to add additional ingress detection systems in watertight spaces already equipped with level monitoring. The Sub-Committee agreed to task the correspondence group to further develop detailed guidelines, based on the above conclusions and also taking into consideration the effects of excessive trim and heel.

Definition of the term "unfavourable conditions of trim and list"

3.22 The Sub-Committee noted that the group had considered the definition of the term "unfavourable conditions of trim and list" as prepared by DE 50, taking into account documents SLF 50/3/5 and SLF 50/3/1, and had agreed that this new definition was better than the previously proposed one, but was still open to different interpretations. In general, the group considered that life-saving appliances should be able to be deployed at heel angles of 20°, but reasonable trim angles to be accounted for when installing LSA may depend on the context. The group did not find it possible to give general guidance on what "worst combinations of maximum trim and list" would mean in relation to damage stability requirements. Noting that the definition was currently being reviewed and possibly further refined and clarified by the LSA Correspondence Group of the DE Sub-Committee, the Sub-Committee agreed to refer the above views of the group to the DE Sub-Committee, and requested the Secretariat to act accordingly.

Establishment of a correspondence group

3.23 In view of the above developments, the Sub-Committee established the SDS Correspondence Group, under the co-ordination of Sweden and the United States*, and instructed it to:

.1 develop the final draft text of the Explanatory Notes to the SOLAS chapter II-1 subdivision and damage stability regulations in the form of an MSC circular, taking into account MSC/Circ.1226 and document SLF 50/WP.1;

.2 develop draft Guidelines for flooding detection systems required by new SOLAS regulation II-1/22-1, taking into account document SLF 50/WP.1;

.3 consider the list of SOLAS chapter II-1 regulations identified as needing future improvement and make relevant recommendations, taking into account document SLF 50/WP.1; and

.4 submit a report to SLF 51.

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4 REVISION OF THE INTACT STABILITY CODE

General

4.1 The Sub-Committee recalled that SLF 49 had agreed, in principle, to the modifications to the text of the draft revised IS Code, as contained in document SLF 49/5, and that the delegation of Germany had offered to prepare a consolidated text of the draft revised Code in a format used for IMO instruments and submit it to this session.

4.2 The Sub-Committee also recalled that SLF 49 had established the Correspondence Group on Intact Stability and instructed it to develop draft amendments to the 1974 SOLAS Convention and the 1988 LL Protocol in order to make the IS Code mandatory under these instruments.

4.3 The Sub-Committee had for its consideration the report (part 2) of the IS Working Group at SLF 49 (SLF 50/4) submitted by the Chairman of the working group and the report of the IS Correspondence Group (SLF 50/4/10) submitted by Germany; and documents submitted by China (SLF 50/4/7 and SLF 50/4/8), Germany (SLF 50/4/1, SLF 50/4/2, SLF 50/4/9 and SLF 50/INF.2), Italy (SLF 50/4/5 and SLF 50/4/12), Japan (SLF 50/4/6), Japan, the Netherlands and the United States (SLF 50/4/4), Poland (SLF 50/4/11), the Republic of Korea (SLF 50/INF.3), Turkey (SLF 50/4/3) and the Secretariat (SLF 50/4/13).

Report of the correspondence group

4.4 The Sub-Committee considered the report of the correspondence group (SLF 50/4/10), containing draft amendments to the 1974 SOLAS Convention and the 1988 LL Protocol to make the IS Code mandatory; providing an equivalency section in part A of the draft revised IS Code; addressing the problem of some ships with wide beam and small depth; and making proposals regarding the work programme on this issue, together with relevant submissions and, having approved it in general, took action as outlined in paragraphs 4.5 to 4.14.

Text of the draft revised Intact Stability Code

4.5 The Sub-Committee, having considered document SLF 50/4/1 providing the text of the draft revised Intact Stability Code, incorporating modifications agreed at SLF 49, decided that the text of the draft revised IS Code should be finalized incorporating only amendments of editorial nature; matters related to the inclusion of some flexibility to 25° GZ_{max} criterion in part A of the draft revised IS Code; and regulations for certain types of ships, and agreed to refer the document, together with related documents, to the IS Working Group for finalization.

Inclusion of an equivalency section in part A of the draft revised IS Code

4.6 With regard to inclusion of an equivalency section in part A of the draft revised IS Code, the Sub-Committee, having considered the report of the correspondence group (SLF 50/4/10) together with document SLF 50/4/11, commenting on novel design and alternative criteria, agreed not to include an equivalency section in the revised Code since the revised SOLAS chapter II-1 and the 1988 LL Protocol already adequately covered this issue.

Problem of some ships with wide beam and small depth

4.7 With regard to the problems associated with wide beam and small depth ships, the Sub-Committee considered the report of the correspondence group (SLF 50/4/10) together with documents SLF 50/4/5, SLF 50/4/6 and SLF 50/4/8, proposing solutions for offshore supply vessels, multi-hull craft and ships with a large ratio of B/D. Following discussion, the Sub-Committee agreed, in principle, that some flexibility with regard to the 25° GZ_{max} criterion should be included, based on the same level of the safety, in part A of the draft revised IS Code. In addition, the Sub-Committee agreed that the Explanatory Notes to the revised Code should provide appropriate guidance on this matter for application purposes, in particular to ships having wide beam and small depth as a short-term solution, taking into account that the performance-based criteria to be developed would address the matter in the longer term (see paragraph 4.15).

Regulations for certain types of ships

4.8 With regard to regulations for certain types of ships, the Sub-Committee considered document SLF 50/4/7, containing proposals concerning the effect on stability of fire-fighting water accumulating on the ro-ro deck of a ro-ro passenger ship, and decided not to refer the aforementioned document to the IS Working Group since SOLAS regulation II-2/20.6.1.4 already requires that scuppers be fitted to ensure that fire-fighting water accumulating on deck is rapidly discharged.

4.9 The Sub-Committee noted document SLF 50/INF.3, containing the results of a study on applying intact stability criteria to small vessels, and thanked the delegation of the Republic of Korea for this information (see also paragraph 4.22).

Amendments to the 1974 SOLAS Convention and the 1988 LL Protocol

4.10 In considering the draft amendments to the 1974 SOLAS Convention prepared by the correspondence group (SLF 50/4/10), the Sub-Committee noted that the revised SOLAS chapter II-1, in particular regulation II-1/5-1 (Intact stability information), could not be amended until after it has been accepted on 1 July 2008.

4.11 In considering whether it is necessary to amend both the 1974 SOLAS Convention and the 1988 LL Protocol to make part A of the revised IS Code mandatory, the Sub-Committee noted the views that if both instruments were not amended then certain types of vessels may not be subject to the mandatory application of part A of the revised Code. In this context, the Sub-Committee also noted that regulation 5 (Intact stability information) of the revised SOLAS chapter II-1 applies to every passenger ship regardless of size and every cargo ship having a length of 24 m and upwards.

4.12 After extensive discussion, the Sub-Committee, whilst being mindful of the problems associated with the:

.1 disparity of standards applying to the 1988 LL Protocol compared with the 1966 LL Convention;

.2 technical barrier to Parties migrating to the 1988 LL Protocol;

.3 delay in implementing the mandatory part A of the IS Code for those ships to which it would apply only through the SOLAS amendments; and

.4 possible complications with harmonizing future amendments between the 1988 LL Protocol and the 1974 SOLAS Convention, agreed that both the 1974 SOLAS Convention and the 1988 LL Protocol should be amended and instructed the working group to prepare the relevant draft amendments based on the draft text contained in document SLF 50/4/10.

Fishing vessel safety

4.13 The Sub-Committee agreed to refer the matter related to inconsistency between the IS Code and the Fishing Vessel Safety Code to the IS Working Group for further consideration.

Explanatory Notes to the revised Intact Stability Code

4.14 The Sub-Committee considered the text of the draft Explanatory Notes to the revised Intact Stability Code (SLF 50/4/2) together with document SLF 50/4/3, providing comments on severe wind and rolling criterion, and agreed to refer the above documents to the IS Working Group, including the matters related to the problems with wide beam and small depth ships (see paragraph 4.7) with a view towards finalization of the draft Explanatory Notes at this session.

Dynamic stability and performance-based criteria

4.15 The Sub-Committee considered part 2 of the report of the working group at SLF 49 (SLF 50/4) together with relevant submissions (SLF 50/4/4, SLF 50/4/9, SLF 50/4/11, SLF 50/4/12 and SLF 50/INF.2) on dynamic stability and performance-based criteria and decided to refer the above documents to the IS Working Group for further consideration with a view to advising the Sub-Committee on how best to proceed with new work on performance-based criteria.

Review of action plan for intact stability work

4.16 The Sub-Committee instructed the IS Working Group to update the action plan, as appropriate, taking into account the comments and decisions made in plenary and the progress made at the session.

IACS Unified Interpretation on Emergency fire pumps in cargo ships

4.17 As requested by FP 51 (SLF 50/4/13), the Sub-Committee considered the relevant parts of document FP 51/9/9, containing a revised IACS Unified Interpretation SC 178 on Emergency fire pumps in cargo ships, and agreed to refer the above document to the IS Working Group for further consideration.

Work programme

4.18 The Sub-Committee considered matters related to this work programme item, taking into account the correspondence group's report, and agreed that the IS Working Group should prepare the appropriate documentation for expanding or modifying the scope of the current work programme item, if necessary.

Establishment of the working group

4.19 The Sub-Committee established the Working Group on Intact Stability, and instructed it, taking into account comments made and decisions taken in plenary, to:

.1 finalize the draft revised IS Code, on the basis of document SLF 50/4/1, including matters related to the inclusion of some flexibility with regard to 25° GZ_{max} criterion in part A of the draft revised IS Code, and regulations for certain types of ships, taking into account document SLF 50/4/10;

.2 finalize the draft amendments to the 1974 SOLAS Convention and the 1988 LL Protocol based on paragraphs 4 and 5 of document SLF 50/4/10;

.3 finalize the draft Explanatory Notes to the revised Intact Stability Code on the basis of document SLF 50/4/2, including the problem of some ships with wide beam and small depth, taking into account documents SLF 50/4/3, SLF 50/4/5, SLF 50/4/6 and SLF 50/4/8;

.4 further consider the dynamic stability and performance-based criteria, taking into account documents SLF 50/4, SLF 50/4/4, SLF 50/4/9, SLF 50/4/11, SLF 50/4/12 and SLF 50/INF.2;

.5 consider IACS Unified Interpretation SC 178 on Emergency fire pumps in cargo ships (FP 51/9/9) and advise the Sub-Committee as appropriate;

.6 review the plan of action contained in annex 8 to document SLF 49/17 and prepare the appropriate documentation for amending the scope of the current work programme item, if necessary, taking into account the progress made during the session;

.7 consider whether it is necessary to establish a correspondence group and, if so, prepare terms of reference for consideration by the Sub-Committee; and

.8 submit a written report (part 1) by Thursday, 3 May 2007, except on subitem .4 above; and continue working through the week on subitem .4 and submit part 2 of the report to SLF 51, as soon as possible after this session so that it can be taken into account by the correspondence group, if established.

Report of the working group

4.20 Having received the report of the working group (SLF 50/WP.2), the Sub-Committee approved it in general and took action as indicated in the following paragraphs.

Draft text of the new IS Code

4.21 Following consideration of the group's proposed modifications (SLF 50/WP.2, annex 1) to the draft text of the new IS Code (SLF 50/4/1, annex), the Sub-Committee agreed to the draft International Code on Intact Stability, 2008 (2008 IS Code) and an associated draft MSC resolution, set out in annex 2, for submission to MSC 83 for approval and subsequent adoption.

4.22 The Sub-Committee noted the group's views that proposals in documents SLF 50/4/6 (Japan) and SLF 50/INF.3 (Republic of Korea) should be the subject of future consideration.

Draft amendments to the 1988 LL Protocol and the 1974 SOLAS Convention to make part A of the 2008 IS Code mandatory

4.23 The Sub-Committee considered the report of the working group (SLF 50/WP.2, annex 2), proposing the draft amendments to the 1988 LL Protocol for making the Introduction and part A of the 2008 IS Code mandatory, which took into account the report of the correspondence group (SLF 50/4/10) and part 1 of the report of the working group at SLF 49 (SLF 49/WP.2, annex 5), and agreed to the draft amendments to the 1988 LL Protocol, set out in annex 3, for submission to MSC 83 for approval, with a view to subsequent adoption (see also paragraphs 4.24 and 4.25 in respect of the date of adoption).

4.24 With regard to the draft amendments to the 1974 SOLAS Convention, the Sub-Committee noted that the group had discussed two possible options for making the Introduction and part A of the 2008 IS Code mandatory under SOLAS chapter II-1. Having discussed the options prepared by the group, the Sub-Committee agreed that SOLAS regulation II-1/5 (Intact stability information), as adopted by resolution MSC.216(82), should be amended so that the aforementioned regulation is to be part of the logical framework for the new stability regulations in SOLAS part B-1 (Stability). Recognizing that the amendment procedure would only permit the Committee to adopt the proposed amendments to the revised SOLAS chapter II-1 after the revised SOLAS chapter II-1 has been accepted or has entered into force, the Sub-Committee agreed to recommend the Committee adopting the draft amendments to SOLAS and the 1988 LL Protocol after 1 July 2008, so that a common entry into force date could be achieved.

4.25 In light of the above, the Sub-Committee agreed to the draft amendments to the 1974 SOLAS Convention, set out in annex 4, for submission to MSC 83 for approval, with a view to subsequent adoption after 1 July 2008, possibly at MSC 85.

Early implementation of the 2008 IS Code

4.26 The Sub-Committee, noting the view that Member Governments might wish to apply the provisions of the draft 2008 IS Code after its expected adoption at MSC 85 and before it has become effective, agreed that a draft MSC circular on early implementation of the 2008 IS Code should be drafted at SLF 51 for submission to MSC 85 for approval simultaneously with the adoption of the draft Code.

Draft explanatory notes to the revised IS Code

4.27 With regard to the weather criterion, the Sub-Committee noted that the group had considered document SLF 50/4/3 (Turkey), containing draft explanatory notes to the severe wind and rolling criterion, and agreed that the information contained in document SLF 50/4/3, stressing the importance of roll damping in weather criterion, would be useful in the frame of development of dynamic stability criteria.

4.28 Regarding the comments made in plenary by the delegation of Greece, concerning its request for guidance for the reduction of the pressure P to be used in the application of weather criterion (paragraph 2.3.2 of part A of the Intact Stability Code), the Sub-Committee decided that this matter should be deferred to the correspondence group for further consideration.

4.29 Having noted the group's consideration of the documents submitted by China (SLF 50/4/8), Italy (SLF 50/4/5) and Japan (SLF 50/4/6) on matters related to the problem of some ships with wide beam and small depth, and the statements made by several delegations on the satisfactory experience in applying the alternative criterion proposed by Italy (SLF 50/4/5) during the last decades, the Sub-Committee agreed to add a new chapter 4 after the existing chapter 3 in the draft explanatory notes to the IS Code.

4.30 Subsequently, the Sub-Committee, bearing in mind the relevant documents submitted to the session, agreed to the draft Explanatory Notes to the International Code on Intact Stability, 2008 (2008 IS Code) and an associated draft MSC circular, set out in annex 5, for submission to MSC 83 for approval, in principle, with a view to its formal approval at MSC 85 simultaneously with the 2008 IS Code.

4.31 In the context of the above decisions, the delegation of Germany expressed its opinion that a further paragraph should be added to the new chapter 4 of the Explanatory Notes to inform the Administrations that there is limited experience in extending the alternative criterion, originally intended for vessels with high weathertight integrity, e.g. offshore supply vessels of not more than 100 m in length. They proposed to evaluate and check the criteria in detail on the basis of experience to be reported in due course. Therefore, the delegation of Germany was of the view that the Explanatory Notes, with regard to this matter, should be deferred to the correspondence group for review with the aim to achieve the requirement of an equivalent level of safety.

IACS Unified Interpretation SC 178

4.32 Having noted the group's consideration of the relevant parts of document FP 51/9/9 (IACS), which provides a revised Unified Interpretation SC 178 on Emergency fire pumps in cargo ships, proposing specific pitch, roll and heave values, and, having noted the sentence "all conditions of list, trim, roll and pitch likely to be encountered in service" contained in paragraph 2.2.1.3 of chapter 12 of the FSS Code, the Sub-Committee agreed that:

.1 the roll motion may be considered limited according to the operating capability of the fire-fighting equipment; and

.2 the pitch motion may be considered capable of limitation in a powered ship and in dead ship condition will be limited by the ship's response to the seaway.

4.33 Having regard to the above, the Sub-Committee considered that the combination of heave and pitch, as well as heave and roll, contained in the revised IACS Unified Interpretation SC 178 (FP 51/9/9, annex) were acceptable and requested the Secretariat to inform the FP Sub-Committee of this outcome.

Review of the plan of action

4.34 The Sub-Committee noted that the group had reviewed the plan of action for this work programme item (SLF 49/17, annex 8), taking into account the progress made during the session, and agreed to the updated plan of action prepared by the group, as set out in annex 6 to document SLF 50/WP.2.

Establishment of a correspondence group

4.35 Subsequently, the Sub-Committee established a correspondence group, under the co-ordination of Germany*, and instructed it to:

.1 continue to work on the items contained in the updated plan of action for intact stability work, as set out in annex 6 to document SLF 50/WP.2, taking into account documents SLF 50/4/3, SLF 50/4/4, SLF 50/4/6, SLF 50/4/9, SLF 50/4/11, SLF 50/4/12, SLF 50/INF.2, SLF 50/INF.3 and relevant documents from previous sessions;

.2 collect information on experience on the reduction of the pressure P to be used in the application of weather criterion (paragraph 2.3.2 of part A of the Intact Stability Code);

.3 complete the tasks 2.1 and 2.2 of the updated plan of action (SLF 50/WP.2, annex 6); and

.4 submit a report to SLF 51.

4.36 In view of the above development, the Sub-Committee agreed to invite the Committee to extend the target completion date of the item to 2010.

5 SAFETY OF SMALL FISHING VESSELS

General

5.1 The Sub-Committee recalled that, at SLF 49, it had agreed that the title for draft provisions under development should be "Safety recommendations for decked fishing vessels of less than 12 metres in length and undecked fishing vessels" and established the correspondence group to finalize the draft Safety recommendations.

Report of the correspondence group

5.2 Following consideration of the report of the correspondence group (SLF 50/5, SLF 50/5/1, SLF 50/5/2, SLF 50/5/3 and SLF 50/5/4), the Sub-Committee approved the report in general and, in particular:

.1 noted the progress during the intersessional period;

.2 noted the information regarding the proposed ILO convention and recommendation concerning work in the fishing sector;

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.3 noted the information provided by FAO regarding its project on scantling for small wooden fishing vessels;

.4 agreed, in principle, to the timetable for the completion of work contained in paragraph 12 of document SLF 50/5;

.5 with regard to the referral of the chapters and their related annexes to other sub-committees, agreed that the working group should finalize the list of relevant sub-committees in paragraph 13 of document SLF 50/5;

.6 endorsed the recommendations, given in paragraphs 14 and 15 of document SLF 50/5, with respect to providing clear background information to other sub-committees and requesting the Secretariat to review, on finalization, the text of the draft Safety recommendations; and

.7 having discussed the recommendation that the Safety recommendations be published in all official languages of the IMO, agreed that this matter should not be addressed until all work has been completed.

5.3 With regard to the draft Safety recommendations prepared by the correspondence group, the Sub-Committee agreed to refer the draft recommendations to the working group for further consideration, including the finalization of the list of relevant sub-committees in paragraph 13 of document SLF 50/5.

5.4 In the course of the discussion, the representative from FAO stated:

.1 with regard to FAO's work on wooden vessel construction standards, that FAO had reached an agreement with the Norwegian University of Science and Technology in Trondheim on a research project concerning scantlings for small wooden fishing vessels and the outcome of this project, which is planned to be completed in December 2007, is expected to result in revisions to Annex II of the Safety recommendations; and

.2 with regard to the meeting of the Committee on Fisheries of FAO held its 27th session in Rome from 5 to 9 March 2007, that a large number of Members present at the meeting expressed concern about the safety of fishing vessels, especially small-scale fishing vessels and that FAO was urged to continue collaboration with IMO in addressing the matter. In addition, it was suggested that FAO should develop guidelines on best practices for safety at sea and that the Committee on Fisheries should consider developing an International Plan of Action on the subject.

5.5 The representative from ILO stated that the ILO delegation to SLF 50 consisted of a representative of the Secretariat, of the Employers and of the Workers, in line with decisions taken by the Governing Body of the ILO. He looked forward to participating in the envisaged working group, as its work was in keeping with the ILO's longstanding interest in the safety and health of fishers; and, as noted in paragraph 10 of document SLF 50/5, it would be important to ensure that the Safety recommendations were consistent with the ILO Convention and Recommendation concerning work in the fishing sector, should such instruments be adopted by the 96th session of the International Labour Conference in June 2007.

Extension of the scope of the current work programme

5.6 In the course of the discussion, the need to develop guidelines for implementation of Safety recommendations as well as the Code of Safety for Fishermen and Fishing Vessels, 2005, part B (Safety Code B) and the Voluntary Guidelines for the Design, Construction and Equipment of Small Fishing Vessels, 2005 (Voluntary Guidelines) to provide technical guidance for Administrations was expressed and the Sub-Committee, agreeing in principle, instructed the working group to prepare justification for extension of the scope of the current work programme to include the development of such guidelines (see paragraph 5.11).

Establishment of the working group

5.7 The Sub-Committee established the Working Group on Safety of Small Fishing Vessels and instructed it, taking into account comments made and decisions taken in plenary, to:

.1 prepare modifications to the draft Safety recommendations for decked fishing vessels of less than 12 metres in length and undecked fishing vessels, based on the text contained in documents SLF 50/5/1, SLF 50/5/2, SLF 50/5/3 and SLF 50/5/4, so that the consolidated text of the draft Safety recommendations can be prepared by the Secretariat immediately after the session for relevant sub-committees and Member Governments to consider and comment as appropriate;

.2 prepare a draft justification for the extension of the scope of the current work programme item, concerning the development of guidelines for the implementation of the Safety recommendations, Safety Code B and Voluntary Guidelines; and

.3 consider whether it is necessary to re-establish the correspondence group and, if so, prepare draft terms of reference for consideration by the Sub-Committee.

Report of the working group

5.8 Having received the report of the working group (SLF 50/WP.3), the Sub-Committee approved it in general and took action as indicated in the following paragraphs.

Modifications to the draft Safety recommendations

5.9 The Sub-Committee, having noted that the group had reviewed in detail all chapters of the draft Safety recommendations prepared by the correspondence group (SLF 50/5/1, SLF 50/5/2, SLF 50/5/3 and SLF 50/5/4), agreed, in principle, to the proposed modifications to the text of the draft Safety recommendations for decked fishing vessels of less than 12 metres in length and undecked fishing vessels. Subsequently, the Sub-Committee requested the Secretariat to prepare, immediately after the session, a consolidated text of the draft Safety recommendations so that the relevant sub-committees and Member Governments could consider and comment on the aforementioned recommendations, as appropriate.

5.10 Having endorsed the group's recommended timeframe for finalization of this work (SLF 50/WP.3, paragraph 5), specifying, *inter alia*, 2010 as the date for submission of the final draft Safety recommendations to the Committee for approval (see also paragraph 16.1), the Sub-Committee agreed to refer the preamble, chapter 1 and other respective chapters of the consolidated text of the draft Safety recommendations, as indicated in paragraph 7 (as amended in plenary) of document SLF 50/WP.3, to the COMSAR (chapter 9), DE (chapters 2, 4, 6 and 7), FP (chapter 9), NAV (chapter 10) and STW (chapters 8 and 12) Sub-Committees as well as the MSC/MEPC Working Group on Human Element (chapter 11) so that they consider the Safety recommendations, as appropriate, and report back to SLF 51 their comments and proposals.

Justification for the extension of the scope of the work programme item

5.11 The Sub-Committee, having agreed, in principle, to the group's recommendation for expanding the work on this agenda item to include the development of guidelines to assist in implementation of the Safety recommendations, the Fishing Vessel Safety Code (part B) and the Voluntary Guidelines, invited the Committee to consider the justification for expanding the scope of the current work programme item, set out in annex 6, and take action as appropriate.

Establishment of the correspondence group

5.12 The Sub-Committee established a correspondence group, under the co-ordination of South Africa*, and instructed it to:

.1 taking into account the pending adoption of the ILO Convention and Recommendation concerning work in the fishing sector, examine the text of the draft Safety recommendations to ensure consistency;

.2 review the work to be submitted by FAO on scantlings of wooden fishing vessels related to Annex II of the draft Safety recommendations;

.3 consider any comments of other sub-committees on the draft Safety recommendations, as appropriate;

.4 consider the use of the words "should" and "would" where the Secretariat has not been directed to make these changes; and

.5 submit a report to SLF 51.

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6 DEVELOPMENT OF OPTIONS TO IMPROVE EFFECT ON SHIP DESIGN AND SAFETY OF THE 1969 TM CONVENTION

General

6.1 The Sub-Committee recalled that SLF 48 had discussed broader issues relating to tonnage measurement, in particular, the possible revision of the 1969 TM Convention and that, while a number of delegations supported the need to address long-term effect of tonnage measurement upon ship design and safety, SLF 48, recognizing that those issues were beyond the current Sub-Committee's mandate, had invited the delegation of Australia to submit an appropriate proposal to the Committee.

6.2 The Sub-Committee also recalled that MSC 81, in considering document MSC 81/23/7 (Australia), had decided to include a high priority item on "Development of options to improve effect on ship design and safety of the 1969 TM Convention", with a target completion date of 2008, in the Sub-Committee's work programme and the provisional agenda for SLF 50.

6.3 The Sub-Committee had for its consideration:

.1 document SLF 50/6 (Secretariat), reporting on the outcome of DSC 11 which requested the Sub-Committee to review the 1969 TM Convention to encourage ship designers, builders and owners to reduce stack heights of containers so that the need for lashing on ships can be reduced;

.2 document SLF 50/6/1 (Australia), proposing that a third type of tonnage ('register tonnage') based on "maritime real estate" principles (length x breadth x summer draught) should be added to the 1969 TM Convention; and

.3 document SLF 50/6/2 (ICFTU), identifying the need for a long-term solution to rectify negative aspects of the 1969 TM Convention with respect to safety and the training and welfare of seafarers.

