GUIDELINES FOR STATUTORY IMPLEMENTATION

PART 6. STATUTORY

VOLUME 3
GUIDELINES ON INTACT STABILITY
2014 EDITION

BIRO KLASIFIKASI INDONESIA

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Foreword

This Guidelines is BKI technical publication that covers Society's provisions on intact stability and related to the context lied down in IACS UR L2 Intact stability - matter of class.

The developments of this Guidelines is intended to primarily serve as mandatory reference in applying intact stability requirements for ships prior to admission to BKI class.

This Guidelines contains the following 7 (seven) main sections and 1 (one) appendix:

Section 1	General
Section 2	General Criteria
Section 3	Special Criteria for Certain Types of Ships
Section 4	Guidance in preparing stability information
Section 5	Stability Calculations performed by Stability Instruments
Section 6	Icing considerations
Section 7	Determination of lightship parameters
Annex	Detailed guidance for the conduct of an inclining test

This Guidelines is to be used in conjunction with other applicable BKI Rules and Guidelines, codes and standards referenced therein. Special attention should be taken when applicable flag state requirements and national regulations exist, then relevant flag state and authority requirements prevail.

In order to BKI can apply the suitable provisions regarding this Guidelines, the detail of ship's service and operation which effect intact stability is to be filed as an addendum to the application for BKI classification service to be made by applicant (designer/builder/owner/operator/manager).

The following Guidelines come into force on January 1st, 2014

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Section 1
General

A. Application

1. The criteria stated under Section 2 of this part present a set of minimum requirements that shall apply to cargo[1] and passenger ships.

2. The criteria stated under Section 3 are special criteria for certain types of ships.

3. This Guideline contains intact stability criteria for the following types of ships and other marine vehicles of unless otherwise stated:

- cargo ships;
- cargo ships carrying timber deck cargoes;
- passenger ships;
- fishing vessels;
- special purpose ships;
- offshore supply vessels;
- mobile offshore drilling units;
- pontoons;
- cargo ships carrying containers on deck and containerships; and
- barges[2].

4. BKI may impose additional requirements regarding the design aspects of ships of novel design or ships not otherwise covered by the Guidelines.

5. BKI may make special requirement as instructed by flag-government of ship or the government of the sovereign nations in which the ships navigate.

6. Special consideration may be given to the ships registered for a restricted service.

B. Dynamic stability phenomena in waves

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

[1] For containerships of 100 m in length and over, provisions of Section 3, H may be applied as an alternative to the application ofSection 2, B. Offshore supply vessels and special purpose ships are not required to comply with provisions of Section 1, C. For offshore supply vessels, provisions of Section 3, I may be applied as an alternative to the application of Section 2, B. For special purpose ships, provisions of Section 3, J may be applied as an alternative to the application of Section 2, B.

[2] For barges, provisions of Section 3, G may be applied as an alternative to the application of Section 2, B and 2, C.

in seaways which may cause large roll angles and/or accelerations have been identified hereunder.

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.

2. Resonant roll in dead ship condition

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

3. Broaching and other manoeuvring related phenomena

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

C. Definitions

For the purpose of this Guideline the definitions given hereunder shall apply. For terms used, but not defined in this Guideline, the definitions as given in the International Convention for the Safety of Life at Sea (1974 SOLAS Convention) as amended shall apply.

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

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.

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.

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 International Convention for the Prevention of Pollution from Ship, 1973 as modified by the protocol 1978 (MARPOL Convention) when it is carrying a cargo or part cargo of oil in bulk.

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

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

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

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

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

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.

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.

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

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.

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

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

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:

8.5.1 *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;

8.5.2 *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

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

9. *High-speed craft* (HSC)[3] is a craft capable of a maximum speed, in metres per second (m/s), equal to or exceeding:

$$3.7 \times \nabla^{0.1667}$$

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

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

11. *Freeboard* is the distance between the assigned load line and freeboard deck[4].

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.

[3] The International Code of Safety for High-Speed Craft, 2000 (2000 HSC Code) was developed following a thorough revision of the International 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.

[4] 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.

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.

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.