6.4 In the course of the consideration of the above documents:

.1 with regard to the proposal to introduce a third type of tonnage (SLF 50/6/1), whilst some delegations supported the proposal, others expressed the concern on the need to introduce such a third type of tonnage, in particular, to amend the 1969 TM Convention;

.2 with regard to the proposal that the safety, the training and welfare of seafarers be taken into account (SLF 50/6/2), there was a general support for the proposal;

.3 the Sub-Committee agreed that all consequences should be considered before making a decision on this issue; and

.4 with regard to the outcome of DSC 11 (SLF 50/6), the Sub-Committee, having noted that, if the "maritime real estate" principles (length x breadth x summer draught) are introduced, it may have an effect of reducing the above-deck stacking of containers through increased utilization of open-top containerships with full-height cell guides, requested the Secretariat to inform the DSC Sub-Committee of the above outcome.

Establishment of a correspondence group

6.5 Subsequently, the Sub-Committee established a correspondence group, under the co-ordination of Australia*, and instructed it to:

.1 develop "maritime real estate" (SLF 50/6/1) and other options to improve the effect on ship design and safety of the 1969 TM Convention, both:

.1 involving amendments to the 1969 TM Convention; and

.2 not requiring such amendments;

.2 identify pros and cons of the aforementioned options, taking into account safety, the training and welfare of seafarers and also taking into account the anticipated effectiveness of those options in improving safety;

.3 consider the merits of amending the Convention to incorporate tacit amendment provisions or, alternatively, adopting a protocol to the Convention, with a view to facilitating future amendments;

.4 make recommendations as appropriate on above items; and

.5 submit a report to SLF 51.

Statement by the representative of ILO

6.6 The representative from ILO stated that the 1969 TM Convention had a direct impact on safety and, what is of particular interest to the ILO, on crew accommodation for many types of vessels, including not only cargo ships but also fishing vessels; and that crew accommodation is an issue of longstanding concern for the ILO. He pointed out that significant provisions concerning crew accommodation were set out in several ILO instruments, including the recently adopted Maritime Labour Convention, 2006, and were also under consideration in the proposed Convention and Recommendation concerning work in the fishing sector, referred to in submission by ICFTU (SLF 50/6/2). He recalled that, in 2001, the 29th Session of the ILO's Joint Maritime Commission had adopted a resolution concerning tonnage measurement and the accommodation of crews. In the above resolution, the Commission, noting that the 1969 TM Convention had an impact on the design of ships, including crew accommodation, which may have implications for the occupational safety and health of seafarers and dockworkers, invited the Director-General to communicate these matters to the IMO Secretary-General, with a view to mitigating any adverse effects of that Convention. He, therefore, stated that the ILO should be involved in those aspects relevant to, or that has an impact on, crew accommodation and suggested that the Sub-Committee consider inviting the IMO Secretariat to consult with the ILO Secretariat on the best means of achieving this.

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6.7 The Sub-Committee, having noted the statement by the representative of ILO and the establishment of the aforementioned correspondence group, invited the ILO Secretariat to participate in the correspondence group and requested the IMO Secretariat to communicate with the ILO Secretariat accordingly.

7 GUIDELINES FOR UNIFORM OPERATING LIMITATIONS ON HIGH-SPEED CRAFT

7.1 The Sub-Committee recalled that MSC 81, endorsing a proposal by DE 49, had decided to include, in the DE Sub-Committee's work programme, a high priority item on "Guidelines for uniform operating limitations of high-speed craft", with a target completion date of 2009, and also in the work programmes of the COMSAR, NAV and SLF Sub-Committees and the provisional agendas for COMSAR 11, NAV 53 and SLF 50, with a target completion date of 2008.

7.2 The Sub-Committee noted documents submitted by:

.1 the United Kingdom (SLF 50/INF.4), presenting a brief summary of the research undertaken into the behaviour of high-speed craft in following and stern-quartering seas, together with the operational guidelines derived from the work; and

.2 the Secretariat (SLF 50/7), reporting on the outcome of DE 49's consideration of document DE 49/5/3 wherein RINA proposed the development of an MSC circular to guide Administrations in determining the operating limitations in a consistent manner.

7.3 In the context of the item, the Sub-Committee also noted that DE 50 had established a correspondence group to develop draft Guidelines for uniform operating limitations of high-speed craft, taking into account any contributions from the COMSAR, NAV and SLF Sub-Committees as they become available.

7.4 Following a brief consideration of the above documents, the Sub-Committee, having noted general support to the proposed information in SLF 50/INF.4, agreed that the guidelines should be primarily for Administrations, taking into account sea-keeping, stability and measurement of wave heights for operational matters.

7.5 The Sub-Committee, noting also that DE 50 has established a correspondence group on the matter, invited Member Governments and international organizations to contribute to the above correspondence group and to also submit their proposals and comments to SLF 51. In this context, the Sub-Committee noted that DE 51 may finalize the draft Guidelines for uniform operating limitations of high-speed craft for submission to MSC 85 for approval, subject to consideration by SLF 51 of the respective provisions of the draft Guidelines within the Sub-Committee's purview and reporting directly to MSC 85.

7.6 The Sub-Committee requested the Secretariat to inform the DE Sub-Committee of the above outcome.

8 TIME-DEPENDENT SURVIVABILITY OF PASSENGER SHIPS IN DAMAGED CONDITION

General

8.1 The Sub-Committee recalled that SLF 48, recognizing the need to make progress on time domain flooding and (dynamic) damaged ship stability prediction models and methodologies, noted the SDS Working Group's recommendation that the International Towing Tank Conference (ITTC) should include further benchmarking and assessment of computer codes that simulate time-to-flood and related ship motion behaviour of damaged ships in their current work and that new work programme item on "Time-dependent survivability of passenger ships in damaged condition" should be included in the Sub-Committee's work programme to monitor the above research.

8.2 The Sub-Committee also recalled that MSC 81, following consideration of the report of the Working Group on Passenger Ship Safety, had decided to include, in the Sub Committee's work programme, a high priority item on "Time-dependent survivability of passenger ships in damaged condition".

8.3 The Sub-Committee further recalled that MSC 82, having included, in the Sub-Committee's work programme, a new item on "Stability and seakeeping characteristics of damaged passenger ships in a seaway when returning to port by own power or under tow", had instructed SLF 50 to give a preliminary consideration to the matter under this agenda item.

8.4 The Sub-Committee had for its consideration:

.1 document SLF 50/8 (ITTC), providing the progress report on benchmark testing of numerical codes for time-to-flood prediction for damaged passenger ships, requested by the Sub-Committee; and

.2 document SLF 50/8/1 (United Kingdom), addressing matters relating to the evaluation of the standards of stability that constitute a viable ship.

Time-dependent survivability of passenger ships in damaged condition

8.5 With regard to time-dependent survivability of passenger ships in damaged condition, the Sub-Committee, having noted the information provided in document SLF 50/8, expressed its appreciation to ITTC, inviting it to provide updated information on this matter, and invited Member Governments and international organizations to submit relevant documents to SLF 51.

Stability and seakeeping characteristics of damaged passenger ships in a seaway when returning to port by own power or under tow

8.6 With regard to stability and seakeeping characteristics of damaged passenger ships in a seaway when returning to port by own power or under tow, the Sub-Committee recalled that MSC 82 had tasked the Sub-Committee to:

.1 develop amendments for SOLAS regulation II-1/8-1 to give effect to design requirements for safe return to port; and

.2 develop guidelines for reference by masters in assessing operational damage stability for safe return to port under own power or under tow, based on relevant research outcomes.

8.7 In consideration of document SLF 50/8/1 and following an extensive debate on how best to proceed on this issue, the Sub-Committee established a correspondence group, under the co-ordination of the United Kingdom*, and instructed it to:

.1 develop design and damage stability criteria for passenger ships for safe return to port by own power or under tow, determining loading conditions, heel/trim and environment limits and, where applicable, establishing the extent to which damage control measures should be taken into account;

.2 develop an initial draft guidelines for operational information for masters of passenger ships for safe return to port by own power or under tow, which should include the format of that information, weather/environment conditions, ship- and shore-based information and computer support, and guidance on implementation of damage control measures; and

.3 submit a report to SLF 51 under the agenda item on "Stability and seakeeping characteristics of damaged passenger ships in a seaway when returning to port by own power or under tow".

9 CONSIDERATION OF IACS UNIFIED INTERPRETATIONS

9.1 The Sub-Committee recalled that MSC 78 had instructed the sub-committees to review the IACS unified interpretations which fall within their purview and to prepare, on the basis of those unified interpretations, for consideration and preparation of appropriate interpretations for approval by the Committee.

9.2 The Sub-Committee noted that no documents had been submitted to this session under this agenda item.

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10 REVISION OF RESOLUTION A.266(VIII)

General

10.1 The Sub-Committee recalled that SLF 49 had instructed the SDS Correspondence Group to finalize the revision of the Recommendation on a standard method for establishing compliance with the requirements for cross-flooding arrangements in passenger ships (resolution A.266(VIII)) and the associated draft MSC resolution.

Report of the correspondence group

10.2 The Sub-Committee considered the report of the SDS Correspondence Group (SLF 50/10) submitted by Sweden and the United States, which, having addressed technical guidelines for calculating cross-flooding times associated with cross-flooding arrangements other than pipes and technical guidelines to account for the restrictive effect of counter pressure in tanks during cross-flooding, for inclusion in the Recommendation, had provided the draft revised Recommendation, set out in annex 1 to the above document, and invited the Sub-Committee to consider the future status of resolution A.266(VIII).

10.3 The Sub-Committee, having discussed extensively the application of the revised Recommendation, agreed that the revised Recommendation should generally apply to new ships and, if so decided by the Administration, to existing ships; and, recognizing that the revised Recommendation would not be mandatory and would provide a calculation methodology which could be applied to any ships under the revised SOLAS chapter II-1, decided that the words “in passenger ships” should not be included in the title of the revised Recommendation.

Instructions to the SDS Working Group

10.4 Subsequently, the Sub-Committee agreed to instruct the SDS Working Group, established under agenda item 3, to finalize the draft revised Recommendation on a standard method for establishing compliance with the requirements for cross-flooding arrangements and the associated draft MSC resolution, based on document SLF 50/10, taking into account comments made and decisions taken in plenary.

Report of the working group

10.5 Having considered the part of the report of the working group (SLF 50/WP.1) relating to the item, the Sub-Committee took action as outlined in paragraphs 10.6 and 10.7.

10.6 The Sub-Committee agreed to the draft new Recommendation on a standard method for evaluating cross-flooding arrangements and the associated draft MSC resolution, set out in annex 7, for submission to MSC 83 for adoption.

10.7 The Sub-Committee noted that the proposed draft new Recommendation was considered to be a recommended methodology that could be used for any cross-flooding calculation and was, thus, not directed towards any specific ship type or specific arrangement. The Sub-Committee agreed that a footnote referring to the Recommendation should be inserted in regulation 7-2.2 of the revised SOLAS chapter II-1 publication and invited the Committee to request the Secretariat to act accordingly.

Completion of the item

10.8 Since work on the item has been completed, the Sub-Committee invited the Committee to delete the item from the Sub-Committee's work programme (see paragraph 16.1).

11 REVIEW OF THE SPS CODE

General

11.1 The Sub-Committee recalled that, at SLF 49, it had established a correspondence group to develop draft amendments to the SPS Code and instructed it to report to SLF 50.

11.2 The Sub-Committee was informed (SLF 50/2/1) that FP 51 had invited Member Governments and international organizations to submit relevant comments and proposals to FP 52, which should take into account the outcomes of DE 50, SLF 50 and DSC 12 on this matter, and that DE 50, having noted that the draft revised Code could not be completed at that session, due to the outstanding contributions from FP 51, SLF 50 and DSC 12, had established the correspondence group and invited the Committee to extend the target completion date for the item to 2008.

Report of the correspondence group

11.3 The Sub-Committee considered the report of the correspondence group (SLF 50/11), providing draft amendments to chapter 2 (Stability and subdivision) of the SPS Code, and noted that the group had prepared two options for consideration, one of which was based on the requirements for cargo ships in the revised SOLAS regulation II-1/6, while the other option provided for the use of requirements in the revised SOLAS regulation II-1/6 for passenger ships carrying less than 200 special personnel.

Instructions to the SDS Working Group

11.4 Following an extensive discussion, the Sub-Committee agreed that the requirements for passenger ships in the revised SOLAS regulation II-1/6 were suitable for special purpose ships and instructed the SDS Working Group, established under agenda item 3, to finalize the draft amendments to the SPS Code, based on the text contained in paragraphs 12, 13 and 14 of document SLF 50/11.

Report of the working group

11.5 Having considered part of the report of the working group (SLF 50/WP.1) relating to the item, the Sub-Committee took action as outlined in paragraphs 11.6 and 11.7.

11.6 The Sub-Committee noted that, generally, special personnel do not have the same maritime skills as ships' crews with respect to emergency situations and, furthermore, that the life-saving requirements of SOLAS chapter III may be unduly onerous, as there is a higher subdivision standard for special purpose ships as compared to cargo ships. Therefore, the damage stability requirements for cargo ships should not be applied to special purpose ships.

11.7 The Sub-Committee, also taking into account resolutions MSC.194(80) and MSC.216(82), agreed to the draft amendments to the SPS Code, set out in annex 3 to document SLF 50/WP.1, as amended, for referral to the DE Sub-Committee for inclusion in the draft revised SPS Code, having agreed that the square brackets concerning the figures and terminology for special personnel or persons in paragraph 2.2 should be decided on by the DE Sub-Committee. The Sub-Committee requested the Secretariat to inform DE 51 accordingly.

Completion of the item

11.8 Noting that work on the item had been completed, the Sub-Committee invited the Committee to delete the item from the Sub-Committee's work programme (see paragraph 16.1).

12 ANALYSIS OF DAMAGE CARDS

12.1 The Sub-Committee recalled that MSC 70 had included in the work programmes of the BLG, DSC, COMSAR, NAV, DE and STW Sub-Committees a continuous item on "Casualty analysis", co-ordinated by the FSI Sub-Committee, and decided that casualty associated with damage stability should be dealt with under the agenda item on "Analysis of damage cards".

12.2 The Sub-Committee also recalled that SLF 49 had agreed to the draft Revised form of damage card and decided to refer it to the FSI Sub-Committee for consideration and appropriate action, aiming at the development of the respective amendments to MSC-MEPC.3/Circ.1, for approval by the Committee.

12.3 Having noted that no documents had been submitted to this session under this agenda item, the Sub-Committee, while agreeing not to include the item in the agenda for SLF 51, invited Member Governments to continue submitting completed damage cards to the Organization.

13 REVISION OF MSC/CIRC.650

General

13.1 The Sub-Committee recalled that SLF 49, having considered the part of the report of the SDS Working Group relating to the item and having noted that the group had generally agreed with the revised Interpretation of alterations and modifications of a major character (MSC/Circ.650), as prepared by the SDS Correspondence Group, had agreed to further consider the proposal at SLF 50.

13.2 The Sub-Committee had for its consideration the report of the SDS Correspondence Group submitted to SLF 49 (SLF 49/13) and document SLF 50/13 (Norway), commenting on the correspondence group's report and also proposing an alternative for clarification of the term "existing cargo ships" within the present circular.

13.3 The Sub-Committee concurred, in general, with the above proposals and agreed that the increase of draught should not be considered as a factor for the purpose of "alterations and modifications of a major character".

Instructions to the SDS Working Group

13.4 The Sub-Committee agreed to instruct the SDS Working Group, established under agenda item 3, to prepare the revised Interpretation of alterations and modifications of a major character (MSC/Circ.650), taking into account comments made and decisions taken in plenary.

Report of the working group

13.5 Having considered the part of the report of the working group (SLF 50/WP.1) relating to the item, the Sub-Committee, noting that the group had prepared a draft revised text to include a definition of the term "existing cargo ship", agreed to a draft MSC circular on Interpretation of alterations and modifications of a major character, set out in annex 8, for submission to MSC 83 for approval, to supersede MSC/Circ.650.

Completion of the item

13.6 Since work on the item has been completed, the Sub-Committee invited the Committee to delete it from the Sub-Committee's work programme (see paragraph 16.1).

14 INTERPRETATION OF ALTERATIONS AND MODIFICATIONS OF A MAJOR CHARACTER UNDER THE REVISED SOLAS CHAPTER II-1

General

14.1 The Sub-Committee recalled that SLF 49, having considered the issue raised by the SDS Correspondence Group concerning the treatment of "alterations and modifications of a major character" for passenger and cargo ships the keels of which are laid before 1 January 2009, when the revised SOLAS chapter II-1 enters into force, had decided that the issue should be dealt with separately from the Explanatory Notes to the SOLAS chapter II-1 subdivision and damage stability regulations under a new agenda item.

14.2 The Sub-Committee also recalled that MSC 82, in endorsing the relevant proposals by SLF 49, had included, in the Sub-Committee's work programme and the provisional agenda for SLF 50, a high priority item on "Interpretation of alternations and modifications of a major character under the revised SOLAS chapter II-1", with a target completion date of 2007.

Instructions to the SDS Working Group

14.3 The Sub-Committee, having borne in mind the outcome of the report of the SDS Correspondence Group submitted to SLF 49 (SLF 49/13), agreed to instruct the SDS Working Group, established under agenda item 3, to prepare, if time permits, a draft interpretation of alternations and modifications of a major character under the revised SOLAS chapter II-1, taking into account comments made and decisions taken in plenary.

Report of the working group

14.4 Having considered the part of the report of the working group (SLF 50/WP.1) relating to the item, the Sub-Committee took action as outlined in paragraphs 14.5 to 14.7.

14.5 The Sub-Committee noted that a clear majority of the group had considered that it would not be necessary to have guidance on how ships built before 1 January 2009 should be handled, since the application of the revised SOLAS chapter II-1 was clearly defined in part A, regulation 1 of the chapter. If a passenger ship built before 1 January 2009 underwent alterations or modifications of major character, it would still remain under the damage stability regulations of the current SOLAS chapter II-1, except in the case of a cargo ship being converted to a passenger ship.

14.6 The delegation of the United States did not agree with the above conclusions of the group.

Completion of the item

14.7 As the majority of the Sub-Committee agreed with the above views of the working group, the Sub-Committee, therefore, concluded that no further work on this matter was necessary and invited the Committee to delete the item from the Sub-Committee's work programme (see paragraph 16.1).

15 GUIDANCE ON THE IMPACT OF OPEN WATERTIGHT DOORS ON EXISTING AND NEW SHIP SURVIVABILITY

15.1 The Sub-Committee recalled that SLF 49, having considered the issue raised by the SDS Correspondence Group concerning the draft Guidance by which Administrations may determine the impact on survivability of open watertight doors, permitted by the revised SOLAS regulation II-1/22.4, had decided that the issue should be dealt with separately from the Explanatory Notes to SOLAS chapter II-1 and under a new agenda item.

15.2 The Sub-Committee also recalled that MSC 82, following the recommendation of the Sub-Committee, had included, in the Sub-Committee's work programme and the provisional agenda for SLF 50, a high priority item on "Guidance on the impact of open watertight doors on existing and new ship survivability", with a target completion date of 2008.

15.3 The Sub-Committee considered documents SLF 50/15 (Sweden and the United States), containing the proposed guidance to determine the impact of open watertight doors on survivability, and SLF 50/15/1 (CLIA), expressing the view that the proposed guidance remains exceedingly deterministic/strict, especially for existing ships and may not be appropriate for new ships.

15.4 In the course of the discussion, the delegation of Greece, supported by other delegations, expressed the view that watertight doors should remain closed during voyage because, indicatively:

.1 opened watertight doors during voyage were one of the main reasons for many casualties, contributing to the loss of human lives and the speed at which a ship may be lost after an accident;

.2 there is no obvious "absolute necessity" for watertight doors to remain open except for urgent facilitation of the crew and passengers for limited time;

.3 in many cases, even during inspections, opened watertight door did not close due to system failure;

.4 an accident can occur at any moment in any place; and

.5 a watertight door that remains open changes the ship stability/subdivision condition and, therefore, the vessel is unsafe during this period.

15.5 Subsequently, the Sub-Committee, having noted that mixed views on the proposed guidance (SLF 50/15) and some delegations' intention to contribute at SLF 51, invited Member Governments and international organizations to submit their proposals and comments to the next session, with a view to finalizing the guidance.

16 WORK PROGRAMME AND AGENDA FOR SLF 51

Work programme and agenda for SLF 51

16.1 Taking into account the progress made at the session and the provisions of the agenda management procedure contained in paragraphs 3.13 to 3.25 of the Guidelines on the organization and method of work (MSC-MEPC.1/Circ.1), the Sub-Committee revised its work programme (SLF 50/WP.5) based on that approved by MSC 82 (SLF 50/2, annex) and prepared the proposed revised work programme and provisional agenda for SLF 51. While reviewing the work programme, the Sub-Committee agreed to invite the Committee to:

.1 delete the following work programme items, as work on them has been completed:

.1.1 item H.4 – Review of the SPS Code;

.1.2 item H.8 – Interpretation of alterations and modifications of a major character under the revised SOLAS chapter II-1

.1.3 item L.1 – Revision of resolution A.266(VIII); and

.1.4 item L.2 – Revision of MSC/Circ.650;

.2 extend the target completion dates of the following work programme items:

.2.1 item H.2 – Safety of small fishing vessels, to 2010 (see paragraphs 5.10 and 5.11); and

.2.2 item H.3 – Revision of the Intact Stability Code, to 2010 (see paragraph 4.36); and

.3 renumber the work programme items accordingly.

16.2 The Sub-Committee invited the Committee to approve the revised work programme of the Sub-Committee and provisional agenda for SLF 51, set out in annex 9.

Arrangements for the next session

16.3 The Sub-Committee agreed to establish, at SLF 51, working groups on the following subjects:

.1 subdivision and damage stability;

.2 intact stability; and

.3 safety of small fishing vessels,

and drafting groups on guidelines for uniform operating limitations on high-speed craft and on stability and seakeeping characteristics of damaged passenger ships in a seaway when returning to port by own power or under tow.

16.4 The Sub-Committee agreed that the SDS Working Group would commence its work at the start of the next meeting (i.e., at 9.30 a.m. on Monday, 14 July 2008) on the basis of the draft terms of reference to be prepared by the Chairman, pending formal discussion of those terms of reference under the agenda item on "Development of explanatory notes for harmonized SOLAS chapter II-1".

Date of the next session

16.5 The Sub-Committee noted that the fifty-first session of the Sub-Committee had been tentatively scheduled to take place from 14 to 18 July 2008.

17 ELECTION OF CHAIRMAN AND VICE-CHAIRMAN FOR 2008

17.1 The Sub-Committee, in accordance with the Rules of Procedure of the Maritime Safety Committee, unanimously re-elected Mr. R. Gehling (Australia) as Chairman and Mr. Z. Szozda (Poland) as Vice-Chairman, both for 2008.

18 ANY OTHER BUSINESS

Amendments to the MODU Code

18.1 The Sub-Committee considered the outcome of DE 50 (SLF 50/2/1) on matters related to the review of the MODU Code and noted that DE 50 had agreed to request SLF 50 and COMSAR 12 to review the parts of the draft amendments to the Code, as identified in paragraphs 6, 7 and 9 of document DE 50/11. In this regard, the Sub-Committee also noted that DE 50, having considered part 1 of the report of the drafting group (DE 50/WP.5), also agreed to refer the items relating to deadweight surveys for column-stabilized units; the 1988 LL Protocol; subdivision and damage stability of surface and self-elevating units; and ballast pumping arrangements on column stabilized units to the SLF Sub-Committee for consideration.

18.2 Following a general discussion, the Sub-Committee, having agreed, in principle, that only the 1988 LL Protocol should be referred to in the revised MODU Code, requested an informal group of experts to prepare modifications to the draft amendments to the MODU Code proposed by DE 50 (SLF 50/2/1, annex).

18.3 Having received the report of the group (SLF 50/WP.4), the Sub-Committee considered the proposed modifications prepared by the group and agreed to the draft amendments to the MODU Code for referral to DE 51 for inclusion in the draft revised MODU Code.

Error in publication of revised SOLAS chapter II-1

18.4 The Sub-Committee noted the information by the delegation of the United States regarding a printing error on page 93 of the publication of SOLAS Amendments 2003, 2004 and 2005, where, in the formula for $s_{mom,i}$, in regulation II-1/7-2.4, the term "GM_{max}" should be replaced by the term "GZ_{max}", and requested the Secretariat to issue the appropriate errata for the above and other editorial errors as may be identified by the Secretariat in the publication.

19 ACTION REQUESTED OF THE COMMITTEE

19.1 The Maritime Safety Committee is invited to:

.1 approve the draft MSC circular on Guidelines for damage control plans and information to the master (paragraph 3.18 and annex 1);

.2 endorse the Sub-Committee's recommendation that the two existing footnotes in the revised SOLAS regulation II-1/19 publication, referring to the guidelines, should be replaced by a single footnote with an asterisk to be inserted after the title of the regulation and request the Secretariat to act accordingly (paragraph 3.18);

.3 note that the Sub-Committee considered the definition of the term "unfavourable conditions of trim and list" as instructed by MSC 82, for referral of its views to the DE Sub-Committee for consideration and appropriate action (paragraph 3.22);

.4 approve the draft International Code on Intact Stability, 2008 (2008 IS Code) and the associated draft MSC resolution, with a view to adoption at MSC 85 (paragraph 4.21 and annex 2);

.5 approve the draft amendments to the 1988 LL Protocol, with a view to adoption at MSC 85 (paragraph 4.23 and annex 3);

.6 approve the draft amendments to the 1974 SOLAS Convention, with a view to adoption at MSC 85 (paragraphs 4.24 and 4.25 and annex 4);

.7 note the Sub-Committee's decision that a draft MSC circular on early implementation of the 2008 IS Code be drafted at SLF 51, with a view to submission to MSC 85 for approval simultaneously with the adoption of the draft Code (paragraph 4.26);

.8 approve the draft MSC circular on Explanatory Notes to the International Code on Intact Stability, 2008 (2008 IS Code), in principle, with a view to its formal approval at MSC 85 simultaneously with the adoption of the 2008 IS Code at MSC 85 (paragraph 4.30 and annex 5);

.9 note the progress made on the development of the draft Safety recommendations for decked fishing vessels of less than 12 metres in length and undecked fishing vessels, in particular the time frame for the finalization of the work on the Safety recommendations and the referral of relevant chapters of the draft Safety recommendations to the COMSAR, DE, FP, NAV and STW Sub-Committees and the MSC/MEPC Working Group on Human Element for consideration and comments as appropriate (paragraphs 5.9 and 5.10);

.10 consider the Sub-Committee's justification for expanding the scope of the existing work programme item on "Safety of small fishing vessels" to include the development of guidelines to assist in implementation of the Safety recommendations, the Fishing Vessel Safety Code (part B) and the Voluntary Guidelines, and take action as appropriate (paragraph 5.11 and annex 6);

.11 note the Sub-Committee's outcome concerning the work on development of options to improve effect on ship design and safety of the 1969 TM Convention (paragraphs 6.3 to 6.7);

.12 adopt the draft MSC resolution on Recommendation on a standard method for evaluating cross-flooding arrangements, and request the Secretariat to insert a footnote referring to the Recommendation in regulation 7-2.2 of the revised SOLAS chapter II-1 publication (paragraphs 10.6 and 10.7 and annex 7);

.13 note that the Sub-Committee agreed to the draft amendments to the SPS Code for referral to the DE Sub-Committee, for inclusion in the draft revised SPS Code (paragraphs 11.6 and 11.7);

.14 approve the draft MSC circular on Interpretation of alterations and modifications of a major character (paragraph 13.5 and annex 8);

.15 note the Sub-Committee's conclusion regarding an interpretation of alternations and modifications of a major character under the revised SOLAS chapter II-1 (paragraphs 14.5 to 14.7);

.16 approve the proposed revised work programme of the Sub-Committee and provisional agenda for SLF 51 (paragraphs 16.1 and 16.2 and annex 9); and

.17 approve the report in general.

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ANNEX 1

DRAFT MSC CIRCULAR

GUIDELINES FOR DAMAGE CONTROL PLANS AND INFORMATION TO THE MASTER

1 The Maritime Safety Committee, at its [eighty-third session (3 to 12 October 2007)], following a proposal by the Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety at its fiftieth session, approved Guidelines for damage control plans and information to the master, set out in the annex, with the objective to provide advice on the preparation of damage control plans and to set a minimum level for the presentation of damage stability information for use on board passenger and cargo ships to which SOLAS regulation II-1/19, as amended by resolution MSC.216(82), applies.

2 Member Governments are invited to use the annexed Guidelines when applying the requirements of SOLAS regulation II-1/19, as amended by resolution MSC.216(82), and to bring the aforementioned Guidelines to the attention of all parties concerned, in particular shipbuilders, shipmasters, shipowners, ship operators and shipping companies.

GUIDELINES FOR DAMAGE CONTROL PLANS AND INFORMATION TO THE MASTER

1 Application

These Guidelines are intended as advice on the preparation of damage control plans and to set a minimum level for the presentation of damage stability information for use on board passenger and cargo ships to which SOLAS regulation II-1/19, as amended by resolution MSC.216(82), applies.

2 General

2.1 The damage control plan and damage control booklet are intended to provide ship's officers with clear information on the ship's watertight subdivision and equipment related to maintaining the boundaries and effectiveness of the subdivision so that, in the event of damage to the ship causing flooding, proper precautions can be taken to prevent progressive flooding through openings therein and effective action can be taken quickly to mitigate and, where possible, recover the ship's loss of stability.

2.2 The damage control plan and damage control booklet should be clear and easy to understand. It should not include information which is not directly relevant to damage control, and should be provided in the working language of the ship. If the languages used in the preparation of the plan and booklet are not one of the official languages of the SOLAS Convention, a translation into one of the official languages should be included.

3 Damage control plans

3.1 The damage control plan should be of a scale adequate to show clearly the required content of the plan.

3.2 Isometric drawings are recommended for special purposes. The plan should include inboard profile, plan views of each deck and transverse sections to the extent necessary to show the following:

.1 the watertight boundaries of the ship;

.2 the locations and arrangements of cross-flooding systems, blow-out plugs and any mechanical means to correct list due to flooding, together with the locations of all valves and remote controls, if any;

.3 the locations of all internal watertight closing appliances including, on ro-ro ships, internal ramps or doors acting as extension of the collision bulkhead and their controls and the locations of their local and remote controls, position indicators and alarms. The locations of those watertight closing appliances which are not allowed to be opened during the navigation and of those watertight closing appliances which are allowed to be opened during navigation, according to SOLAS regulation II-1/22.4, should be clearly indicated;

.4 the locations of all doors in the shell of the ship, including position indicators, leakage detection and surveillance devices;

.5 the locations of all external watertight closing appliances in cargo ships, position indicators and alarms;

.6 the locations of all weathertight closing appliances in local subdivision boundaries above the bulkhead deck and on the lowest exposed weather decks, together with locations of controls and position indicators, if applicable; and

.7 the locations of all bilge and ballast pumps, their control positions and associated valves.

4 Damage control booklets

4.1 The information listed in section 3 should be repeated in the damage control booklet.

4.2 The damage control booklet should include general instructions for controlling the effects of damage, such as:

.1 immediately closing all watertight and weathertight closing appliances;

.2 establishing the locations and safety of persons on board, sounding tanks and compartments to ascertain the extent of damage and repeated soundings to determine rates of flooding; and

.3 cautionary advice regarding the cause of any list and of liquid transfer operations to lessen list or trim, and the resulting effects of creating additional free surfaces and of initiating pumping operations to control the ingress of water.

4.3 The booklet should contain additional details to the information shown on the damage control plan, such as the locations of flooding detection systems, sounding devices, tank vents and overflows which do not extend above the weather deck, pump capacities, piping diagrams, instructions for operating cross-flooding systems, means of accessing and escaping from watertight compartments below the bulkhead deck for use by damage control parties, and alerting ship management and other organizations to stand by and to co-ordinate assistance, if required.

4.4 If applicable to the ship, locations of non-watertight openings with non-automatic closing devices through which progressive flooding might occur should be indicated as well as guidance on the possibility of non-structural bulkheads and doors or other obstructions retarding the flow of entering seawater to cause at least temporary conditions of unsymmetrical flooding.

4.5 If the results of the subdivision and damage stability analyses are included, additional guidance should be provided to ensure that the ship's officers referring to that information are aware that the results are included only to assist them in estimating the ship’s relative survivability.

4.6 The guidance should identify criteria on which the analyses were based and clearly indicate that the initial conditions of the ship’s loading extents and locations of damage, permeabilities, assumed for the analyses may have no correlation with the actual damaged condition of the ship.

5 Visual guidance to the master

Visual guidance, such as damage consequence diagrams, may be used to provide the master with a rapid means to evaluate the consequence of damage to the ship.

6 Placement on board the ship

6.1 For passenger ships, the damage control plan should be permanently exhibited or readily available on the navigation bridge, as well as in the ship's control station, safety centre or equivalent.

6.2 For cargo ships, the damage control plan should be permanently exhibited or readily available on the navigation bridge. Furthermore, the damage control plan should be permanently exhibited or readily available in the cargo control room, all ship's office or other suitable location.

7 Use of on-board computers

Damage control plans and damage control booklets should be in printed form. The use of on-board computers*, with damage stability software developed for the specific ship, and familiar to properly trained ship's officers can provide a rapid means to supplement the information in the plan and booklet for effective damage control.

8 Shore-based emergency response systems

8.1 A shore-based emergency response system may be used to supplement the damage control booklet referred to in section 4.

8.2 Contact information for gaining access to shore-based facilities together with a list of information required for making damage stability assessments should be readily available.

***

* Refer to the Guidelines for the on-board use and application of computers (MSC/Circ.891).

ANNEX 2

DRAFT MSC RESOLUTION

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 resolution MSC…[(85)], by which it adopted, *inter alia*, amendments to the International Convention for the Safety of Life at Sea, 1974, as amended (1974 SOLAS Convention) and to the Protocol of 1988 relating to the International Convention on Load Lines, 1966, (1988 LL Protocol) to make the introduction and the provisions of part A of the International Code on Intact Stability, 2008 mandatory under the Convention and the 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 LL 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 LL 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 LL 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 and Parties to the 1988 LL 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 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 and 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* means a mechanically self-propelled ship which, by reason of its function, carries on board more than 12 special personnel as defined in paragraph 1.3.3 of the Code of Safety for Special Purpose Ships (resolution A.534(13)), including passengers (ships engaged in research, expeditions and survey; ships for training of marine personnel; whale and fish factory ships not engaged in catching; ships processing other living resources of the sea, not engaged in catching or other ships with design features and modes of operation similar to ships mentioned above which, in the opinion of the Administration may be referred to this group).

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)[1] 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].

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.

[1] The Code of Safety for High-Speed Craft, 2000 (2000 HSC Code) has been developed following a thorough revision of the Code of Safety for High-Speed Craft, 1994 (1994 HSC Code) which was derived from the previous Code of Safety for Dynamically Supported Craft (DSC Code) adopted by IMO in 1977, recognizing that safety levels can be significantly enhanced by the infrastructure associated with regular service on a particular route, whereas the conventional ship safety philosophy relies on the ship being self-sustaining with all necessary emergency equipment being carried on board.

[2] For the purposes of application of chapters I and II of Annex I of the International Convention on Load Lines, 1966 or the Protocol of 1988 as amended, as applicable to open-top containerships, "freeboard deck" is the freeboard deck according to the International Convention on Load Lines, 1966 or the Protocol of 1988 as amended, as applicable as if hatch covers are fitted on top of the hatch cargo coamings.

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.[3]

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 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 A *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

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[3] Refer to regulation 42(1) of the International Convention on Load Lines, 1966 or the Protocol of 1988 as amended, as applicable.

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

2.26 A *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 Stability Booklet are met in any operational loading condition. A 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[4] 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.

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*

1.2.3.1 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.

1.2.3.2 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.

1.2.3.3 It is recognized by the Organization that performance oriented criteria for the identified phenomena listed above need to be developed and implemented to ensure a uniform international level of safety.

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[4] For containerships of 100 m in length and over, provisions of chapter 2.3 of part B may be applied as an alternative to the application of chapter 2.2 of this part. Offshore supply vessels and special purpose ships are not required to comply with provisions of chapter 2.3 of part A. For offshore supply vessels, provisions of chapter 2.4 of part B may be applied as an alternative to the application of chapter 2.2 of this part. For special purpose ships, provisions of chapter 2.5 of part B may be applied as an alternative to the application of chapter 2.2 of this part.

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 $\varphi = 30°$ angle of heel and not less than 0.09 metre-radians up to $\varphi = 40°$ or the angle of down-flooding φ_f[5] 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.

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5 φ_f is an 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.

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[6], 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 the 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:

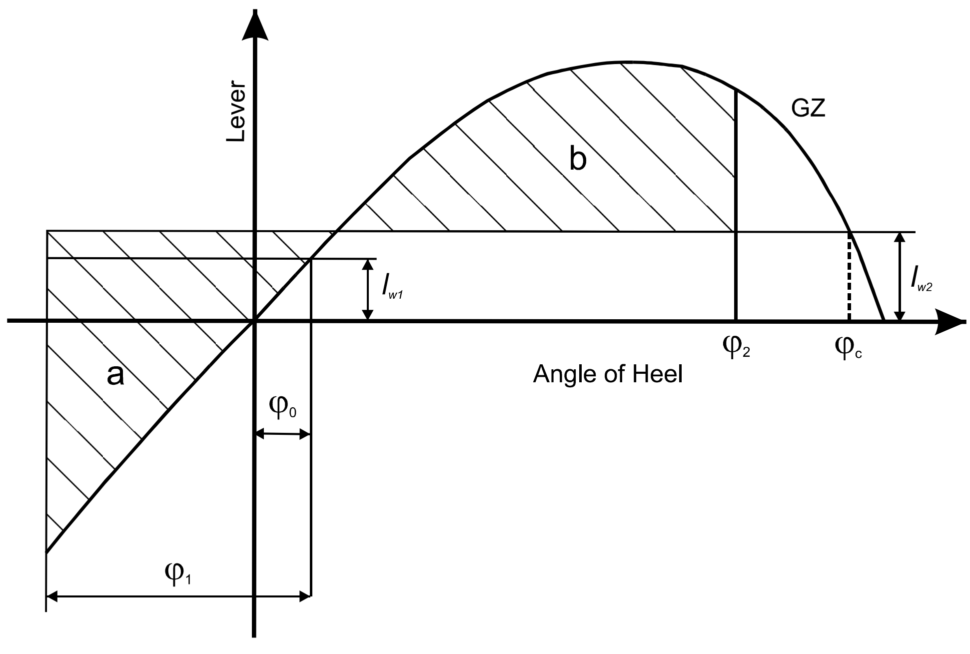

Figure 2.3.1 – Severe wind and rolling

6 Refer to the Explanatory Notes to the International Code on Intact Stability, 2008 (MSC.1/Circ.[...]).

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 and footnote 6)

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[7]. 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.

7 Refer to the Interim Guidelines for alternative assessment of the weather criterion (MSC.1/Circ.1200).

2.3.4 The angle of roll (φ_1)[8] 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)

[8] The angle of roll for ships with anti-rolling devices should be determined without taking into account the operation of these devices unless the Administration is satisfied with the proof that the devices are effective even with sudden shutdown of their supplied power.

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 (m²)

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;

.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 dwt and above

Oil tankers, as defined in the section Definitions, 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 Line Convention.

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)[9] 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_0 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).[10]

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9 Refer to regulation 44(2) of the International Convention on Load Lines, 1966 or the Protocol of 1988 relating thereto as amended, as applicable.

10 Refer to part C of chapter VI of the 1974 SOLAS Convention as amended by resolution MSC.23(59).

3.5 High-speed craft

High-speed craft, as defined in paragraph 2 of the Introduction (Definitions), constructed on or after 1 January 1996, 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 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 guideline 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 Definitions. 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*[11]

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)

[11] Refer to regulation III/2 of the 1993 Torremolinos Protocol.

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 0.20;

.2 l_s/L smaller than 0.60;

.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 3.0; 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;

.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 540Pa (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*[12]

These requirements apply to containerships greater than 100 m in length as defined in paragraph 2 of the Introduction (Definitions). 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 φ = 30° angle of heel, and not less than 0.016/C metre-radians up to φ = 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.

---

12 Since the criteria in this section were empirically developed with the data of containerships less than 200 m in length, they should be applied to ships beyond such limits with special care.

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).

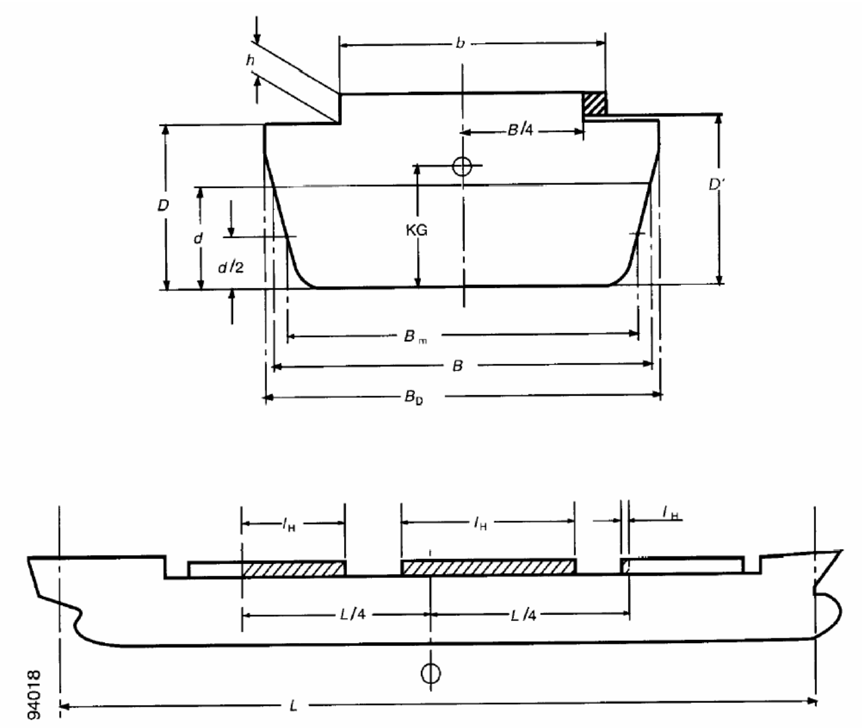

Figure 2.3-1

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 paragraph 2 of the Introduction (Definitions), 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 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 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 0.070 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:

$$0.055 + 0.001\ (30° - \varphi_{max})\ \text{metre-radians}$$[13];

.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 0.20 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 Definitions, 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.

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[13] φ_{max} is the angle of heel in degrees at which the righting lever curve reaches its maximum.

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 Definitions, 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.

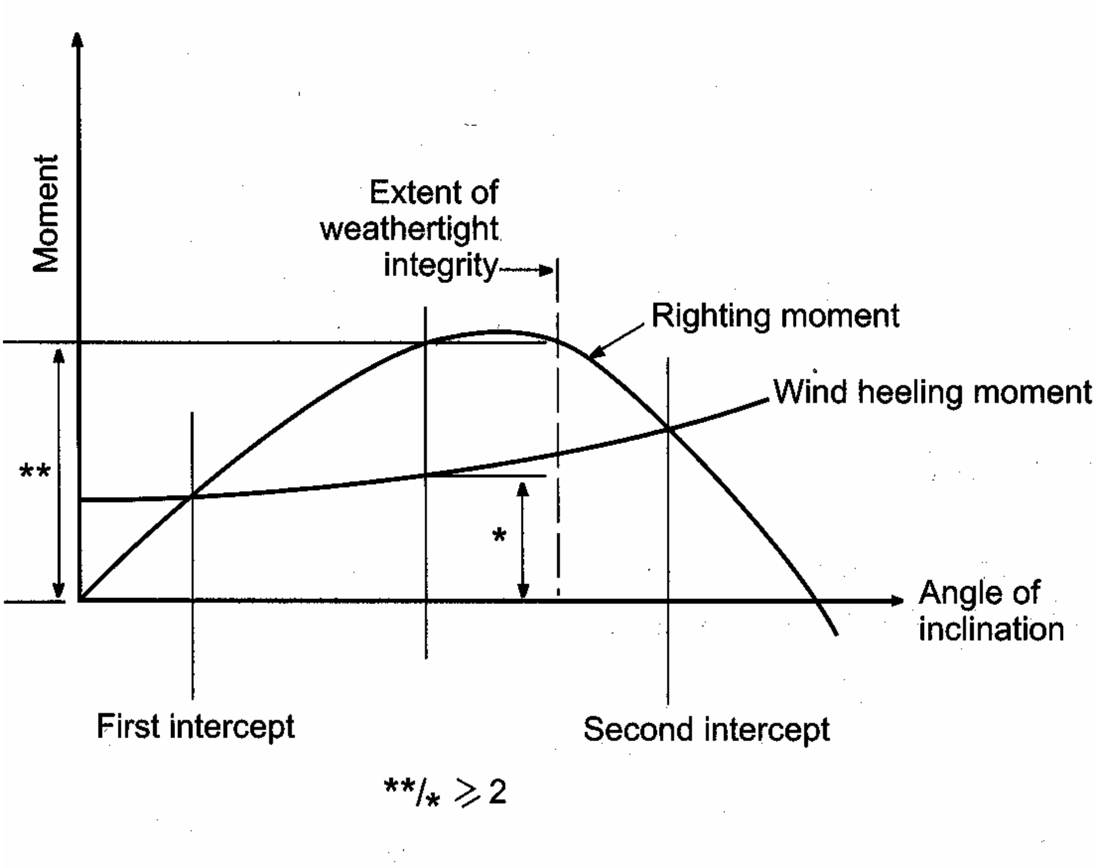

Figure 2.6-1 – Righting moment and wind heeling moment curves

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	1.00
15.3 – 30.5	1.10
30.5 – 46.0	1.20
46.0 – 61.0	1.30
61.0 – 76.0	1.37
76.0 – 91.5	1.43
91.5 – 106.5	1.48
106.5 – 122.0	1.52
122.0 – 137.0	1.56
137.0 – 152.5	1.60
152.5 – 167.5	1.63
167.5 – 183.0	1.67
183.0 – 198.0	1.70
198.0 – 213.5	1.72
213.5 – 228.5	1.75
228.5 – 244.0	1.77
244.0 – 256.0	1.79
Above 256	1.80

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.

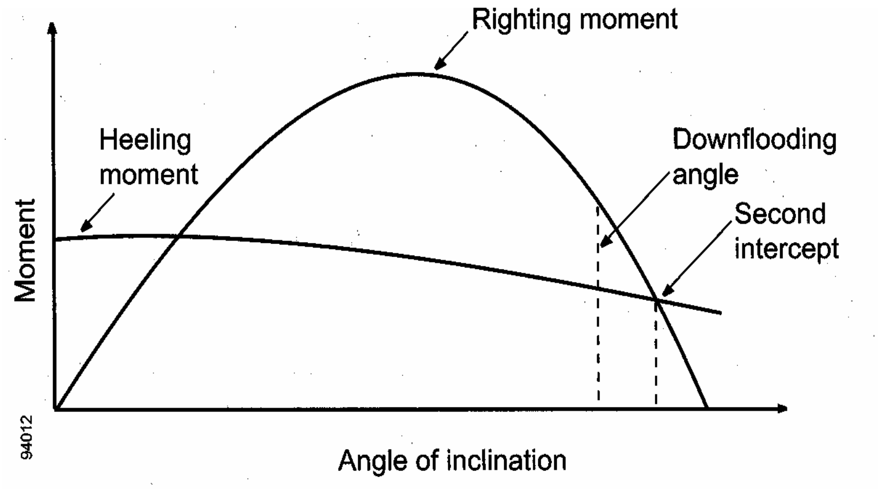

Figure 2.6-2 – Righting moment and heeling moment curves

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

$L_{wp}/[V_c * (L_{ptn}/2)]$ 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' must 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

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

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

Parameters used in the above equations are defined in paragraph 2.6.4.3.

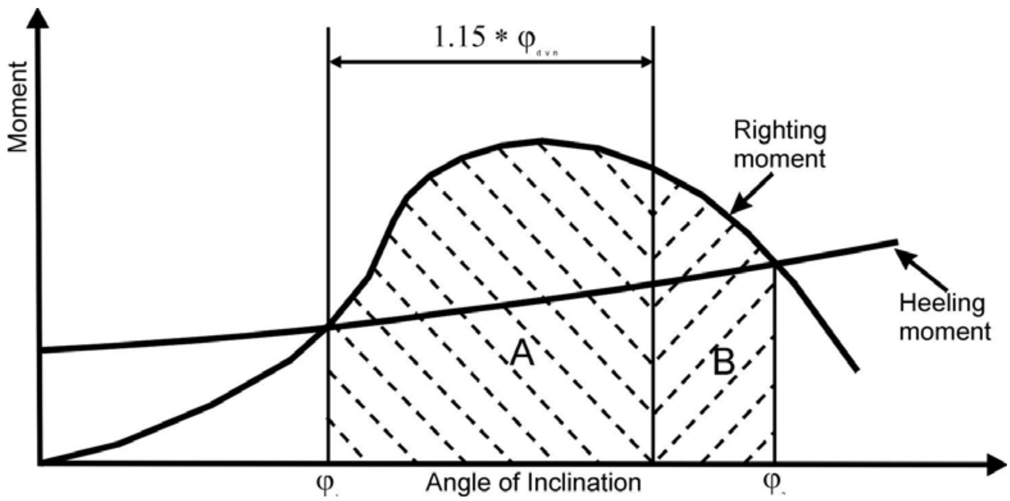

Figure 2.6-3 – Righting moment and heeling moment curves

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 1.10, 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) + 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 4.0)

QSD_1 is equal to DFD_0 minus quasi-static down-flooding distance at φ_1 (m), but not to be taken less than 3.0 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).

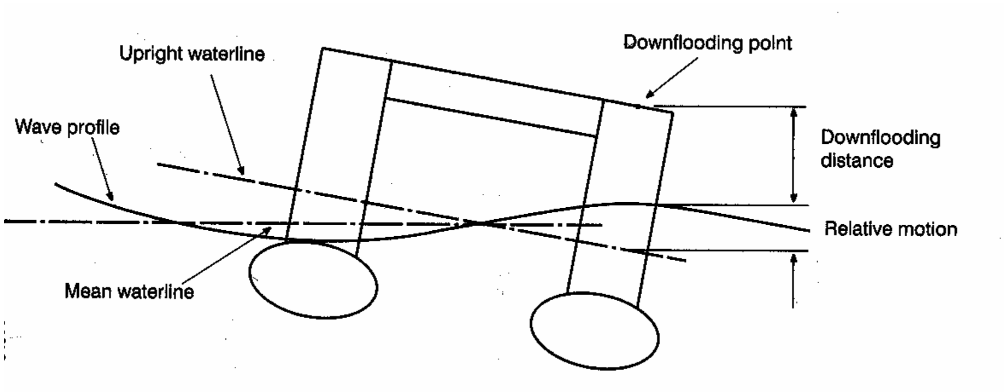

Figure 2.6-4 – Definition of down-flooding distance and relative motion

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)/(1.0 + GM/(1.46 + 0.28BM))	=	....	deg
Area 'A'	....	=	....	m-deg
Area 'B'	....	=	....	m-deg

Results Reserve energy ratio:

'B'/'A' = ... (minimum = 0.10)

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

Note: The minimum GM is that which produces a 'B'/'A' ratio = 0.10

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	....	=	1.10	

Determine

φ_1		....	=	....	deg
DFD_1		....	=	....	m
QSD_1	=	$DFD_0 - DFD_1$	=	....	m
a	=	$(FBD_0/D_m)*(S_{ptn} * L_{ccc})/A_{wp}$	=	....	($a_{min} = 4.0$)
k	=	$0.55 + 0.08*(a - 4.0) + 0.056*(1.52 - GM)$ ..	=	....	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:

DFD0 - 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.[14]

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[15] 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.

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[14] Refer to the intact stability design criteria, contained in MARPOL regulation I/27, together with the associated Unified Interpretation 45.

[15] A sufficient number of loading conditions representing the initial, intermediate and final stages of the filling or discharge operation using the free surface correction at the filling level in each tank at the considered stage may be evaluated to fulfil this recommendation.

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[16]

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 0 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.

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[16] Care should be taken in the assessment of compliance with stability criteria, especially conditions in which liquid transfer operations might be expected or anticipated, to insure that the stability criteria is met at all stages of the voyage.

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)).[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*[18]*:*

.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.

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17 Refer to chapter VI of the 1974 SOLAS Convention and to part C of chapter VI of the 1974 SOLAS Convention as amended by resolution MSC.22(59).

18 Refer to regulation III/7 of the 1993 Torremolinos Protocol.

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 are to 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% due 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 1988 Protocol 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[19] with regard to the required strength of the surrounding structure.[20]

[19] As a guidance for Administrations a safety margin of 30% should be applied.
[20] IMO guidance for testing these windows is to be developed.

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 1988 Protocol 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 1988 Protocol 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 1988 Protocol 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.[21]

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;[22]

.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[23]:

.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;

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[21] Refer to regulation II-1/22 of the 1974 SOLAS Convention, as amended, regulation 10 of the International Convention on Load Lines, 1966 or the Protocol of 1988 as amended, as applicable and regulation III/10 of the 1993 Torremolinos Protocol.

[22] Refer to regulation II-1/22 of the 1974 SOLAS Convention, as amended, and regulation 10(2) of the International Convention on Load Lines, 1966 or the Protocol of 1988 as amended, as applicable.

[23] Refer to Model Loading and Stability Manual (MSC/Circ.920).

.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.[24]

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.

[24] Refer to the Guidance on intact stability of existing tankers during liquid transfer operations (MSC/Circ.706 – MEPC/Circ.304).

CHAPTER 4 – STABILITY CALCULATIONS PERFORMED BY STABILITY INSTRUMENTS

4.1 Stability instruments[25]

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 is to 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 is to 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.

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25 Refer to the Guidelines for the approval of stability instruments (MSC.1/Circ.1229).

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 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 are to 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 are to 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 are to 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 are to 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 paragraph 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 paragraph 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 are to 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 are to 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 is to 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 are to 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 are to 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 is to 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 is to 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.[26]

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.[27]

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.

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[26] Refer to the Revised Guidance to the master for avoiding dangerous situations in adverse weather and sea conditions (MSC.1/Circ.1228).

[27] Refer to the Guidelines for the preparation of the Cargo Securing Manual (MSC/Circ.745).

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.[28]

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.

[28] Refer to the Revised Guidance to the master for avoiding dangerous situations in adverse weather and sea conditions (MSC.1/Circ.1228).

5.3.8 Use of operational guidelines for avoiding dangerous situations in severe weather conditions or an on-board 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.[29]

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*[30]

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.

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[29] Refer to regulation 44(10) of the 1966 Load Line Convention and regulation 44(7) of the 1988 Load Line Protocol as amended.

[30] Refer to regulation III/8 of the 1993 Torremolinos Protocol.

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 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 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 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 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.

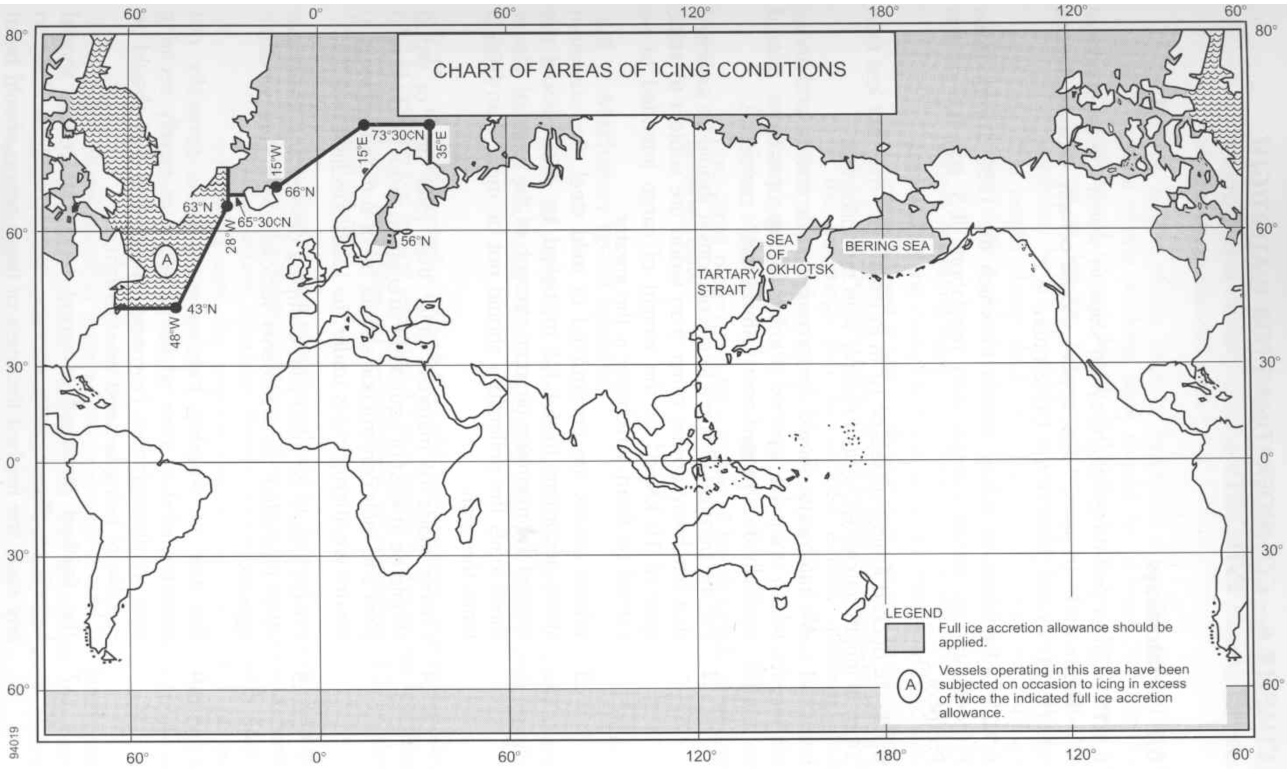
6.3.4 Operational procedures related to ensuring a fishing vessel's endurance in conditions of ice formation are given in annex 2 (Recommendations for skippers of fishing vessels on ensuring a vessel's endurance in conditions of ice formation).

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, applies should comply with regulations 13, 14, 15, 16 and 26(5) of this Convention.

7.1.2 Hatchways in fishing vessels to which the 1993 Torremolinos Protocol applies should comply with regulations II/5 and II/6 of this 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 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-l/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-1/15-10 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 0 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-1/15-2 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.[31]

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.

[31] Refer to regulation II/8 of the 1993 Torremolinos 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.[32]

7.8.2 In ships to which the International Convention on Load Lines, 1966 or the Protocol of 1988 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:[33]

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.

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[32] Refer to regulation 24(5) of the International Convention on Load Lines, 1966 or the Protocol of 1988 as amended, as applicable and regulation 11/14(4) of the 1993 Torremolinos Protocol.

[33] Refer to regulation II/l 4 of the 1993 Torremolinos Protocol.

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.[34]

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*[35] < 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.

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[34] Refer to regulation II-1/5 of the 1974 SOLAS Convention, as amended.

[35] For the purpose of paragraphs 8.1.2 and 8.1.5 the length (*L*) means the subdivision length (L_S) as defined in regulation II-1/2.1 of the 1974 SOLAS Convention, as amended. For ships to which the Convention applies, and for other ships the length (*L*) means the length of ship as defined in 2.12 of the Purpose and Definitions of this Code.

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:

$M_{fs} = l*b^3*\rho_t/12$ (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.

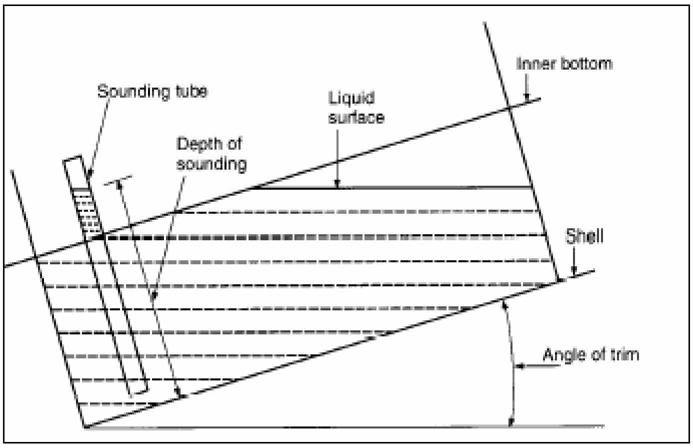

Figure A1-2.1.3

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.

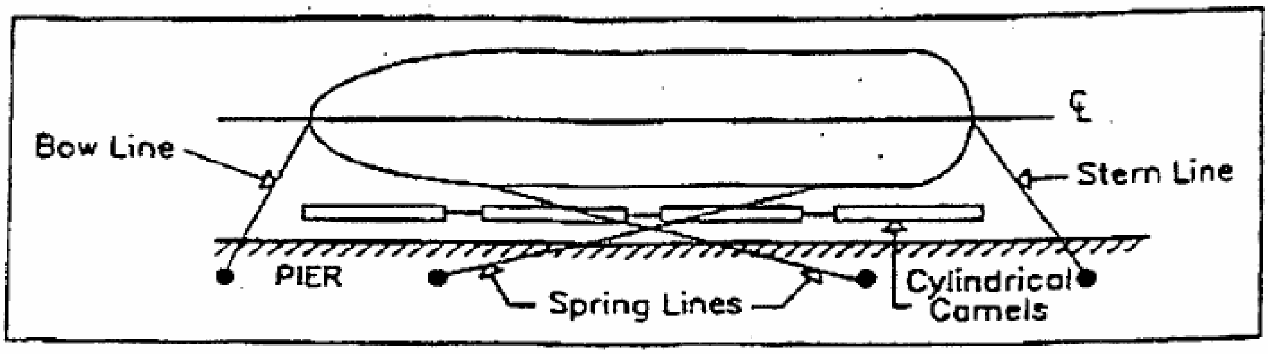

Figure A1-2.2.2

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.

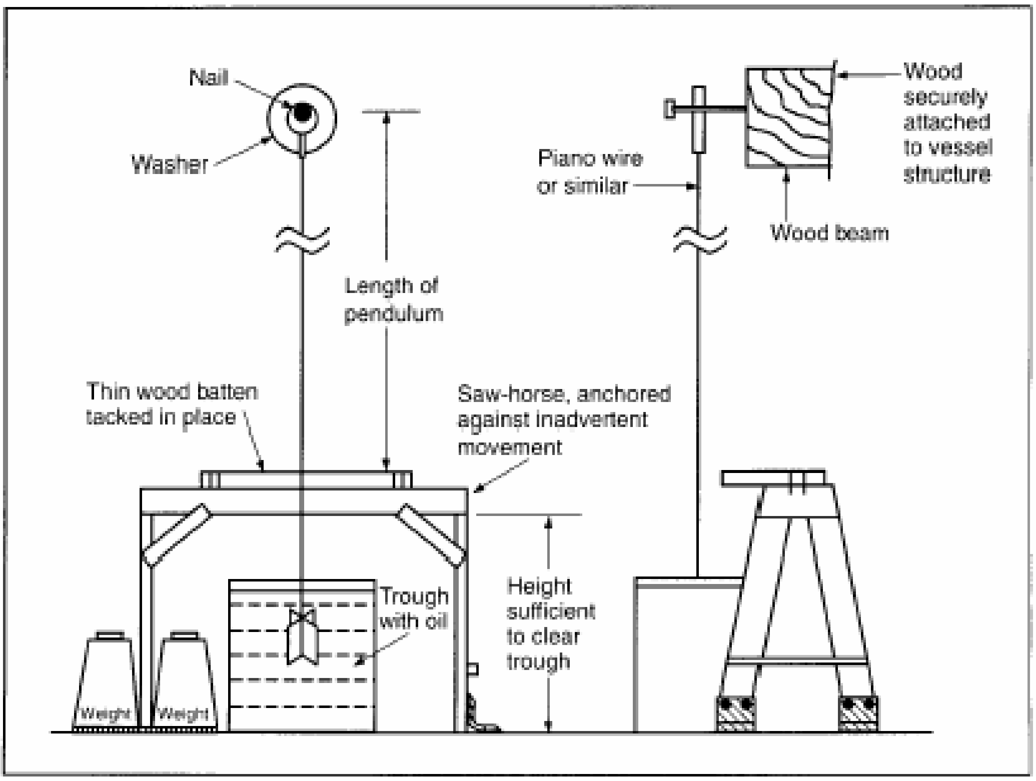

Figure A1-2.4.6

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 A2-4.3.2-1 give a good spread of points on the test plot.

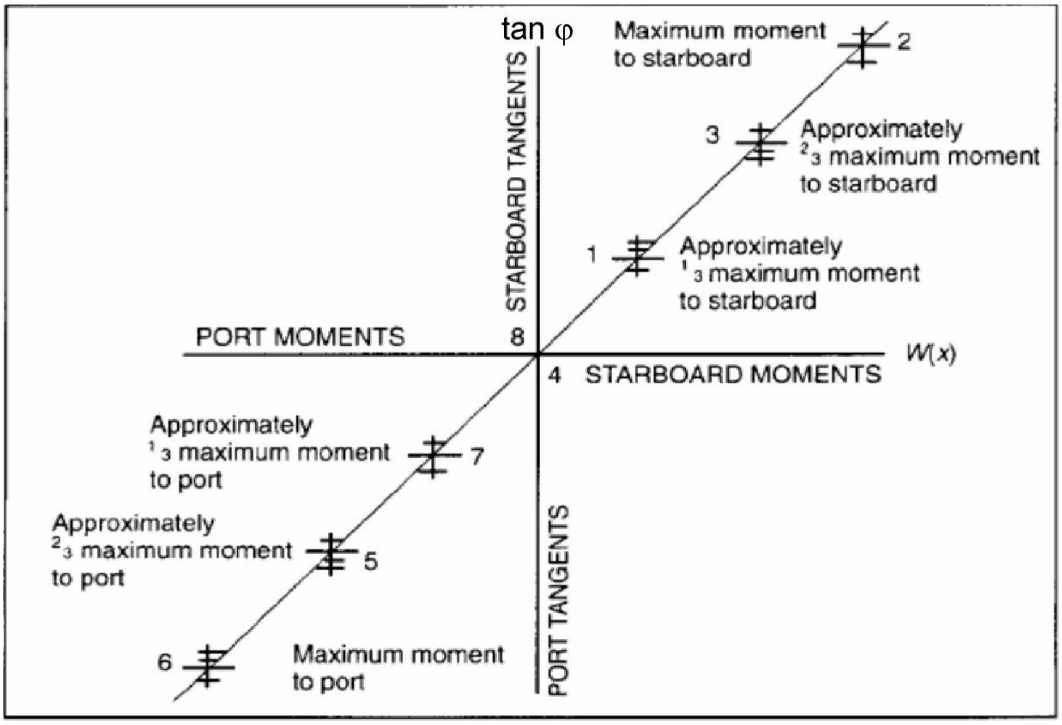

Figure A1-4.3.2-1

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.

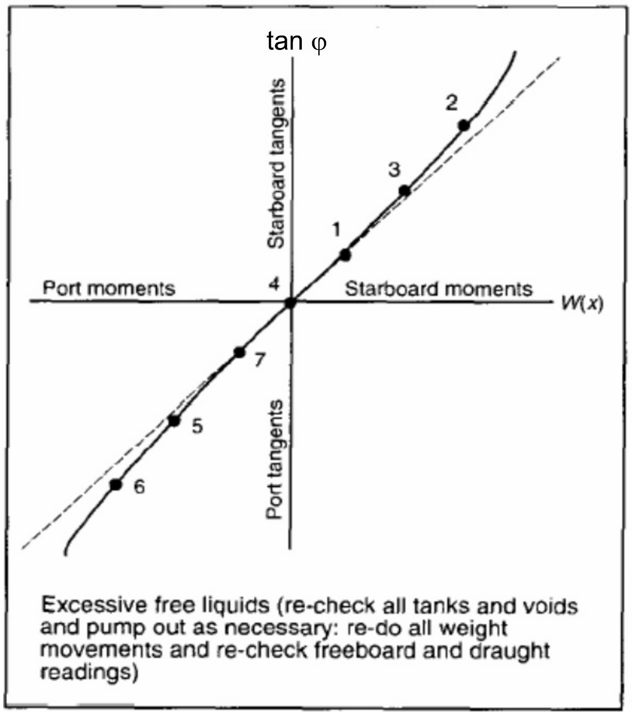

Figure A1-4.3.2-2

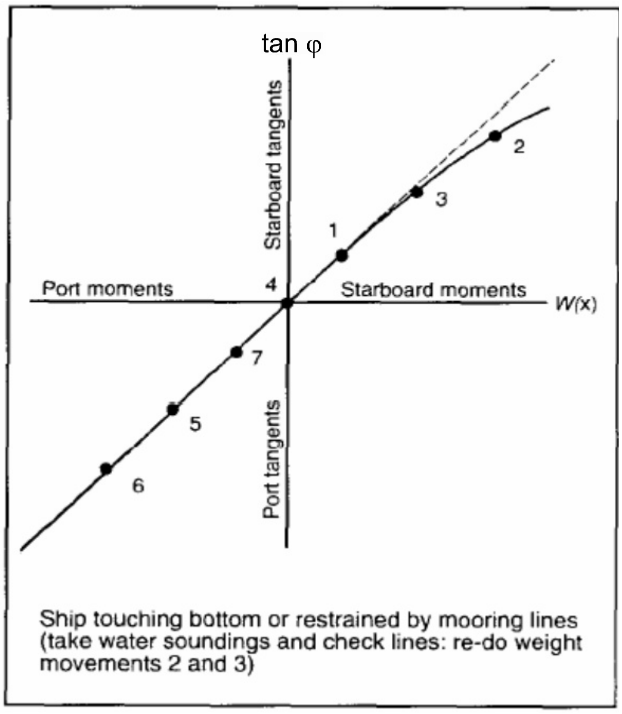

Figure A1-4.3.2-3

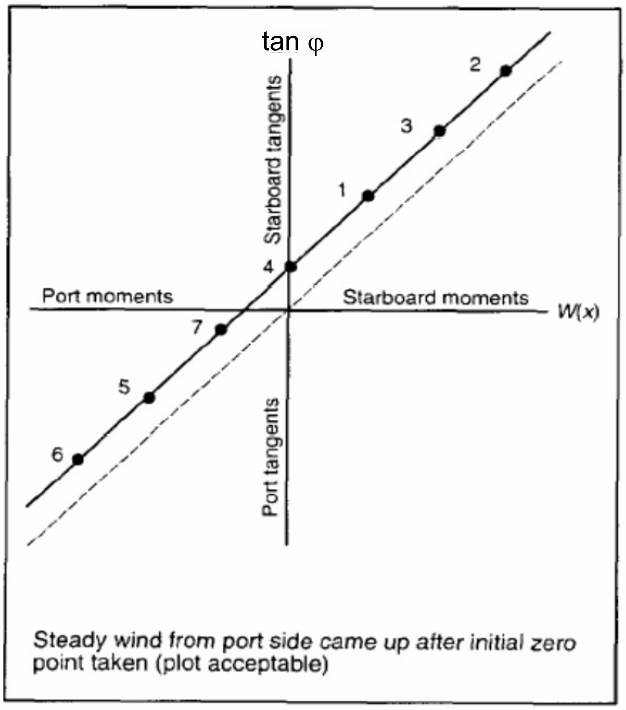

Figure A1-4.3.2-4

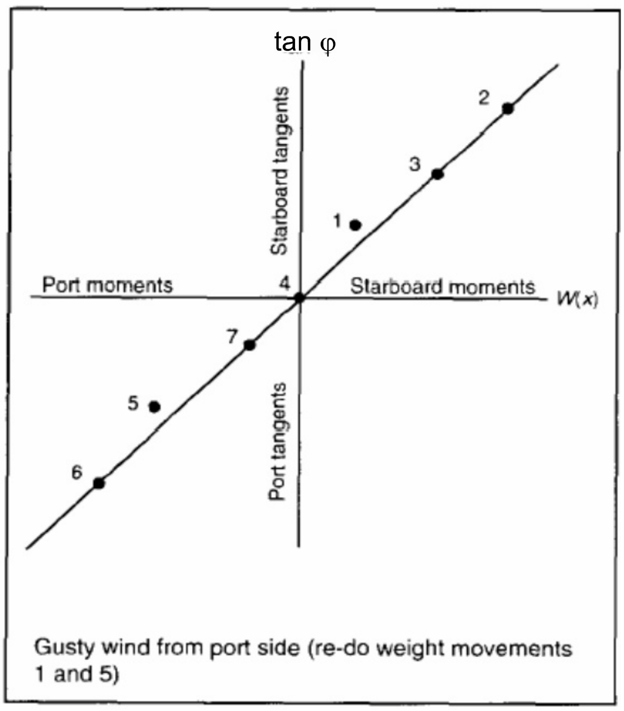

Figure A1-4.3.2-5

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.

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ANNEX 3

DRAFT AMENDMENTS TO THE 1988 LL PROTOCOL

ANNEX B
ANNEXES TO THE CONVENTION AS MODIFIED BY THE PROTOCOL OF 1988 RELATING THERETO

ANNEX I
REGULATIONS FOR DETERMINING LOAD LINES

CHAPTER I
GENERAL

Regulation 1 – Strength and intact stability of ships

1 The existing text of paragraph (3) is replaced by the following:

"(3) *Compliance*

(a) Ships constructed before [date to be determined] shall comply with an intact stability standard acceptable to the Administration;

(b) Ships constructed on or after [date to be determined] shall as a minimum comply with the requirements of part A of the Intact Stability Code, 2008."

Regulation 3 – Definitions of terms used in the annexes

2 The following new paragraph (16) is added after the existing paragraph (15):

"(16) *Intact Stability Code, 2008* (2008 IS Code) means the International Code on Intact Stability, 2008, consisting of an introduction, part A (the provisions of which shall be treated as mandatory) and part B (the provisions of which shall be treated as recommendatory), as adopted by resolution MSC …(…), provided that:

.1 amendments to the introduction and part A of the Code are adopted, brought into force and take effect in accordance with article VI of the 1988 LL Protocol concerning the amendment procedure applicable to Annex B to the Protocol; and

.2 amendments to part B of the Code are adopted by the Maritime Safety Committee in accordance with its Rules of Procedure."

CHAPTER II
CONDITIONS OF ASSIGNMENT OF FREEBOARD

Regulation 10 – Information to be supplied to the master

3 The existing text of paragraph (2) is replaced by the following:

"(2) Information shall be approved by the Administration or a recognized organization, and shall be provided to the master. Stability information, and loading information, also related to ship strength when required under paragraph (1), shall be carried on board at all times together with evidence that the information has been so approved."

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ANNEX 4

DRAFT AMENDMENTS TO THE 1974 SOLAS CONVENTION

CHAPTER II-1
CONSTRUCTION – STRUCTURE, SUBDIVISION AND STABILITY, MACHINERY AND ELECTRICAL INSTALLATIONS

PART A
GENERAL

Regulation 2 – Definitions

1 The following new paragraph 27 is added after the existing paragraph 26:

"27 *Intact Stability Code, 2008 (2008 IS Code)* means the International Code on Intact Stability, 2008, consisting of an introduction, part A (the provisions of which shall be treated as mandatory) and part B (the provisions of which shall be treated as recommendatory), as adopted by resolution MSC …(…), provided that:

.1 amendments to the introduction and part A of the Code are adopted, brought into force and take effect in accordance with article VIII of the present Convention concerning the amendment procedures applicable to the annex other than chapter I; and

.2 amendments to part B of the Code are adopted by the Maritime Safety Committee in accordance with its Rules of Procedure."

PART B-1
STABILITY

Regulation 5 – Intact stability information

2 In the existing title of the regulation, the word "information" is deleted.

3 In paragraph 1, the following new sentence is added after the existing sentence:

"In addition to any other applicable requirements of the present regulations, ships having a length of 24 m and upwards constructed on or after [date to be determined] shall as a minimum comply with the requirements of part A of the Intact Stability Code, 2008."

Regulation 5-1 – Stability information to be supplied to the master

4 Subparagraph .1 of paragraph 2 is replaced by the following:

".1 curves or tables of minimum operational metacentric height (GM) versus draught which assures compliance with the intact stability requirements according to the requirements of part A of the Intact Stability Code, 2008 and relevant damage stability requirements, alternatively corresponding curves or tables of the maximum allowable vertical centre of gravity (KG) versus draught, or with the equivalents of either of these curves;"

5 Subparagraph .3 of paragraph 2 is replaced by the following:

".3 all other data and aids which might be necessary to maintain the required intact stability according to the requirements of part A of the Intact Stability Code, 2008 and stability after damage."

***

ANNEX 5

DRAFT MSC CIRCULAR

EXPLANATORY NOTES TO THE INTERNATIONAL CODE ON INTACT STABILITY, 2008

1 The Maritime Safety Committee, at its [eighty-fifth session (… to … 2008)], adopted, by resolution MSC.[….(85)], the International Code on Intact Stability, 2008 (2008 IS Code). In adopting the 2008 IS Code, the Committee recognized the necessity of appropriate explanatory notes to ensure uniform interpretation and application.

2 To this end, the Maritime Safety Committee, at its [eighty-fifth session (… to … 2008)], approved the Explanatory Notes to the Intact Stability Code, 2008, set out in the annex, as prepared by the Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety at its fiftieth session.

3 The Explanatory Notes are intended to provide Administrations and the shipping industry with specific guidance to assist in the uniform interpretation and application of the intact stability requirements of the 2008 IS Code.

4 Member Governments are invited to use the Explanatory Notes when applying the intact stability requirements of the 2008 IS Code adopted by resolution MSC.[….(85)] and to bring them to the attention of all parties concerned.

ANNEX

EXPLANATORY NOTES TO THE INTERNATIONAL CODE ON INTACT STABILITY, 2008

CONTENTS

EXPLANATORY NOTES TO THE INTERNATIONAL CODE ON INTACT STABILITY, 2008

CHAPTER 1 – GENERAL

1.1 Introduction

The intact stability criteria given in part A (mandatory) and part B (recommendatory) of the 2008 IS Code are prescriptive rules developed from ship operation statistics and weather criterion collected in the middle of the twentieth century. To enable a proper understanding and application of these criteria, their origin and development are presented in chapter 3.

1.2 Purpose

The purpose of these explanatory notes is to deliver to the user of the Code information on the history, background and method of elaboration of the present stability criteria, as set out in part A of the 2008 IS Code.

CHAPTER 2 – TERMINOLOGY

It should be noted that, while the terms listed below are in common usage, they are not those given in MSC/Circ.920, MODEL LOADING AND STABILITY MANUAL, section 2.2, table 1, which are based on ISO standards (ISO 7462 and ISO 7463).

Particular care should be taken with regard to asymmetric weight and buoyancy distribution.

Term, as used in the 2008 IS Code	Term, as used in MSC/Circ.920	Explanation
LCG	XG	**Longitudinal Centre of Gravity (m from A.P.)** Longitudinal distance from reference point to centre of gravity, reference point usually at Aft Perpendicular (forward + / aft -).
TCG	YG	**Transversal Centre of Gravity (m from C.L.)** Transversal distance from reference point to centre of gravity, reference point in the Midship Plane (port + / starboard -).
VCG	KG	**Vertical Centre of Gravity (m above B.L.)** Vertical distance from reference point to centre of gravity, reference point on Base Line (upwards + / down -).
LCB	XB	**Longitudinal Centre of Buoyancy (m from A.P.)** Longitudinal distance from reference point to centre of buoyancy, reference point usually at Aft Perpendicular (forward + / aft -).
TCB	--	**Transversal Centre of Buoyancy (m from C.L.)** Transversal distance from reference point to centre of buoyancy, reference point in Midship Plane (port + / starboard -).
VCB	--	**Vertical Centre of Buoyancy (m above B.L.)** Vertical distance from reference point to centre of buoyancy, reference point on Base Line (upward + / down -).
LCF	XF	**Longitudinal Centre of Flotation (m from A.P.)** Longitudinal distance from reference point to centre of flotation, reference point usually at Aft Perpendicular (forward + / aft -).
TCF	--	**Transversal Centre of Flotation (m from C.L.)** Transversal distance from reference point to centre of flotation, reference point in Midship Plane (port + / starboard -).

In all cases it is of utmost importance to define clearly the reference points/planes and the signs of the positive and negative directions along the vessel's co-ordinate system.

CHAPTER 3 – ORIGIN OF PRESENT STABILITY CRITERIA

3.1 General

3.1.1 The Maritime Safety Committee requested the Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety, (SLF) to develop a range of intact stability requirements to cover all ship types for eventual incorporation into the 1974 SOLAS Convention. At the thirty-third session of the Sub-Committee (SLF 33), the Working Group on Intact Stability considered this matter and foresaw the procedural problems that would arise by incorporating a wide range of stability criteria covering different ship types into the Convention, and also recognized that these criteria could not be developed in a short time. The group recommended that, alternatively, consideration should be given to developing a comprehensive code to incorporate the then existing stability requirements contained in all IMO recommendations and codes for various types of ships. Criteria for additional ship types could be added later as each ship type was considered and a criterion developed. The group also suggested that the 1974 SOLAS Convention should either: include a basic stability standard and refer to the Code for varying ship types or, alternatively, it should only refer to the Code. The proposed Code could be divided into two parts: part A containing mandatory requirements, and part B containing recommendatory requirements. Development of the proposed Code was given priority [IMO 1988].

3.1.2 In considering the proposal by the group, SLF 33 agreed that the development of a stability code for all ships covered by IMO instruments (IS Code) would be of value, so that the generally accepted and special stability requirements for all types of ships' forms would be contained in a single publication for ease of reference. This was thought to be important because stability requirements were dissipated amongst various documents which made their use by designers and authorities difficult [IMO 1988a]. The Sub-Committee emphasized that the Code should contain instructions on operational procedures as well as technical design characteristics. This course of action was approved by the Maritime Safety Committee at its fifty-seventh session.

3.1.3 The collation of the stability requirements contained in various IMO instruments and the preparation of the first draft of the Code was undertaken by Poland and submitted to IMO [IMO 1990]. This formed the basis for the development of the Code which was to include the following groups of requirements as proposed by Poland [Kobylinski 1989]:

- .1 ship construction;
- .2 physical characteristics of ships;
- .3 information available onboard and navigational aids; and
- .4 operations.

3.1.4 This framework was eventually adopted by SLF 35, which also agreed that the Code should have recommendatory status. The final draft of the Code was agreed by SLF 37 and subsequently adopted by resolution A.749(18) [IMO 1993]. It was subsequently amended in 1998 by resolution MSC.75(69). The Code was considered to be a "living" document under constant review, into which all new requirements developed by IMO would be incorporated.

3.1.5 The 2008 IS Code superseded, at the time of its adoption, resolutions A.167(ES.IV), A.168(ES.IV) and A.562(14). Other compulsory stability requirements included in SOLAS are referred to in the Code.

3.2 Background of criteria regarding righting lever curve properties (part A of the 2008 IS Code)

3.2.1 *Introduction*

3.2.1.1 The statistical stability criteria were originally included in resolutions A.167(ES.IV) and A.168(ES.IV). They were developed as a result of discussions conducted at several sessions of the Sub-Committee on Subdivision and Stability Problems (STAB), a forerunner of the SLF Sub-Committee and the Working Group on Intact Stability. There was general agreement that the criteria would have to be developed on the basis of the statistical analysis of stability parameters of ships that had suffered casualties and of ships that were operating safely.*

3.2.1.2 The Working Group on Intact Stability agreed to a programme of work that eventually included the following item:

.1 collation, analysis and evaluation of existing national rules or recommendations on stability;

.2 evaluation of stability parameters which could be used as stability criteria;

.3 collection of stability characteristics of those ships that become casualties or experienced dangerous heeling under circumstances suggesting insufficient stability;

.4 collection of stability characteristics of those ships which were operating with safe experience;

.5 comparative analysis of stability parameters of ships becoming casualties and of ships operated safely;

.6 estimation of critical values of chosen stability parameters; and

.7 checking formulated criteria against a certain number of existing ships.

3.2.1.3 The analysis of existing national stability requirements (paragraph 3.2.1.2.1) [IMO 1964] revealed considerable consistency in the applicability of certain parameters as stability criteria. It was noted also that in many countries there was a tendency to adopt weather criterion. However, weather criterion was not considered by the Working Group on Intact Stability at that time.

3.2.1.4 With regard to paragraph 3.2.1.2.2 of the programme, the Working Group on Intact Stability singled out a group of parameters characterizing the curve of righting levers for the ship at rest ($V = 0$) in still water. This was done notwithstanding the fact that if a ship sails in a seaway, the curve of static stability levers changes. However, it was decided that the only practical solution would be to use the "stipulated" curve of righting levers and this curve could be characterized using the following set of parameters:

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* The detailed discussion of the work of these IMO bodies and of the method used in the development of stability standards was reported in the following papers: Nadeinski and Jens [1968] and Thompson and Tope [1970].

.1 initial stability – GM_0,

.2 righting levers at angles – GZ_{10}, GZ_{20}, GZ_{30}, GZ_{40}, GZ_{φ}, GZ_m,

.3 angles – φ_m, φ_v, φ_f, φ_{fd},

.4 levers of dynamic stability – e_{20}, e_{30}, e_{40}, e_{φ}.

3.2.1.5 The number of stability parameters which could be used as stability criteria should be, however, limited. Therefore, by analysing the parameters used in various national stability requirements, the Working Group on Intact Stability concluded the following eight parameters have to be left for further consideration: GM_0, GZ_{20}, GZ_{30}, GZ_m, φ_m, φ_v, φ_{fd}, e.

3.2.1.6 During the realization of paragraph 3.2.1.2.3 of the programme, a special form of casualty record was prepared and circulated amongst IMO Member States [IMO 1963]. It was requested that the form be filled in carefully with as many details of the casualty as possible. Altogether there were casualty records collected for 68 passenger and cargo ships and for 38 fishing vessels [IMO 1966, 1966a]. In a later period, some countries submitted further casualty records so that, in the second analysis that was performed in 1985, data for 93 passenger and cargo ships and for 73 fishing vessels were available [IMO 1985]. On the basis of the submitted data, tables of details of casualties were prepared.

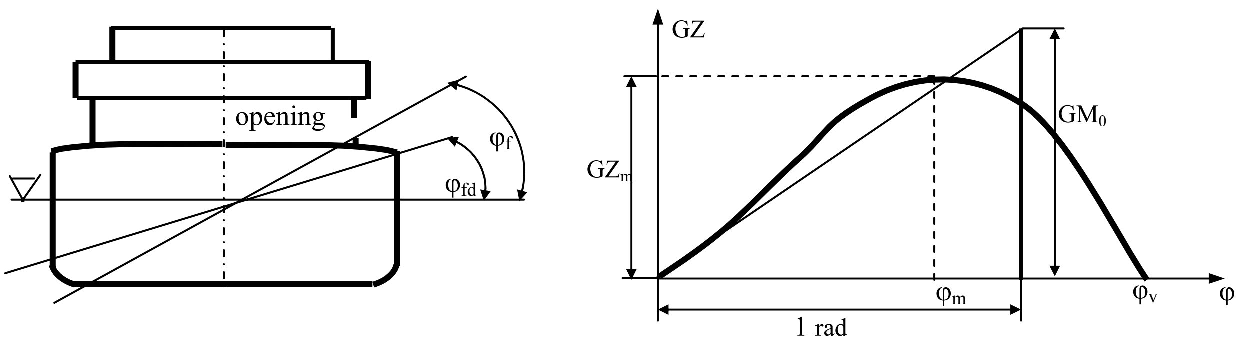


Figure 1 – Explanation of righting levers and heeling angles

3.2.1.7 Within paragraph 3.2.1.2.4 of the programme, data on stability characteristics for 62 passenger and cargo ships and for 48 fishing vessels, which were operated safely, were collected and for this purpose a special instruction containing detailed specifications for the manner how the stability information was to be submitted was developed. Also, for these ships, tables were prepared of stability parameters.

3.2.1.8 Paragraph 3.2.1.2.5 of the programme included analysis of the collected data, the results of which were submitted to IMO in several documents separately prepared for passenger and cargo ships and for fishing vessels [IMO 1965; 1966; 1966a; 1966b].

3.2.1.9 After IMO resolutions A.167(ES.IV) and A.168(ES.IV) had been adopted and further intact stability casualty data were collected, it was decided to repeat the analysis in order to find out if additional data might change conclusions drawn in the first analysis. This second analysis confirmed, in general, the results achieved in the first analysis [IMO 1985]. In the following text, the results of the second analysis that was based on the larger database are referred to.

3.2.1.10 The analysis performed consisted of two parts. In the first part, details relevant to casualties were evaluated, which allowed qualitative conclusions with regard to the circumstances of casualties to be developed and therefore the specification of general safety precautions. In the second part, stability parameters of ships reported as casualties were compared with those for ships which were operated safely. Two methods were adopted in this analysis. The first was identical with the method adopted by Rahola [Rahola 1939] and the second was the discrimination analysis. The results of the analysis of intact stability casualty data and of the first part of the analysis of stability parameters are included in paragraph 3.2.2.2. The results of the discrimination analysis are referred to in paragraph 3.2.2.3.

3.2.2 ***Results of the Analysis of Intact Stability Casualty Records and Stability Parameters***

3.2.2.1 *Analysis of details relevant to the casualties*

3.2.2.1.1 The evaluation of details relevant to the casualties is shown in figures 2 to 7.

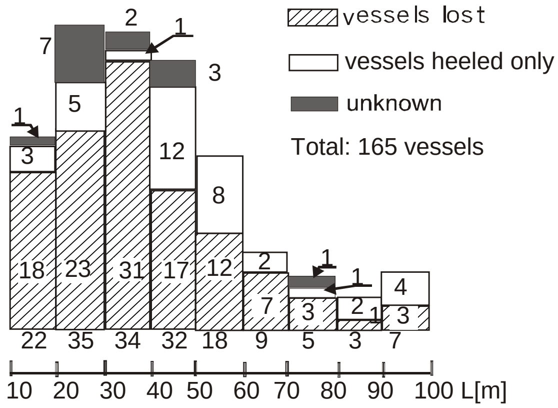


Figure 2 – Distribution of length of capsized ships collated by IMO [1985]

3.2.2.1.2 In all 166 casualties reported, the ships concerned were: 80 cargo ships, 1 cargo and passenger ship, 1 bulk carrier, 4 off-shore supply ships, 7 special service vessels, and 73 fishing vessels. Distribution of ship's length is shown in figure 2. It is seen that the majority of casualties occurred in ships of less than 60 m in length.

3.2.2.1.3 A great variety of cargoes were carried so that no definite conclusions could be drawn. It may be noted, however, that in 35 cases of the 80 cargo ships reported, deck cargo was present.

3.2.2.1.4 The result of the analysis of the location of the casualty is shown in figure 3. It may be seen that the majority of casualties (72% of all casualties) occurred in restricted water areas, in estuaries and along the coastline. This is understandable because the majority of ships lost were small ships of under 60 m in length. From the analysis of the season when the casualty occurred (figure 4) it may be seen that the most dangerous season is autumn (41 % of all casualties).

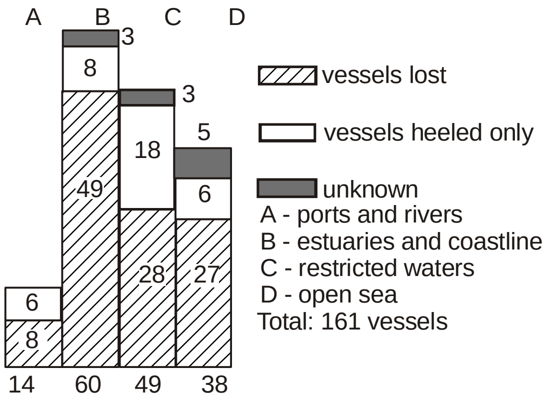


Figure 3 – Place of casualty [IMO 1985]

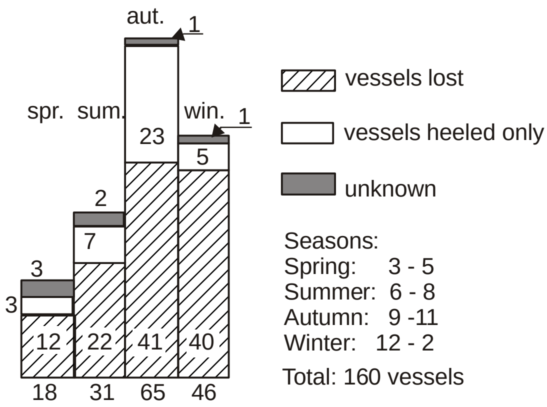


Figure 4 – Season of casualty [IMO 1985]

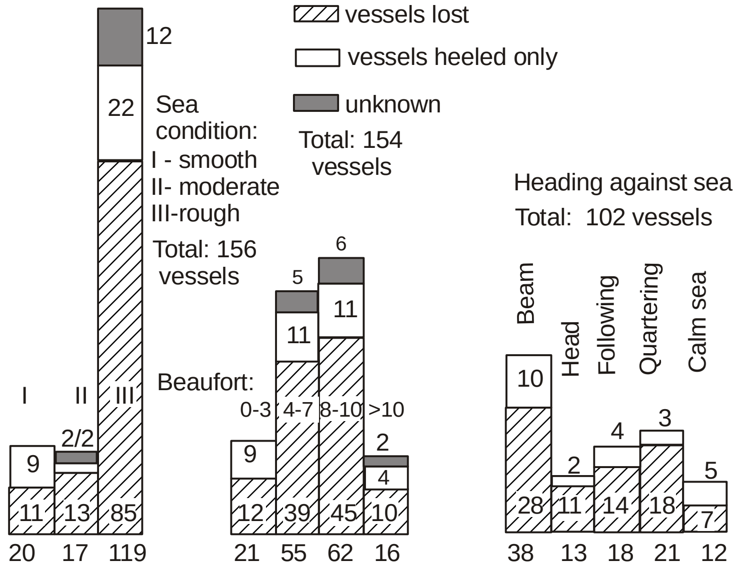


Figure 5 – Sea and wind condition during casualty [IMO 1985]

3.2.2.1.5 The result of the analysis of the weather conditions is shown in figure 5. About 75% of all casualties occurred in rough seas at a wind force of between Beaufort 4 to 10. Ships were sailing most often in beam seas, less often in quartering and following seas.

3.2.2.1.6 The manner of the casualty was also analysed (figure 6). It showed that the most common casualty was through gradual or sudden capsizing. In about 30% of casualties, ships survived the casualty and were heeled only.

3.2.2.1.7 In figure 7 the results of the analysis of the age of ships are shown. No definite conclusions could be drawn from this analysis.

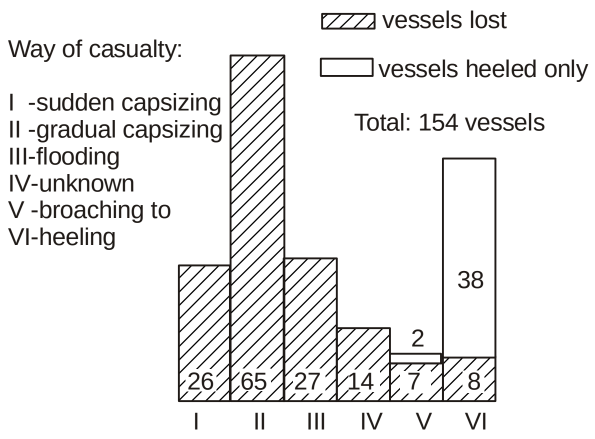


Figure 6 – Way of casualty [IMO 1985]

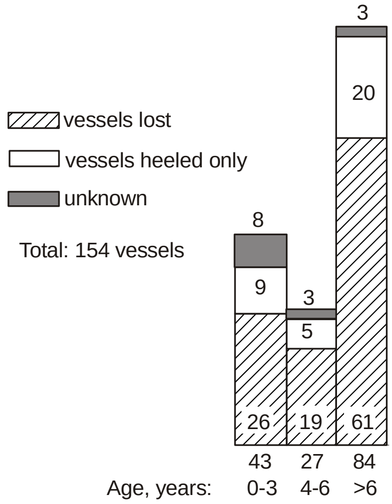


Figure 7 – Age of vessel during casualty [IMO 1985]

3.2.2.1.8 The distributions of stability parameters for ships' condition at time of loss are shown in figures 8 to 14.

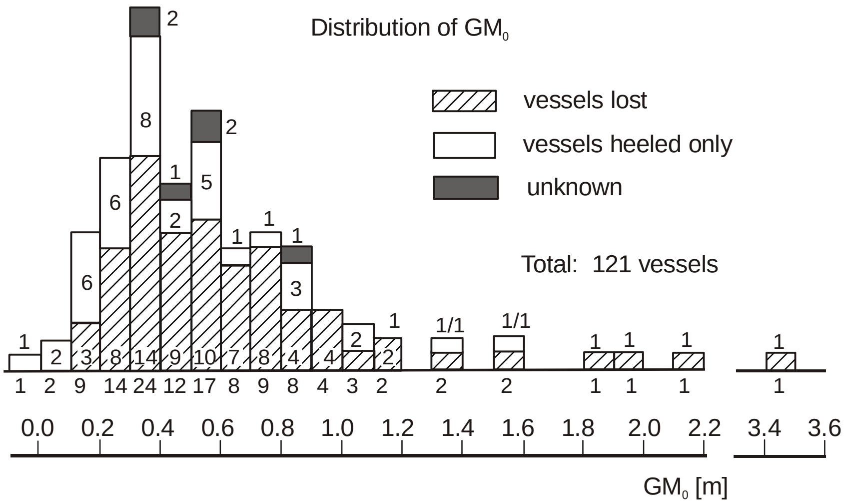


Figure 8 – Condition at time of casualty. Distribution of GM_0 [IMO 1985]

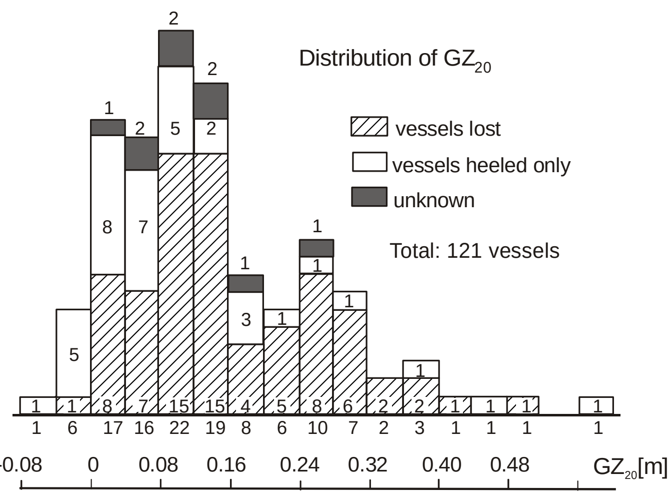


Figure 9 – Condition at time of casualty. Distribution of GZ_{20} [IMO 1985]

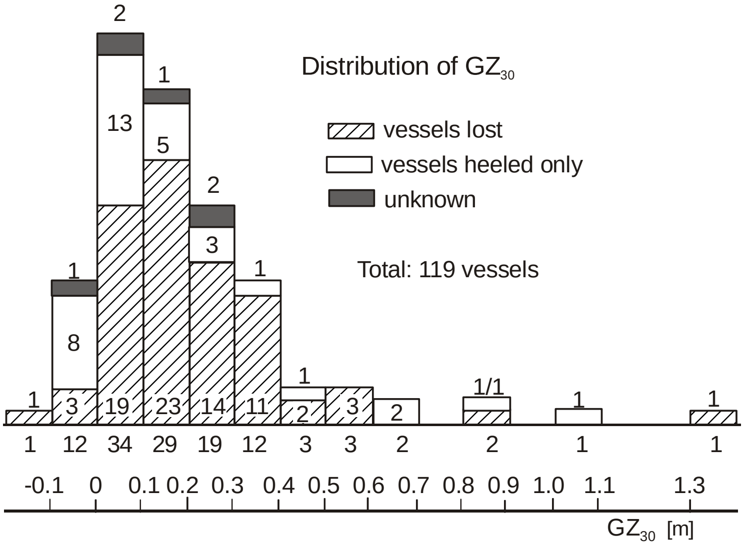


Figure 10 – Condition at time of casualty. Distribution of GZ_{30} [IMO 1985]

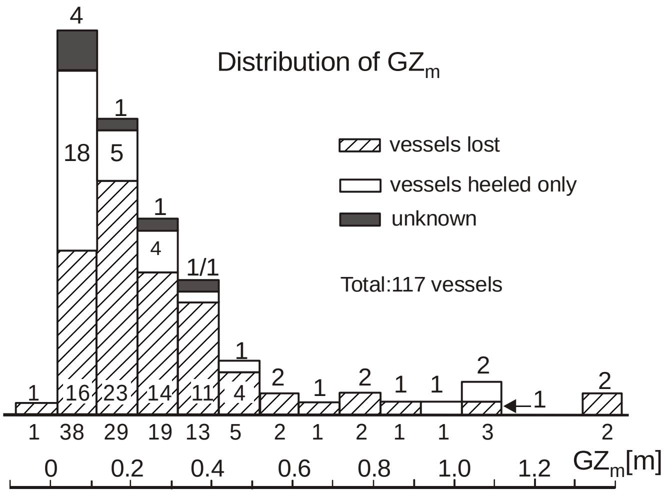


Figure 11 – Condition at time of casualty. Distribution of GZ_m [IMO 1985]

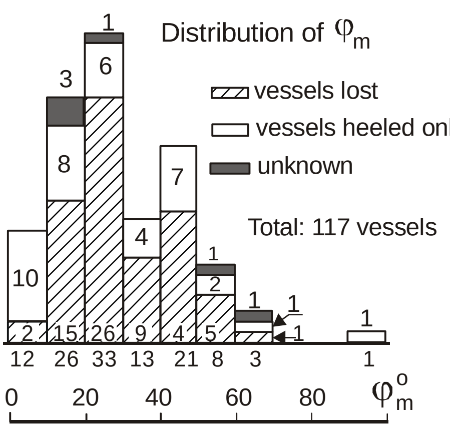


Figure 12 – Condition at time of casualty. Distribution of φ_m [IMO 1985]

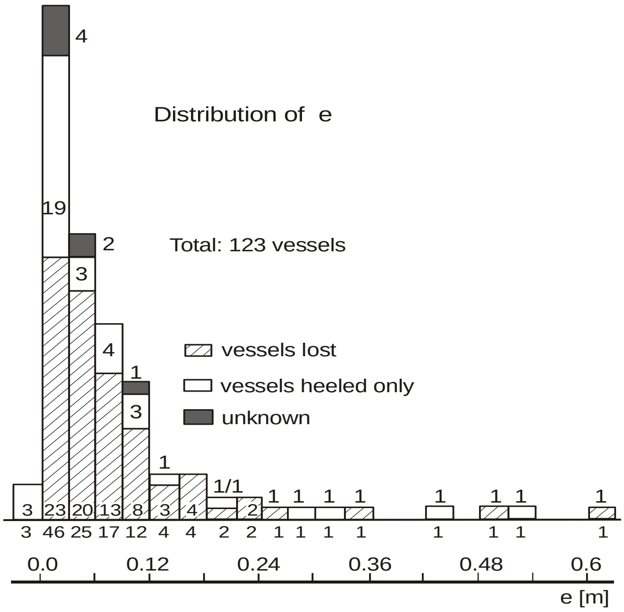


Figure 13 – Condition at time of casualty. Distribution of *e* [IMO 1985]

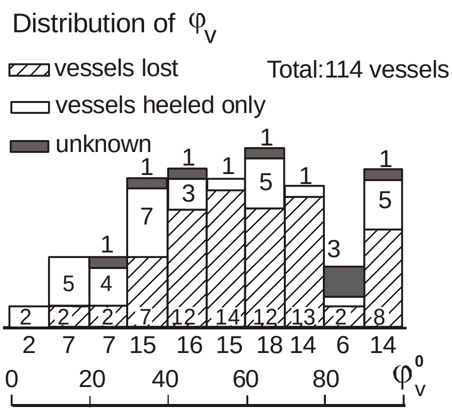


Figure 14 – Condition at time of casualty. Distribution of φ_V [IMO 1985]

3.2.2.2 *Analysis of stability parameters using Rahola method*

3.2.2.2.1 The stability parameters for casualty condition were analysed by plotting in a similar manner, as was done by Rahola, together with parameters for ships operated safely for comparison.

3.2.2.2.2 The parameters chosen for analysis were GM_0, GZ_{20}, GZ_{30}, GZ_{40}, GZ_m, e_{40}, and φ_m. From the available data, histograms were prepared, where respective values of stability parameters for casualty condition were entered by starting with the highest value at the left of the vertical line (ordinate) down to the lowest value, and the values of the same parameter for safe ships were entered on the right side by starting from the lowest and ending with the highest value. Thus, at the ordinate, the highest value of the parameter for casualty condition is next to the lowest value of the parameter for the safe case. In figure 15 an example diagram for righting levers comprising all ships analysed is shown. In the original analysis [IMO 1966, 1966a, 1985] diagrams were prepared separately for cargo and fishing vessels, but they are not reproduced here.

3.2.2.2.3 In the diagram (figure 15), the values for casualty condition are shaded, only those that have to be specially considered due to exceptional circumstances were left blank. On the right side of the ordinate the areas above the steps were shaded in order to make a distinction between the safe and unsafe cases easier. The limiting lines or the imaginary static stability lever curves were drawn in an identical way as in the Rahola diagram. Percentages of ships in arrival condition, the respective stability parameters which are below the limiting lines are shown in table 1. The lower percentages mean in general that there is better discrimination between safe and unsafe conditions.

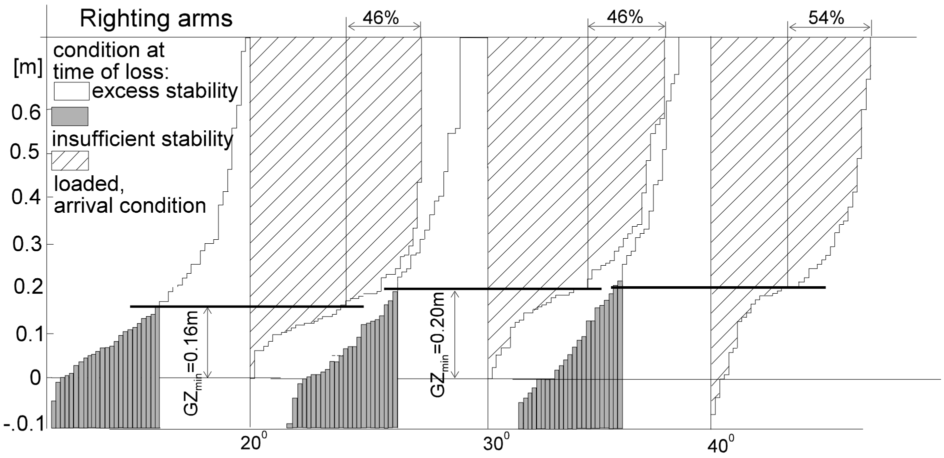


Figure 15 – Plot of righting levers for ships at time of casualty. Cargo vessels only. [IMO 1966, 1985]

Table 1 – Percentages of ships below limiting line

Stability parameter	Percentages		
	all ships	cargo	fishing
GZ_{20}	39	54	26
GZ_{30}	48	54	42
GZ_{40}	48	46	48
e	55	56	53

3.2.2.2.4 The type of analysis described above is not entirely rigorous; it was partly based on intuition and allows arbitrary judgement. Nevertheless, from the point of view of practical application, it provided acceptable results and finally was adopted as a basis for IMO stability criteria.

3.2.2.3 *Discrimination Analysis*

3.2.2.3.1 When two populations of data, as in this case, data for capsized ships and for ships considered safe, are available and the critical values of parameters from these two sets have to be obtained, the method of discrimination analysis may be applied.

3.2.2.3.2 The application of the discrimination analysis in order to estimate critical values of stability parameters were contained in a joint report by [IMO 1966, 1966a], and constituted the basis for development of IMO stability criteria along the previously described Rahola method.

3.2.2.3.3 In this investigation, discrimination analysis was applied independently to nine stability parameters. Using data from intact stability casualty records (group 1) and from intact stability calculations for ships considered safe in operation (group 2) the distribution functions were plotted, where for group 1 the distribution function F_1 and for group 2 function $(1 - F_2)$ were drawn. Practically, on the abscissa axis of the diagram, values for the respective stability parameter were plotted and the ordinates represent the number of ships in per cent of the total number of ships considered having the respective parameter smaller than the actual value for ships of group 1 and greater than the actual value for ships of group 2 considered safe.

3.2.2.3.4 The point of intersection of both curves in the diagram provides the critical value of the parameter in question. This value is dividing the parameters of group 1 and of group 2. In an ideal case, both distribution functions should not intersect and the critical value of the respective parameter is then at the point between two curves (see figure 16).

3.2.2.3.5 In reality, both curves always intersect and the critical value of the parameter is taken at the point of intersection. At this point, the percentage of ships capsized having the value of the respective parameter higher than the critical value is equal to the percentage of safe ships having the value of this parameter lower than the critical value.

3.2.2.3.6 The set of diagrams was prepared in this way for various stability parameters based on IMO statistics for cargo and passenger ships and for fishing vessels. One of the diagrams is reproduced in figure 17. It means that the probability of capsizing of a ship with the considered parameter higher than the critical value is the same as the probability of survival of a ship with this parameter lower than the critical value.

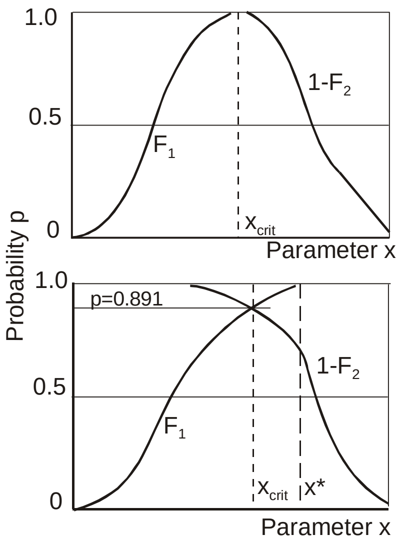


Figure 16 – Estimation of critical parameter

3.2.2.3.7 In order to increase the probability of survival, the value of the parameter should be increased, say up to x^* (figure 16), at which the probability of survival (based on the population investigated) would be 100%. However, this would mean excessive severity of the criterion, which usually is not possible to adopt in practice because of unrealistic values of parameters obtained in this way curves do intersect could be explained in two ways. It is possible that ships of group 2 having values of the parameter in question $x < x_{crit}$ are unsafe, but they were lucky not to meet excessive environmental conditions which might cause capsizing. On the other hand, the conclusion could also be drawn that consideration of only one stability parameter is not sufficient to judge the stability of a ship.

3.2.2.3.8 The last consideration led to an attempt to utilize the IMO data bank for a discrimination analysis where a set of stability parameters was investigated [Krappinger and Sharma 1974]. The results of this analysis were, however, available after the SLF Sub-Committee had adopted criteria included in resolutions A.167(ES.IV) and A.168(ES.IV) and were not taken into consideration.

3.2.2.3.9 As can be seen from figure 17, the accurate estimation of the critical values of the respective parameters is difficult because those values are very sensitive to the running of the curves in the vicinity of the intersection point, especially if the population of ships is small.

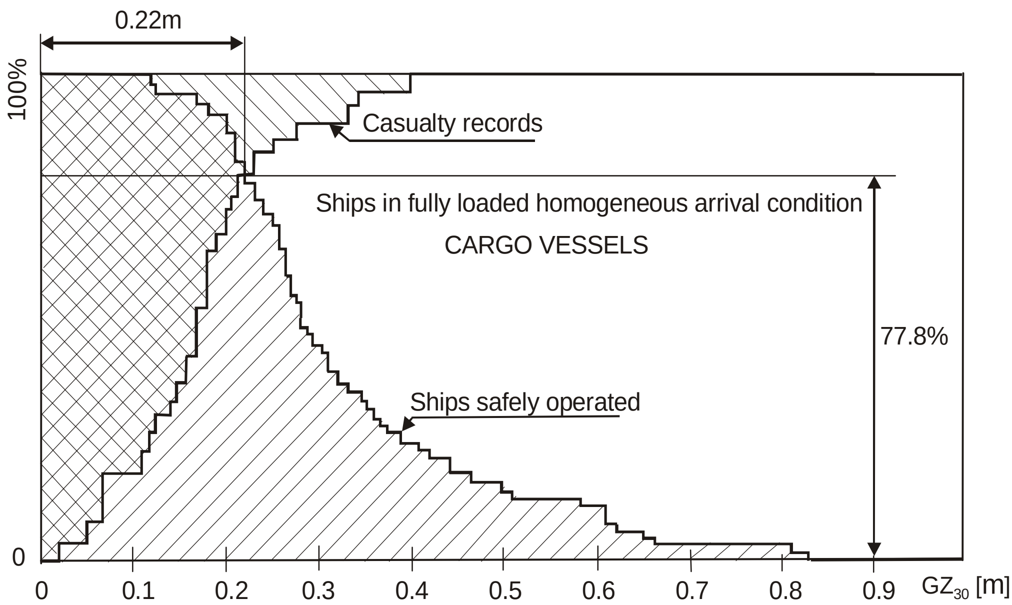


Figure 17 – Discrimination analysis for parameter GZ_{30} [IMO 1965]

3.2.2.4 *Adoption of the final criteria and checking the criteria against a certain number of ships*

3.2.2.4.1 The final criteria, as they were evaluated on the basis of the diagrams, are prepared in the form as shown in figures 15 and 17. The main set of diagrams did show righting lever curves (figure 15), but diagrams showing distribution of dynamic stability levers were also included. Diagrams were prepared jointly for cargo and passenger vessels and for fishing vessels, except vessels carrying timber deck cargo. Sets of diagrams were also separately prepared for cargo ships and fishing vessels. Diagrams in the form as shown in figure 17 were prepared separately for each stability parameter and separately for cargo and passenger ships and for fishing vessels.

3.2.2.4.2 After discussion by the Working Group on Intact Stability and the SLF Sub-Committee, the stability criteria were rounded off and finally adopted in the form as they appear in the resolutions A.167(ES.IV) and A.168(ES.IV).

3.2.2.4.3 In the original analysis the angle of vanishing stability was also included. However, due to the wide scatter of values of this parameter, it was not included in the final proposal.

3.2.2.4.4 As each criterion or system of criteria has to be checked against a sample of the population of existing ships, it was necessary to find the common basis for comparison results achieved with the application of different criteria. The most convenient basis for the comparison was the value of KG_{crit} that is the highest admissible value of KG satisfying the criterion or system of criteria, and the higher the value of KG_{crit}, the less severe the criterion.

3.2.2.4.5 As an example, criteria related to the righting lever curves could be written as:

$$GZ = KZ - KG \sin\varphi \quad (1)$$

and

$$KG = \frac{KZ(\Delta,\varphi) - GZ}{\sin\varphi} \quad (2)$$

3.2.2.4.6 If for GZ and φ, values of respective criterion are inserted, values of KG_{crit} for respective displacement are obtained. Then the curve $KG_{crit} = f(\Delta)$ could be drawn. KG_{crit} could also be obtained graphically as shown in figure 18. It is possible to calculate values KG_{crit} also for dynamic criteria, although the method is more complicated.

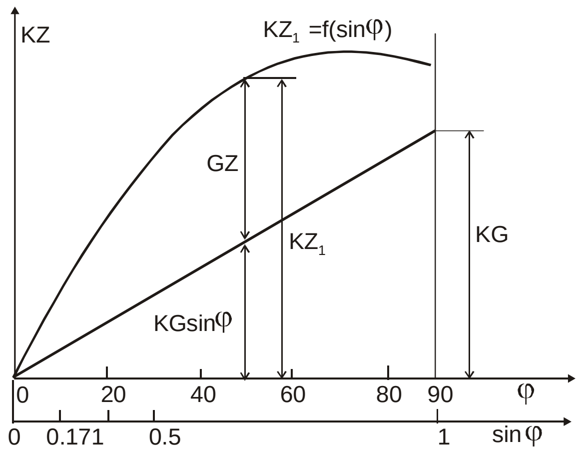


Figure 18 – Graphical estimation of KG_{crit}

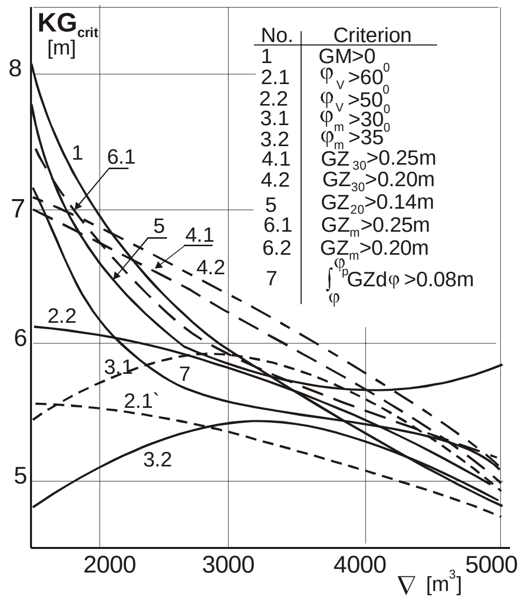
3.2.2.4.7 Figure 19 shows the results of calculations of KG_{crit} for a fishing vessel ([IMO 1966]). Curves $KG_{crit} = f(\Delta)$ for 11 different criteria are plotted in the figure. By having such curves for each individual criterion, it is easy to determine critical KG curve for a system of criteria by drawing envelope.

3.2.2.4.8 Curves for KG_{crit}, as shown in figure 19, also allow conclusions to be drawn regarding the relative severity of various criteria or systems of criteria and to single out the governing one. If, in addition, actual values of KG for the particular ship are available, then it is possible to estimate whether the ship satisfies the criteria and which criterion leads to the condition most close to the actual condition. If it is assumed that ships in service are safe from the point of view of stability, it could be concluded which criterion or system of criteria fits in the best way without excessive reserve of stability.

3.2.2.4.9 With

$$k = \frac{KG_{actual}}{KG_{critical}}$$

a histogram of distribution of *k* is shown for the group of ships analysed (figure 20).



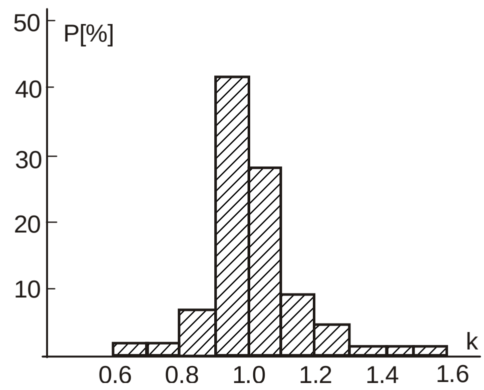


Figure 19 – Plot of the KG_{crit} curves for various criteria

Figure 20 – Distribution of coefficient *k* for a group of ships analysed [Sevastianov 1968]

3.3 Background of the approximate formula for the minimum GM_0 for small fishing vessels (part B, paragraph 2.1.5.1 of the 2008 IS Code)

3.3.1 The approximate formula for the minimum metacentric height for small fishing vessels was developed using the method of regression analysis. In 1967 the Panel of Experts on Fishing Vessels Stability (PFV) of IMO recommended to develop an appropriate stability standard for small fishing vessels less than 30 m in length. The reason for this was the fact that for small fishing vessels quite often no drawings and stability data are available; therefore, the application of criteria of resolution A.168(ES IV) is not possible. It was proposed that a stability standard for those vessels could be developed in the form of a formula for GM_{crit} that could be compared with the actual GM_0 estimated on the basis of the rolling test. The value of GM_{crit} should correspond to the criteria of resolution A.168(ES IV).

3.3.2 For the development of the appropriate formula, members of the Panel were requested to submit stability data for as many small fishing vessels as possible and also information regarding approximate formulae on GM_{crit} used in their countries, if any. Those formulae were later compared with the formulae developed by the regression analysis. The review of all approximate formulae revealed a rather wide scatter of values of GM_{crit}. This could be expected because it is obvious that the formulae do not take into account all parameters of the ship's hull that are important from the point of view of stability. Therefore, none of the formulae were adopted by

IMO and it was decided to develop a new formula based on a regression analysis of a larger number of data for small fishing vessels.

3.3.3 The formula should provide results as close as possible to those provided by using IMO criteria included in resolution A.168(ES IV). As it would be impossible to take into account all criteria, it was decided that the representative criterion which should be satisfied was $GZ_{30} = 0.20$ m.

3.3.4 Stability data was collected on 119 vessels of between 15 and 29 m in length and analysed [IMO 1968a].

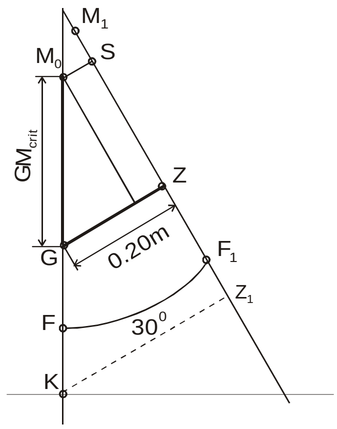


Figure 21 – Relation between GM_{crit} and GZ = 0.20m

3.3.5 As the condition for GM_{crit} is $GZ_{30} = 0.2$ m, the following is valid (figure 21):

$$GZ_{30} = GM_0 \sin 30^0 + MS_{30} \qquad (3)$$

then:

$$GM_{crit} = 0.40 - 2B\left(\frac{MS_{30}}{B}\right) \qquad (4)$$

3.3.6 As MS_{30}/B depends only on geometrical parameters of the hull, this parameter might be used not only to evaluate GM_{crit} but also to compare different hull shapes from the stability point of view.

3.3.7 It is assumed that, in general, $\frac{MS_{30}}{B} = f\left\{\frac{f}{B}, \frac{B}{D}, \frac{l_{sup}}{L}\right\}$ polynomial expressions of different type were tested with coefficients evaluated by regression analysis. The evaluation of errors while estimating GM_{crit} of those expressions with respect to the actual GM_{crit} of the analysed vessels showed, as expected, that for about 50% of the vessels the calculated GM_{crit} was smaller than the actual value. For another 50% it was greater than the actual value (figure 22a) with the distribution of errors considered acceptable. To increase the safety, it was then decided that the calculated values of GM_{crit} should be increased by a certain amount, C_{GM} , in order to achieve a situation where about 85% of vessels were on the safe side (figure 22b). This supplementary C_{GM} was evaluated by an iteration process and it was determined that the proper value is $C_{GM} = 0.1250$.

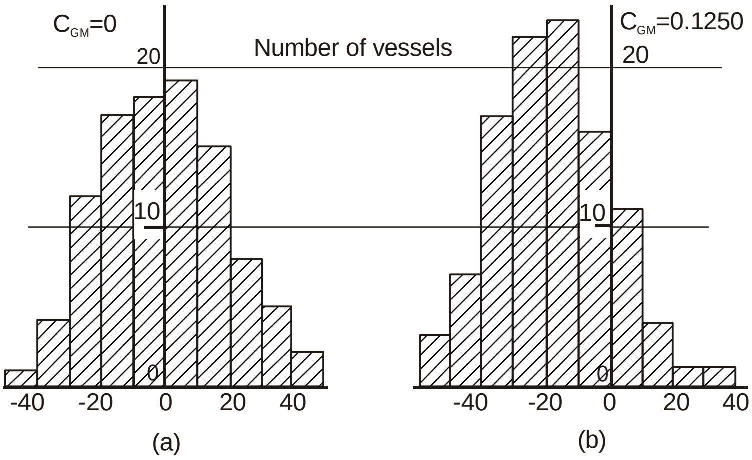


Figure 22 – Distribution of errors in estimation of GM_{crit} for small fishing vessels

3.3.8 The formula (4) was modified as follows:

$$GM_{crit} = 0.40 + C_{GM} - 2B\left(\frac{MS_{30}}{B}\right) \quad (5)$$

3.3.9 The final formula, as given in resolution A.207(VII), was:

$$GM_{crit} = 0.40 + C_{GM} - 2B\left[a_0 + a_1\left(\frac{f}{B}\right) + a_2\left(\frac{f}{B}\right)^2 + a_3\left(\frac{B}{T}\right) + a_4\left(\frac{l_{sup}}{L}\right)\right] \quad (6)$$

where:

C_{GM}	=	0.1250	a_2	=	- 0.8340
a_0	=	- 0.0745	a_3	=	0.0137
a_1	=	0.3704	a_4	=	0.0321

3.4 References relating to paragraphs 3.1 to 3.3

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3.5 Background of the severe wind and rolling criterion (weather criterion)

3.5.1 *Introduction*

3.5.1.1 The severe wind and rolling criterion (weather criterion) is one of general provisions of the 2008 IS Code. This criterion was originally developed to guarantee the safety against capsizing for a ship losing all propulsive and steering power in severe wind and waves, which is known as a dead ship. Because of no forward velocity of ships, this assumes a irregular beam wind and wave condition. Thus operational aspects of stability are separated from this criterion, and are dealt with the guidance to the master for avoiding dangerous situation in following and quartering seas (MSC/Circ.707), in which a ship could capsize more easily than beam seas under some operational actions.

3.5.1.2 The weather criterion firstly appeared in the IMO instruments as Attachment No.3 to the Final Act of Torremolinos International Convention for the Safety of Fishing Vessels, 1977. During the discussion for developing the Torremolinos Convention, the limitation of the GZ curve criterion based on resolution A.168(ES.IV) was remarked; it is based on experiences of fishing vessels only in limited water areas and it has no way for extending its applicability to other ship types and other weather conditions. Thus, other than the GZ curve criterion, the Torremolinos Convention adopted the severe wind and rolling criterion including a guideline of calculation. This new provision is based on the Japanese stability standards for passenger ships (Tsuchiya, 1975; Watanabe *et al*, 1956).

3.5.1.3 Then, a similar criticism to the GZ curve criterion for passenger and cargo ships, resolution A.167(ES.IV), was raised at IMCO. At least resolution A.167 was claimed to be applicable to ships of 100 m in length or below because of the limitation of statistical data source. As a result, a weather criterion was adopted also for passenger and cargo ships as well as fishing vessels of 45 m in length or over, as given in resolution A.562(14) in 1985. This new criterion keeps the framework of the Japanese stability standard for passenger ships but includes USSR's calculation formula for roll angle. For smaller fishing vessels, resolution A.685(17) in 1991 was passed. Here the reduction of wind velocity near sea surface is introduced reflecting USSR's standard. When the IS Code was established as resolution A.749(18) in 1993, all the above provisions were superseded.

3.5.2 *Energy Balance Method*

3.5.2.1 The basic principle of the weather criteria is energy balance between the beam wind heeling and righting moments with a roll motion taken into account. One of the pioneering works on such energy balance methods can be found in Pierrottet (1935) (figure 23). Here, as shown in figure 3.1, the energy required for restoring is larger than that required for the wind heeling moment. Since no roll motion is taken into account, a ship is assumed to suddenly suffer a wind heeling moment at its upright condition. This was later used in the interim stability requirements of the USSR and then Poland, Rumania, GDR and China (Kobylinski & Kastner, 2003).

3.5.2.2 In Japan the energy balance method is extended to cover a roll motion and to distinguish steady and gusty wind as shown in figure 24. Then it is adopted as the basic principle of Japan's national standard (Watanabe *et al*, 1956). The regulation of the Register of Shipping of the USSR (1961) also assumes initial windward roll angle as shown in figure 24. The current IMO weather criterion of chapter 2.3 of the IS Code, part A, utilizes the energy balance method adopted in Japan without major modification. Here we assume that a ship with a steady heel angle due to steady wind has a resonant roll motion in beam waves. Then, as a worst case, the ship is assumed to suffer gusty wind when she rolls toward windward. In the case of the resonant roll, roll damping moment and wave exciting moment cancel out. Thus, the energy balance between restoring and wind heeling energy can be validated around the upright condition. Furthermore, at the final stage of capsizing, since no resonance mechanism exists near the angle of vanishing stability, the effect of wave exciting moment could be approximated to be small (Belenky, 1993).

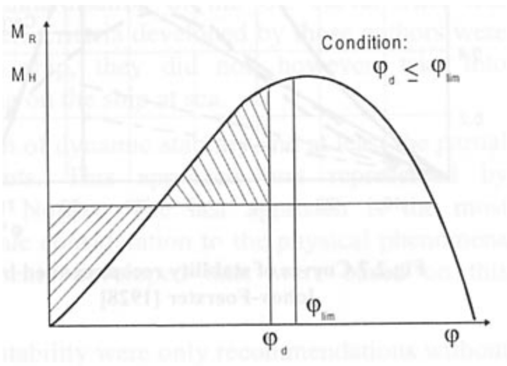

Figure 23 – Energy balance method used by Pierrottet (1935)

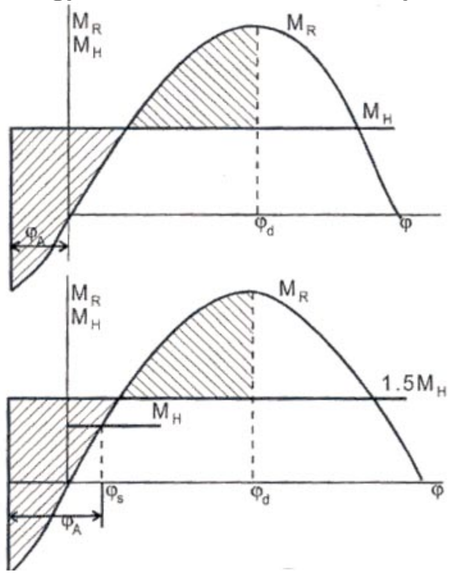

Figure 24 – Energy balance methods in standards of USSR (upper) and Japan (lower) (Kobylinski & Kastner, 2003)

3.5.3 *Wind heeling moment*

3.5.3.1 In the Japanese standard the steady heeling moment, M_w, is expressed as follows:

$$M_W = \frac{1}{2}\rho C_D A H_0 (H / H_0) V_w^{\ 2} \qquad (1)$$

where:

ρ = air density
C_D = drag coefficient
A = lateral windage area above water surface
H = heeling lever
H_0 = vertical distance from centre of lateral windage area to a point at one half the mean draught
V_w = wind velocity

3.5.3.2 Values of C_D obtained from experiments of passenger ships and train ferries ranges from 0.95 to 1.28. In addition, a wind tunnel test for a domestic passenger ship (Okada, 1952) shows that H/H_0 is about 1.2. Considering these data, the value of $C_D(H/H_0)$ was assumed to be 1.22 on average. These formula and coefficients were adopted also at IMO.

3.5.3.3 To represent fluctuating wind, gustiness should be determined. Figure 25 shows the ratio of gustiness measured in various stormy conditions. (Watanabe *et al*, 1955). Here the maximum is 1.7 and the average is $\sqrt{1.5}(\approx 1.23)$. However, these were measured for about 2 hours of duration but capsize could happen within half the roll natural period, say 3 to 8 seconds. In addition, reaction force could act on centre of ship mass because of such short duration. Therefore, in place of the maximum value, the average value of figure 25 is adopted. This results in 1.5 as heeling lever ratio for gustiness as shown in the 2008 IS Code.

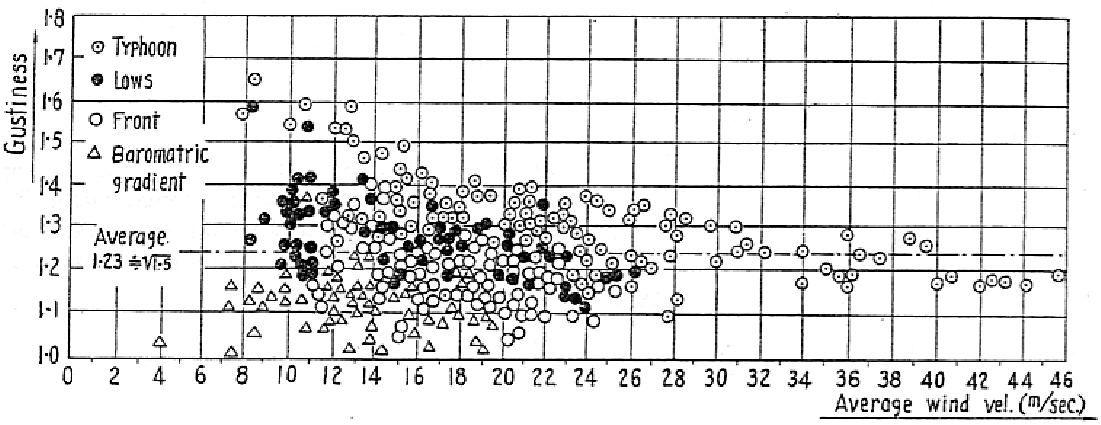

Figure 25 – Gustiness of measured sea wind (Watanabe *et al*, 1956)

3.5.4 *Roll angle in waves (Japanese Method)*

In general, ship motion consists of surge, sway, heave, roll, pitch and yaw. In beam seas, however, only sway, heave and roll are dominant. Furthermore, the effect of heave on roll is negligibly small and coupling from sway to roll can be cancelled with roll diffraction moment (Tasai & Takagi, 1969). Therefore, the roll motion can be modelled without coupling from other motion modes if the wave exciting moment is estimated without wave diffraction. Consequently, considering nonlinear roll damping effect is taken into account, the amplitude of resonant roll in regular beam waves, Φ (degrees), can be obtained as follows:

$$\phi = \sqrt{\frac{\pi r \Theta}{2N(\phi)}} \qquad (2)$$

where:

$\Theta(=180s)$	=	maximum wave slope (degrees)
s	=	wave steepness
r	=	effective wave slope coefficient
N	=	Bertin's roll damping coefficient as a function of roll amplitude.

3.5.4.1 *Wave steepness*

Based on observations at sea, Sverudrup and Munk (1947) published a relationship between wave age and wave steepness as shown in figure 26. Here the wave age is defined with the ratio of wave phase velocity, u, to wind velocity, v, and wave height, H_w, means significant wave height. If we use the dispersion relationship of water waves, $u = \frac{gT}{2\pi}$, this diagram can be converted to that with wave period, T, as shown in figure 27. Further, since the ship suffers a resonant roll motion, the wave period could be assumed to be equal to the ship natural roll period. Here it is noteworthy that the obtained wave steepness is a function of roll period and wind velocity. In addition, because of possible spectrum of ocean waves, regions for the maximum and minimum steepness are modified from the original data.

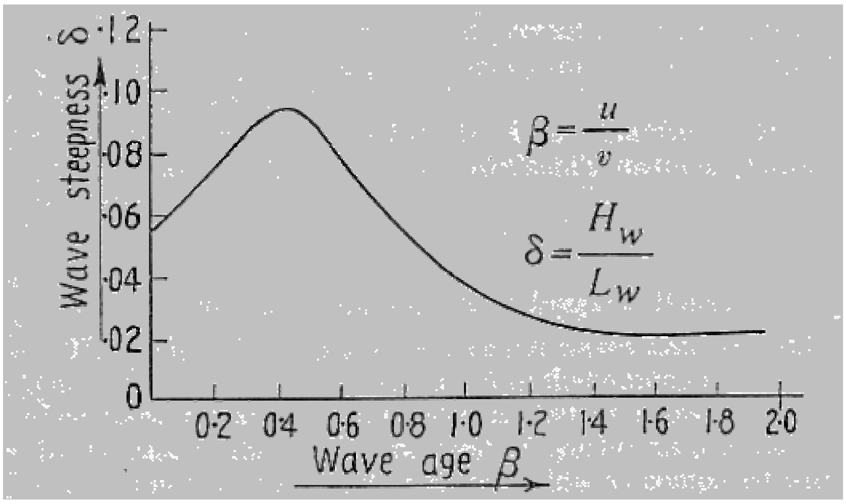

Figure 26 – Relationship between wave age and wave steepness (Sverdrup & Munk, 1947)

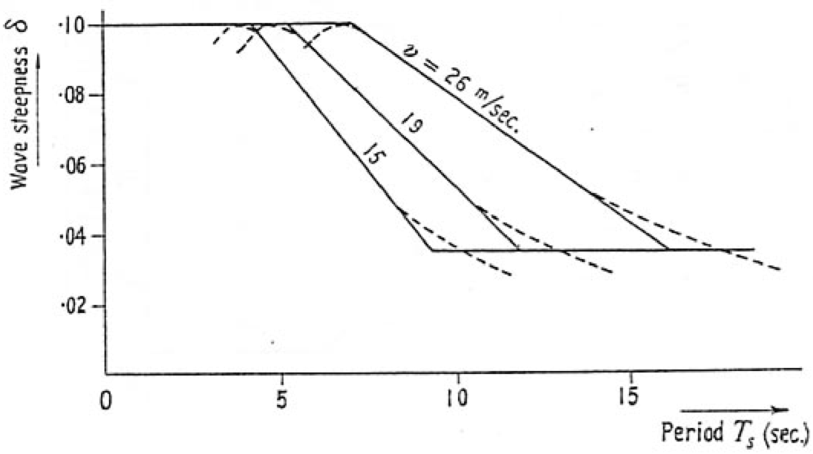

Figure 27 – Relationship between roll period and wave steepness in Japanese criterion (Yamagata, 1959)

3.5.4.2 *Hydrodynamic coefficients*

For using Equation (2), it is necessary to estimate the values of *r* and *N*. Since we should estimate wave exciting moment without wave diffraction due to a ship, it can be obtained by integrating undisturbed water pressure over the hull under calm water surface. Watanabe (1938) applied this method to several ships and developed an empirical formula, which is a function of wave length, VCG, GM, breadth, draught, block coefficient and water plane area coefficient. For simplicity sake, it is further simplified for 60 actual ships only as a function of VCG and draught shown in figure 28. The formula used in the IMO weather criterion for *r* was obtained by this procedure.

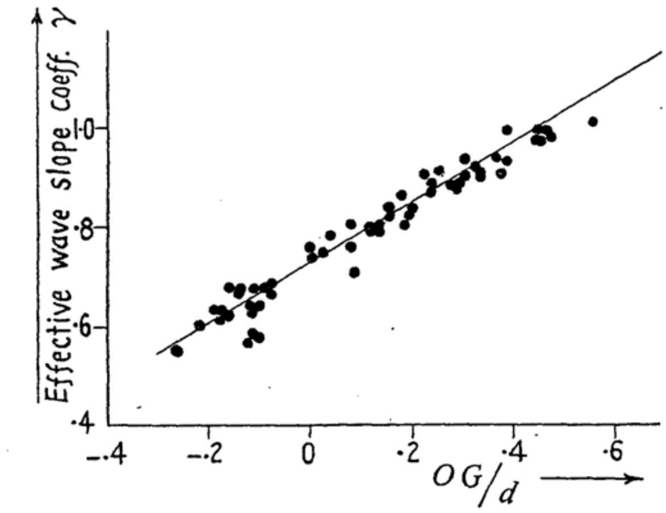

Figure 28 – Effective wave slope coefficient: measurements (circles) and estimation (solid line) (Yamagata, 1959)

For estimating the *N* coefficient, several empirical formulae were available. However, in the Japanese stability standards, *N*=0.02 is recommended for a ship having bilge keels at the roll angle of 20°. Some evidence of this value can be found in figure 29 (Motora, 1957).

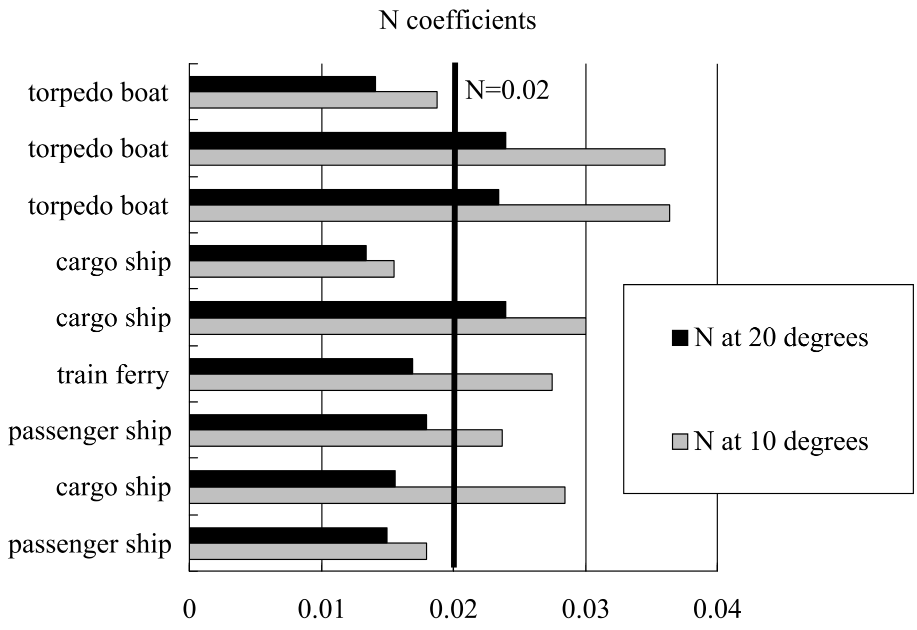

Figure 29 – Example of *N* coefficients measured in model experiments

3.5.4.3 *Natural roll period*

For calculating the wave steepness, it is necessary to estimate the natural roll period for a subject ship. In the Japanese standard, the value measured with the actual ship is corrected with Kato's empirical formula (Kato, 1956). However, at the STAB Sub-Committee, this procedure was regarded as tedious and Japan was requested to develop a simple and updated empirical formula for the roll period. Thus the current formula was statistically developed by Morita, and is based on data measured from 71 full-scaled ships in 1982. As shown in figure 30, all sampled data exist within ±7.5% of error from Morita's formula. More precisely, the standard deviation of the error from the formula is 1.9%. Furthermore, sensitivity analysis of C on required GM indicated that even 20% error of C estimation results in only 0.04 m error of required GM calculation. Therefore, IMO concluded that this formula can be used for weather criteria.

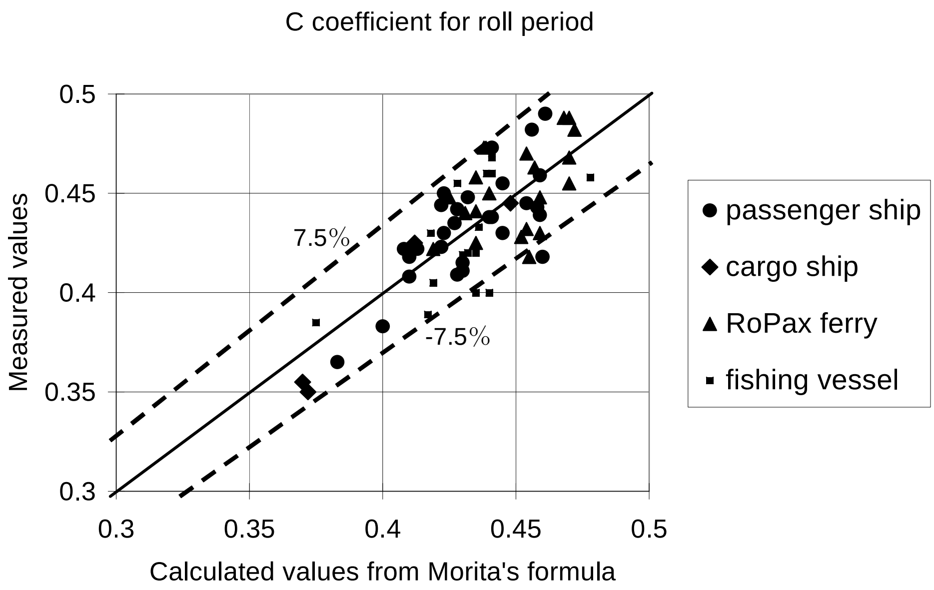

Figure 30 – Estimation accuracy for empirical formula for roll period

3.5.4.4 *Wave randomness*

While the wave steepness obtained from Sverdrup-Munk's diagram is defined by the significant wave height in irregular waves, the resonant roll amplitude given by Equation (2) is formulated for regular waves. For filling the gap between two, the roll amplitude in irregular waves whose significant wave height and mean wave period are equal to height and period of regular waves was compared with the resonant roll amplitude in the regular waves. As shown in figure 31, if we focus the maximum amplitude out of 20 to 50 roll cycles, an obtained reduction factor is 0.7.

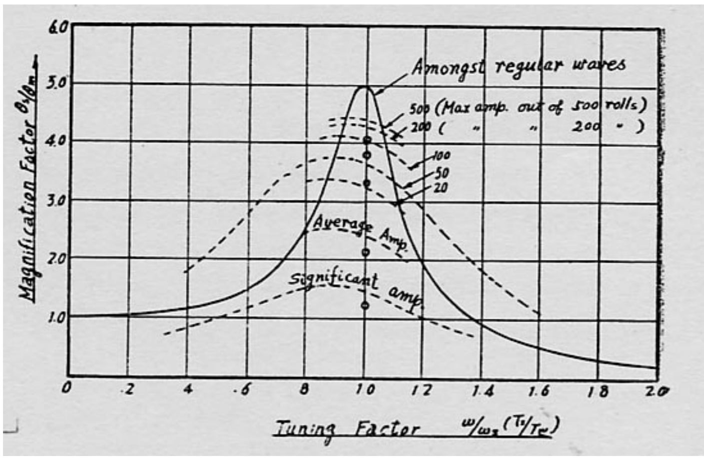

Figure 31 – Comparison of roll amplitude in regular and irregular waves (Watanabe *et al*, 1956)

3.5.4.5 *Steady wind velocity*

As explained above, the Japanese weather criterion introduced probabilistic assumptions for determining gust and roll in irregular waves. These make final probabilistic safety level unclear. Possible estimation error for wind heel lever coefficient, roll damping coefficient, effective wave slope coefficient, natural roll period and wave steepness added uncertainty to the required safety level. Therefore, Japan carried out test calculations for 50 ships, which include 13 ocean going ships as shown in figure 32. Based on these calculated outcomes, the steady wind velocity was determined to distinguish ships having insufficient stability from other ships. In other words, for ships having insufficient stability the energy balance should not be obtained with the above procedure. As a result, the wind velocity for ocean going ships is determined as 26 m/s. Here a sunken torpedo boat (0-12-I), a sunken destroyer (0-13) and three passenger ships having insufficient stability (0-3, 7, and 9) are categorized as unsafe and 2 cargo ships, 3 passenger ships and 3 larger passenger ships are done as safe. It is noteworthy here that 26 m/s of wind velocity is only obtained from casualty statistics for ships and is not directly obtained from actual wind statistics. IMO also adopted 26 m/s as critical wind velocity. If we substitute V_w=26 m/s to Equation (1), the wind pressure in the current IS Code is obtained.

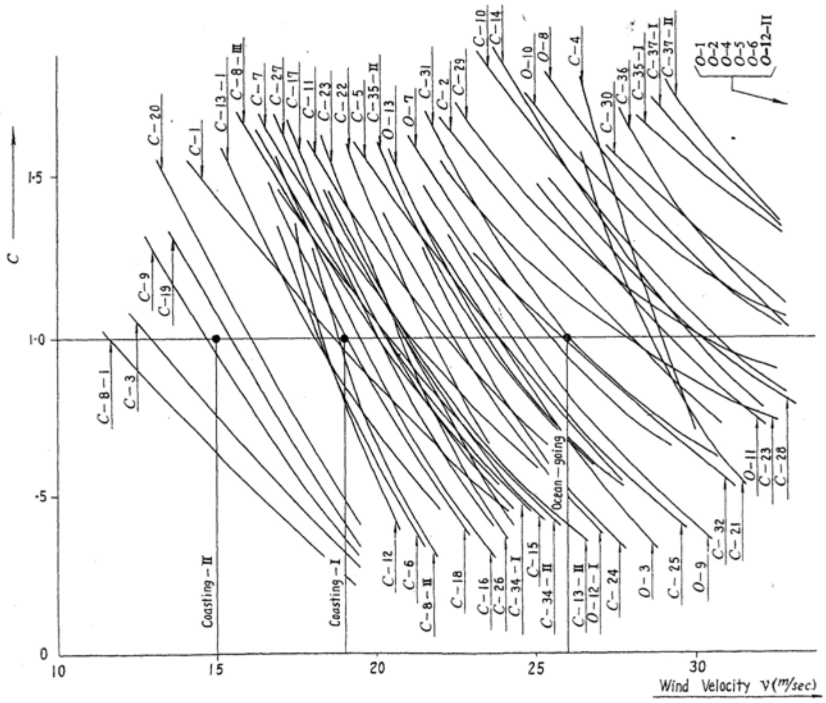

Figure 32 – Results of test calculations for determining steady wind velocity. Relation between wind velocity and the b/a factor for various sample ships (Watanabe *et al*, 1956)

3.5.4.6 *Rolling in waves (USSR's method)*

In the stability standard of USSR (USSR, 1961), the maximum roll amplitude of 50 roll cycles is estimated as follows:

$$\phi_R = kX_1X_2\varphi_A \qquad (3)$$

Here k is a function of bilge keel area, X_1 is a function of B/d, X_2 is a function of the block coefficient and ϕ_A is roll amplitude of the standard ship, which is shown in figure 33. This formula was developed by systematic calculations for a series of ships utilizing the transfer function and wave spectrum (Kobylinski & Kastner, 2003).

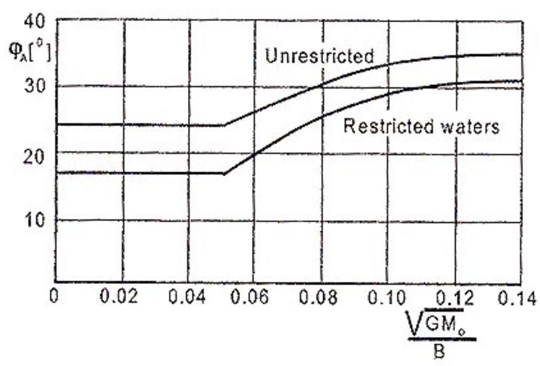

Figure 33 – Standard roll amplitude in USSR's criterion (USSR, 1961)

As mentioned earlier, IMO decided to partly use this USSR's roll formula together with the Japanese criterion. This is because the USSR's formula depends on hull forms for estimating roll damping while the Japanese does not. The proposed formula is as follows:

$$\phi_1(\deg rees) = C_{JR} k X_1 X_2 \sqrt{rs} \qquad (4)$$

Here C_{JR} is a tuning factor for keeping the safety level of the new criterion as the same as the Japanese domestic standard. To determine this factor, member states of a working group of STAB Sub-Committee executed test calculations of Japanese and new formulations for many ships. For example, Japan (1982) executed test calculation for 58 ships out of 8,825 Japanese flagged-ships larger than 100 gross tonnage in 1980. These include 11 cargo ships, 10 oil tankers, 2 chemical tankers, 5 liquid gas carriers, 4 container ships, 4 car carriers, 5 tug boats and 17 passenger or RoPax ships. As a result, IMO concluded that C_{JR} should be 109.

3.6 References relating to paragraph 3.5

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CHAPTER 4 – GUIDANCE FOR THE APPLICATION OF THE 2008 IS CODE

4.1 Criteria regarding righting lever curve properties

For certain ships the requirement contained in paragraph 2.2.3 of part A of the Code may not be practicable. Such ships are typically of wide beam and small depth, indicatively $B/D \geq 2.5$. For such ships Administrations may apply the following alternative criteria:

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

.2 the area under the curve of righting levers (GZ curve) should not be less than 0.070 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:

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

***

* φ_{max} is the angle of heel in degrees at which the righting lever curve reaches its maximum.

ANNEX 6

JUSTIFICATION FOR EXPANDING THE SCOPE OF THE WORK PROGRAMME ITEM ON "SAFETY OF SMALL FISHING VESSELS"

1 Scope of the proposal

Prepare practical guidelines to assist Competent Authorities which elect to introduce related safety provisions (the Code of Safety for Fishermen and Fishing Vessels, 2005, part B, the Voluntary Guidelines for the Design, Construction and Equipment of Small Fishing Vessels, 2005 (Voluntary Guidelines) and the Safety recommendations for decked fishing vessels of less than 12 metres in length and undecked fishing vessels) into their domestic legislation and/or codes of safe practice, or other measures in consultation with all stakeholders in the industry. When developing the guidelines, consideration should be given to ensuring consistency with other related international instruments and guidance.

2 Need

An expansion of the work programme item is necessary to enable the Sub-Committee to:

.1 ensure that the ongoing technological developments related to safety issues for fishing vessels can be used by those Member States that require guidance relating to this matter;

.2 provide specific guidance to Competent Authorities on all safety- and health-related measures. These guidelines should promote co-ordination between inspection services, maritime and fisheries Administrations and other departments of governments; and

.3 ensure that all stakeholders in the industry are consulted and fully informed by the Competent Authority during the development and implementation phases in relation to new safety legislation for fishing vessels and/or in the development of codes of safe practice or other measures.

3 Analysis of the issues involved, having regard to the costs to the maritime industry and global legislative and administrative burdens

Since the expected guidelines are non-mandatory ones to assist Administrations, there will not be costs to the fishing industry and legislative or administrative burdens.

4 Benefits

Injuries and losses of lives of fishermen will be reduced by effectively implementing internationally agreed safety provisions and recommendations at the national level. In addition, the cost in research undertaken and time used by Competent Authorities in preparation for the effective implementation of such provisions and recommendations would be greatly reduced by providing such guidelines.

5 Priority and target completion date

It is expected that three sessions will be needed to deal with this matter. It should be considered at SLF 51, with a target completion date of 2010.

6 Specific indication of the action required

Develop guidelines to assist Competent Authorities in implementing the Safety recommendations, part B of the Fishing Vessels Safety Code and the Voluntary Guidelines.

7 Remarks on the criteria for general acceptance

.1 Is the subject of the proposal within the scope of IMO's objectives? Yes

.2 How is the proposed item related to the scope of the Strategic plan for the Organization and fits into the High-level action plan? Strategic directions (3.2.1.2) and High-level action plan (5.2.1)

.3 Do adequate industry standards exist? No

.4 Do the benefits justify the proposed action? Yes

8 Identification of which subsidiary bodies are essential to complete the work

The work should be accomplished by the SLF Sub-Committee, in co-operation with other sub-committees, as appropriate.

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ANNEX 7

DRAFT MSC RESOLUTION

RECOMMENDATION ON A STANDARD METHOD FOR EVALUATING CROSS-FLOODING ARRANGEMENTS

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.266(VIII) entitled "Recommendation on a standard method for establishing compliance with the requirements for cross-flooding arrangements in passenger ships", adopted by the Assembly at its eighth session,

NOTING that the above Recommendation does not include provisions for cross-flooding arrangements other than pipes (i.e., cross-flooding times through ducts) or a provision to ensure adequate air ventilation for efficient cross-flooding (i.e., to account for the restrictive effect of air counter pressure during cross-flooding),

NOTING ALSO the revised SOLAS chapter II-1 subdivision and damage stability requirements for passenger and cargo ships, adopted by resolution MSC.216(82),

RECOGNIZING the need to establish a methodology for evaluating cross-flooding arrangements on ships subject to the applicable subdivision and damage stability requirements of SOLAS chapter II-1 to ensure uniform treatment of cross-flooding and equalization arrangements,

HAVING CONSIDERED the recommendations made by the Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety at its fiftieth session,

1. ADOPTS the Recommendation on a standard method for evaluating cross-flooding arrangements, the text of which is set out in the Annex to the present resolution;

2. INVITES Governments to apply the annexed Recommendation to cross-flooding calculations and to bring the Recommendation to the attention of all parties concerned.

ANNEX

RECOMMENDATION ON A STANDARD METHOD FOR EVALUATING CROSS-FLOODING ARRANGEMENTS

Table of contents **Page**

1 Definitions

$\sum k$: Sum of friction coefficients in the considered cross-flooding arrangement.

$S\left(m^2\right)$: Cross-section area of the cross-flooding pipe or duct. If the cross-section area is not circular, then:

$$S_{equiv} = \frac{\pi \cdot D_{equiv}^2}{4}$$

where:

$$D_{equiv} = \frac{4 \cdot A}{p}$$

A = actual cross-section area

p = actual cross-section perimeter

$\theta_0\left(°\right)$: Angle before commencement of cross-flooding. This assumes that the cross-flooding device is fully flooded but that no water has entered into the equalizing compartment on the opposite side of the damage (see appendix 1).

$\theta_f\left(°\right)$: Heel angle at final equilibrium ($\theta_f \leq \theta$).

$\theta\left(°\right)$: Any angle of heel between the commencement of cross-flooding and the final equilibrium at a given time.

$W_f\left(m^3\right)$: Volume of water which is used to bring the ship from commencement of cross-flooding θ_0 to final equilibrium θ_f.

$W_\theta\left(m^3\right)$: Volume of water which is used to bring the ship from any angle of heel θ to the final equilibrium θ_f.

$H_0\left(m\right)$: Head of water before commencement of cross-flooding, with the same assumption as for θ_0.

$H_\theta\left(m\right)$: Head of water when any angle of heel θ is achieved.

$h_f\left(m\right)$: Final head of water after cross-flooding ($h_f = 0$, when the level inside the equalizing compartment is equal to the free level of the sea).

2 Formulae

2.1 Time required from commencement of cross-flooding θ_0 to the final equilibrium θ_f:

$$T_f = \frac{2W_f}{S \cdot F} \cdot \frac{\left(1 - \sqrt{\frac{h_f}{H_0}}\right)}{\sqrt{2gH_0}} \cdot \frac{1}{\left(1 - \frac{h_f}{H_0}\right)}$$

2.2 Time required to bring the ship from any angle of heel θ to the final equilibrium θ_f:

$$T_\theta = \frac{2W_\theta}{S \cdot F} \cdot \frac{\left(1 - \sqrt{\frac{h_f}{H_\theta}}\right)}{\sqrt{2gH_\theta}} \cdot \frac{1}{\left(1 - \frac{h_f}{H_\theta}\right)}$$

2.3 Time required from commencement of cross-flooding θ_0 until any angle of heel θ is achieved:

$$T = T_f - T_\theta$$

2.4 Dimensionless factor of reduction of speed through an equalization device, being a function of bends, valves, etc., in the cross-flooding system:

$$F = \frac{1}{\sqrt{\sum k}}$$

where F is not to be taken as more than 1.

Values for k can be obtained from appendix 2 or other appropriate sources.

2.5 Cross-flooding through successive devices of different cross-section:

If the same flow crosses successive flooding devices of cross-section S_1, S_2, S_3… having corresponding friction coefficients k_1, k_2, k_3…, then the total k coefficient referred to S_1 is:

$$\Sigma k = k_1 + k_2 \cdot S_1^2 / S_2^2 + k_3 \cdot S_1^2 / S_3^2 \ldots$$

2.6 If different flooding devices are not crossed by the same volume, each k coefficient should be multiplied by the square of the ratio of the volume crossing the device and the volume crossing the reference section (which will be used for the time calculation):

$$\Sigma k = k_1 + k_2 \cdot S_1^2 / S_2^2 \cdot W_2^2 / W_1^2 + k_3 \cdot S_1^2 / S_3^2 \cdot W_3^2 / W_1^2 \ldots$$

2.7 For cross-flooding through devices in parallel that lead to the same space, equalisation time should be calculated assuming that:

$$S \cdot F = S_1 \cdot F_1 + S_2 \cdot F_2 + \ldots$$

with $F = 1/\sqrt{\Sigma k}$ for each device of cross-section S_i

3 Air pipe venting criteria

3.1 In arrangements where the total air pipe sectional area is 10% or more of the cross-flooding sectional area, the restrictive effect of any air back pressure may be neglected in the cross-flooding calculations. The air pipe sectional area should be taken as the minimum or the net sectional area of any automatic closing devices, if that is less.

3.2 In arrangements where the total air pipe sectional area is less than 10% of the cross-flooding sectional area, the restrictive effect of air back pressure should be considered in the cross-flooding calculations. The following method may be used for this purpose:

The k coefficient used in the calculation of cross-flooding time should take into account the drop of head in the air pipe. This can be done using an equivalent coefficient k_e, which is calculated according to the following formula:

$$k_e = k_w + k_a \cdot (\rho_a/\rho_w) \cdot (S_w/S_a)^2$$

where:

k_w	=	k coefficient for the cross-flooding arrangement (water)
k_a	=	k coefficient for the air pipe
ρ_a	=	air density
ρ_w	=	water density
S_w	=	cross-section area of the cross-flooding device (water)
S_a	=	cross-section of air pipe

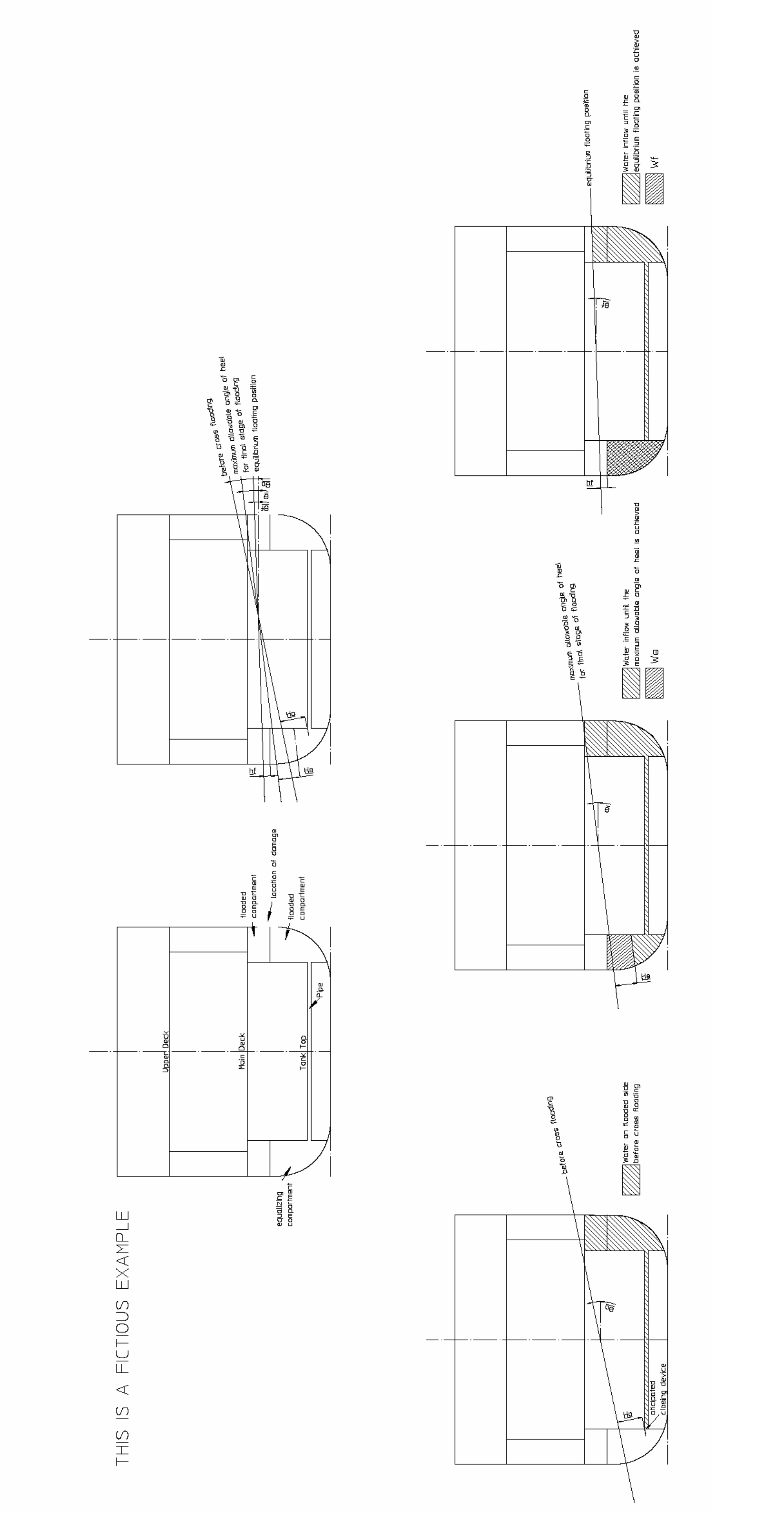
4 Alternatives

As an alternative to the provisions in sections 2 and 3, and for arrangements other than those shown in appendix 2, direct calculation using computational fluid dynamics (CFD), time-domain simulations or model testing may also be used.

APPENDIX 1

EXAMPLE FOR TREATMENT OF HEEL ANGLES AND WATER HEADS AT DIFFERENT STAGES OF CROSS-FLOODING

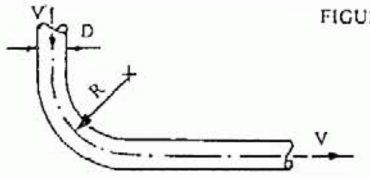
Figure 1



APPENDIX 2

FRICTION COEFFICIENTS IN CROSS-FLOODING ARRANGEMENT

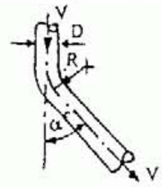
FIGURE 2



R/D	2	3	4	5	6	7
k	.30	.26	.23	.20	.18	.17

90° CIRCULAR BEND

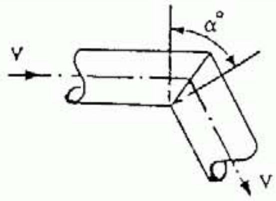
FIGURE 3



α°	15	30	45	60	75	90
k	.06	.12	.18	.24	.27	.30

RADIUS BEND R/D = 2

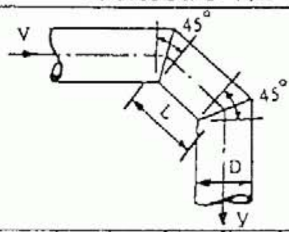
FIGURE 4



α°	5	15	30	45	60	90
k	.02	.06	.17	.32	.68	1.26

MITRE BEND

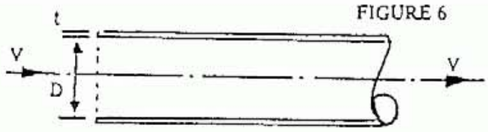
FIGURE 5



L/D	1	2	3	4	5	6
k	.41	.40	.43	.46	.46	.44

90° DOUBLE MITRE BEND

FIGURE 6



t/D	.01	.02	.03	.04	.05	>.05
k	.83	.68	.53	.46	.44	.43

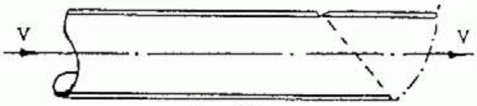
PIPE INLET

FIGURE 7

k = 1.0

PIPE OUTLET

FIGURE 8



k = 0.5

The value of k actually increases with decrease in Froude number, particularly below speeds of 2 m/sec.

NON-RETURN VALVE

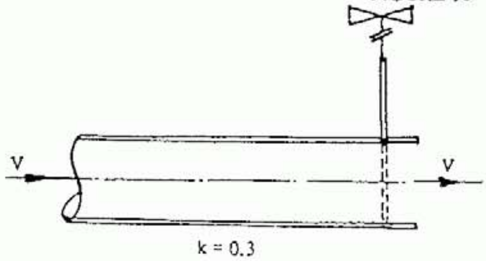
FIGURE 9

$$k = \frac{0.02}{D} \text{ per unit length}$$

The coefficient above is a mean value and does in fact vary as Reynold's number (i.e. varies with V for constant D and ν) as well as with relative roughness.

PIPE FRICTION LOSSES

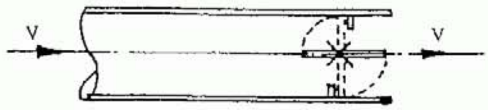
FIGURE 10



k = 0.3

GATE VALVE

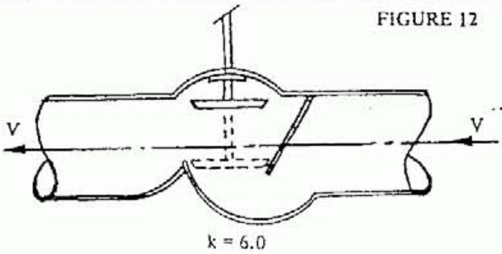
FIGURE 11



k = 0.8

BUTTERFLY VALVE

FIGURE 12



k = 6.0

DISC VALVE

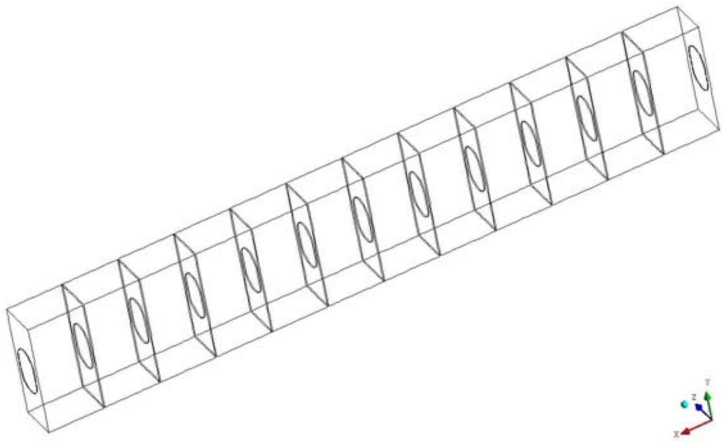
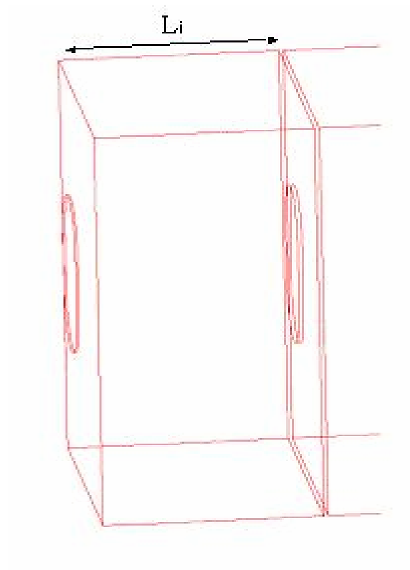


Figure 13
Cross-flooding through a series of structural ducts with 1 manhole

$$k = 0.2748 \cdot L_i + 0.0313 \qquad if \quad 0 < L_i < 1$$
$$k = -0.0986 \cdot L_i^3 + 0.6873 \cdot L_i^2 - 1.0212 \cdot L_i + 0.7386 \qquad if \quad 1 \le L_i \le 4$$
$$k = 1.34 \qquad if \quad L_i > 4$$

Note: k is the friction coefficient related to each space between two adjacent girders. k is evaluated with effective cross-section area therefore in calculations use the real cross-section area A and not S_{equiv}. The pressure loss for entrance in the first manhole is already computed in the calculation, and k = 1 has to be added to take into account the outlet losses.



L_i (in metres)

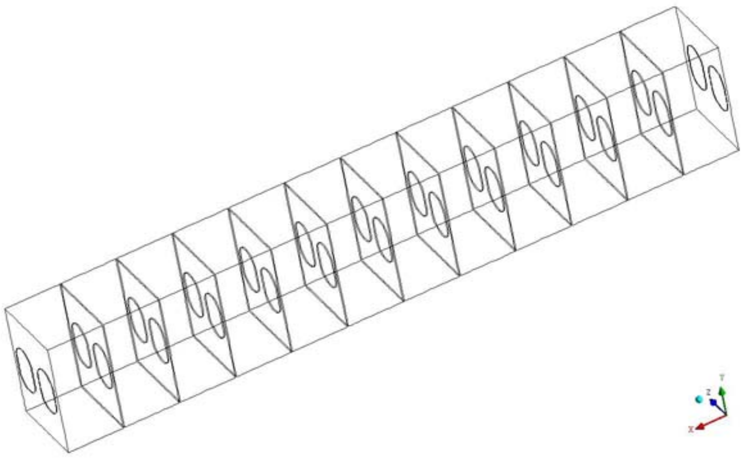


Figure 14
Cross-flooding through a series of structural ducts with 2 manholes

$$k = 0.4045 \cdot L_i + 0.0627 \qquad if \quad 0 < L_i < 1$$
$$k = 0.0424 \cdot L_i^3 - 0.3593 \cdot L_i^2 + 1.1401 \cdot L_i - 0.356 \qquad if \quad 1 \le L_i \le 4$$
$$k = 1.17 \qquad if \quad L_i > 4$$

Note: k is the friction coefficient related to each space between two adjacent girders. k is evaluated with effective cross-section area therefore in calculations use the real cross-section area A and not S_{equiv}. The pressure loss for entrance in the first manhole is already computed in the calculation, and k = 1 has to be added to take into account the outlet losses.

APPENDIX 3

EXAMPLE USING FIGURES FOR A PASSENGER SHIP

Dimension of the considered cross-flooding pipe:

Diameter	$D = 0.39\ m$
Length	$l = 21.0\ m$
Cross-section area	$S = 0.12\ m^2$
Wall thickness	$t = 17.5\ mm$

k-values for the considered cross-flooding system:

Inlet	0.45
Pipe friction $\frac{0.02l}{D}$	1.08
2 radius bends ($\alpha = 45°$)	0.36
Non-return valve	0.50
Outlet	1.00
	$\sum k = 3.39$

Sufficient air venting is assumed to be in place.

From this follows:

$$F = \frac{1}{\sqrt{\sum k}}$$

$$F = \frac{1}{\sqrt{3.39}} = 0.54$$

Time required from commencement of cross flooding θ_o to the final equilibrium condition θ_f:

$$T_f = \frac{2W_f}{S \cdot F} \cdot \frac{\left(1 - \sqrt{\frac{h_f}{H_0}}\right)}{\sqrt{2gH_0}} \cdot \frac{1}{\left(1 - \frac{h_f}{H_0}\right)}$$

Head of water before commencement of cross-flooding:

$$H_0 = 5.3m$$

Volume of water which is used to bring the ship from commencement of cross-flooding to the final equilibrium condition:

$$W_f = 365m^3$$

Final head of water after cross-flooding:

$$h_f = 1.5m$$

$$T_f = \frac{2 \cdot 365m^3}{0.12m^2 \cdot 0.54} \cdot \frac{\left(1 - \sqrt{\frac{1.5m}{5.3m}}\right)}{\sqrt{2 \cdot 9.81 \, {}^{m}\!/_{s^2} \cdot 5.3m}} \cdot \frac{1}{\left(1 - \frac{1.5m}{5.3m}\right)}$$

$$T_f = 721s = 12.0 \min$$

Time required to bring the vessel from the maximum allowable angle of heel for final stage of flooding θ to the final equilibrium condition θ_f:

$$T_\theta = \frac{2W_\theta}{S * F} \cdot \frac{\left(1 - \sqrt{\frac{h_f}{H_\theta}}\right)}{\sqrt{2gH_\theta}} \cdot \frac{1}{\left(1 - \frac{h_f}{H_\theta}\right)}$$

Maximum allowable angle of heel for final stage of flooding $\theta = 7°$

Head of water when the maximum allowable angle of heel for final stage of flooding is achieved $H_\theta = 3.7m$

Volume of water which is used to bring the vessel from the maximum allowable angle of heel for final stage of flooding to the final equilibrium condition $W_\theta = 160m^3$

$$T_\theta = \frac{2 \cdot 160m^3}{0.12m^2 \cdot 0.54} \cdot \frac{\left(1 - \sqrt{\frac{1.5m}{3.7m}}\right)}{\sqrt{2 \cdot 9.81 \, {}^{m}\!/_{s^2} \cdot 3.7m}} \cdot \frac{1}{\left(1 - \frac{1.5m}{3.7m}\right)}$$

$$T_\theta = 354s = 5.9 \min$$

Time required from commencement of cross-flooding θ_o until the maximum allowable angle of heel for final stage of flooding θ is achieved:

$T = T_f - T_\theta$ = 12.0 min – 5.9 min = 6.1 min

***

ANNEX 8

DRAFT MSC CIRCULAR

INTERPRETATION OF ALTERATIONS AND MODIFICATIONS OF A MAJOR CHARACTER

1 The Maritime Safety Committee, at its sixty-third session (16 to 25 May 1994), noted that the Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety (SLF), in considering a definition of the term "modification of a major character" in the context of chapter II-1 of the 1974 SOLAS Convention, had decided that it should be sufficient to relate the modification, whatever its nature and extent, to its effect on the level of subdivision of the ship. The Committee, therefore, agreed to the following interpretation of alterations and modifications of a major character proposed by the SLF Sub-Committee:

> "Where an existing cargo ship is subject to any modification which affects the level of subdivision of that ship, it should be demonstrated that the A/R ratio calculated for the ship after such modifications is not less than the A/R ratio calculated for the ship before the modification. However, in those cases where the ship's A/R ratio before modification is equal to or greater than unity, it is only necessary to demonstrate that the ship after such modification has an 'A' value which is not less than 'R', calculated for the modified ship."

2 The Maritime Safety Committee, at its [eighty-third session (3 to 12 October 2007)], considered a definition of the term "existing cargo ship" in the context of the above interpretation and, following a proposal by the SLF Sub-Committee at its fiftieth session, agreed that, in the context of this circular, an existing cargo ship means:

.1 a cargo ship constructed before 1 February 1992, regardless of length; and

.2 a cargo ship constructed before 1 July 1998, below or equal to 100 m in length.

3 Notwithstanding the above, a cargo ship should not be considered an existing cargo ship if it was:

.1 constructed between 1 February 1992 and 30 June 1998, and lengthened from below to above 100 m;

.2 constructed on or after 1 July 1998.

4 Member Governments are invited to take account of the above interpretation when applying the relevant provisions of chapter II-1 of the 1974 SOLAS Convention.

5 This circular supersedes MSC/Circ.650.

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ANNEX 9

DRAFT REVISED WORK PROGRAMME OF THE SUB-COMMITTEE AND PROVISIONAL AGENDA FOR SLF 51

DRAFT REVISED WORK PROGRAMME OF THE SUB-COMMITTEE

		Target completion date/number of sessions needed for completion	Reference
1	Analysis of intact stability casualty records	Continuous	MSC 70/23, paragraph 20.4; SLF 30/18, paragraphs 4.16 and 4.17
2	Analysis of damage cards	Continuous	MSC 70/23, paragraph 20.4 ; SLF 50/19, section 12
3	**Consideration of IACS unified interpretations**	Continuous	MSC 78/26, paragraph 22.12
H.1	**Development of explanatory notes for harmonized SOLAS chapter II-1**	2008	MSC 69/22, paragraph 20.60.1; ~~SLF 49/17, section 3~~ SLF 50/19, section 3
H.2	**Safety of small fishing vessels** (in co-operation with DE, COMSAR, FP, NAV and STW, as necessary)	~~2009~~ 2010	MSC 79/23, paragraphs 11.15 and 20.32; ~~SLF 49/17, section 6~~ SLF 50/19, section 5
H.3	**Revision of the Intact Stability Code**	~~2007~~ 2010	SLF 41/18, paragraph 3.14; ~~SLF 49/17, section 5~~ SLF 50/19, section 4

Notes: 1 "H" means a high priority item and "L" means a low priority item. However, within the high and low priority groups, items have not been listed in any order of priority.

2 Struck-out text indicates proposed deletions and the shaded text shows proposed additions or changes.

3 Items printed in bold letters have been selected for inclusion in the provisional agenda for SLF 51.

		Target completion date/number of sessions needed for completion	**Reference**
~~H.4~~	~~Review of the SPS Code~~ ~~(co-ordinated by DE)~~	~~2007~~	~~MSC 78/26, paragraph 24.9;~~ ~~SLF 49/17, section 11~~
~~H.5~~ H.4	**Development of options to improve effect on ship design and safety of the 1969 TM Convention**	2008	MSC 81/25, paragraph 23.53; SLF 50/19, section 6
~~H.6~~ H.5	**Guidelines for uniform operating limitations on high-speed craft** (co-ordinated by DE)	2008	MSC 81/25, paragraph 23.45; SLF 50/19, section 7
~~H.7~~ H.6	**Time-dependent survivability of passenger ships in damaged condition**	2009	MSC 81/25, paragraph 23.54; ~~SLF 49/17, section 14~~ SLF 50/19, section 8
~~H.8~~	~~**Interpretation of alterations and modifications of a major character under the revised SOLAS chapter II-1**~~	~~2007~~	~~SLF 49/17, section 13;~~ ~~MSC 82/24, paragraph 21.56;~~
~~H.9~~ H.7	**Guidance on the impact of open watertight doors on existing and new ship survivability**	2008	~~SLF 49/17, section 3;~~ MSC 82/24, paragraph 21.56; SLF 50/19, section 15
~~H.10~~ H.8	**Stability and seakeeping characteristics of damaged passenger ships in a seaway when returning to port by own power or under tow**	2008	MSC 82/24, paragraph 21.57; SLF 50/19, section 8
~~L.1~~	~~**Revision of resolution A.266(VIII)**~~	~~2007~~	~~SLF 45/14, paragraphs 3.19 and 11.1.4.1;~~ ~~MSC 76/23, paragraph 20.50;~~ ~~SLF 49/17, section 9~~
~~L.2~~	~~**Revision of MSC/Circ.650**~~	~~2007~~	~~SLF 47/17, paragraph 3.8;~~ ~~SLF 49/17, section 13~~

DRAFT PROVISIONAL AGENDA FOR SLF 51*

Opening of the session

1 Adoption of the agenda

2 Decisions of other IMO bodies

3 Development of explanatory notes for harmonized SOLAS chapter II-1

4 Revision of the Intact Stability Code

5 Safety of small fishing vessels

6 Development of options to improve effect on ship design and safety of the 1969 TM Convention

7 Guidelines for uniform operating limitations on high-speed craft

8 Time-dependent survivability of passenger ships in damaged condition

9 Consideration of IACS unified interpretations

10 Guidance on the impact of open watertight doors on existing and new ship survivability

11 Stability and seakeeping characteristics of damaged passenger ships in a seaway when returning to port by own power or under tow

12 Work programme and agenda for SLF 52

13 Election of Chairman and Vice-Chairman for 2009

14 Any other business

15 Report to the Maritime Safety Committee

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* Agenda item numbers do not necessarily indicate priority.