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

16. *Pontoon* is considered to be normally:

16.1 non self-propelled;

16.2 unmanned;

16.3 carrying only deck cargo;

16.4 having a block coefficient of 0.9 or greater;

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

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

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.

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[5].

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

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.

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

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.

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

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.

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

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

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

27. *Barge* is considered to be normally:

27.1 non self-propelled;

27.2 unmanned;

27.3 having a block coefficient of 0.9 or greater;

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

27.5 having no hatchways in the deck except small watertight openings.

D. Marking of draughts

Every ship is to have scales of draughts marked clearly at the bow and the stern. In the case where the draught marks are not located where they are easily readable, or operational constraints for a particular trade make it difficult to read the draught marks, then the ship is to also be fitted with a reliable draught indicating system by which the bow and the stern draughts can be determined.

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Section 2
General Criteria

A. General

1. All criteria shall be applied for all conditions of loading as set out in Section 4, C and Section 4, D

2. Free surface effects (Section 4, A) shall be accounted for in all conditions of loading as set out in Section 4, C and Section 4, D.

3. Where anti-rolling devices are installed in a ship, BKI 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 Guidelines.

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

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 Section 6 - Icing considerations) and to losses of weight such as those due to consumption of fuel and stores.

6. Each ship shall be provided with an approved stability booklet, which contains sufficient information (see Section 4, F) to enable the master to operate the ship in compliance with the applicable requirements contained in the Guideline. 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 approval Section 5 - Stability calculations performed by stability instruments).

7. If curves or tables of minimum operational GM (metacentric height) or maximum VCG (centre of gravity) are used to ensure compliance with the relevant intact stability criteria those limiting curves shall extend over the full range of operational trims, unless BKI 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.

B. Criteria regarding righting lever curve properties

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

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

3. The maximum righting lever shall occur at an angle of heel not less than 25°. If this is not

[1] 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.

practicable, due such ships are typically of wide beam and small depth, indicatively B/D > 2.5, the following criteria may be applied[2],:

3.1. the maximum righting lever (GZ) shall accour at an angle of heel not less than 15°; and

3.2. the area under righting lever (GZ curve) shall 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 shall be:

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

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

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

C. Severe wind and rolling criterion (weather criterion)

1. The ability of a ship to withstand the combined effects of beam wind and rolling shall be demonstrated, with reference to the Fig. 2.1 as follows:

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

1.2. 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;

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

1.4. under these circumstances, area b shall be equal to or greater than area a, as indicated in fig. 2.1 below:

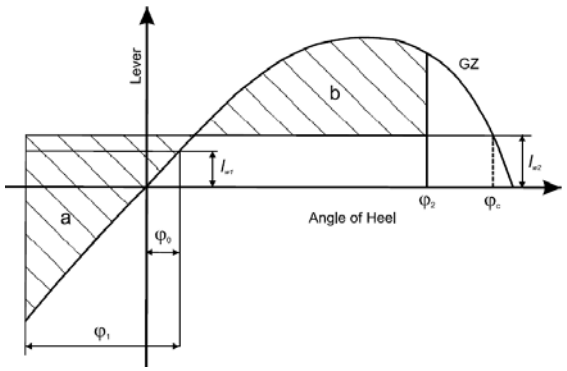

Fig. 2.1 – Severe wind and rolling

where the angles in fig. 2.1 are defined as follows:

φ_0 = angle of heel under action of steady wind

[2] Refer to the Explanatory Notes to the International Code on Intact Stability, 2008 (MSC.1/Circ.1281).

φ_1 = angle of roll to windward due to wave action (see C.1.2., C.4 and footnote 2)

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. The wind heeling levers l_{w1} and l_{w2} referred to in C.1.1 and C.1.3 are constant values at all angles of inclination and shall be calculated as follows:

$$l_{w1} = \frac{P * A * Z}{1000 * g * \Delta} \ (m) \quad \text{and} \quad l_{w2} = 1.5 * l_{w1} \ (m)$$

P = wind pressure according to the following table :

Range of Service[3]	Wind Pressure (Pa)
unlimited ocean service	504
P	300
L	300
T	240
D	200

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

3. Alternative means for determining the wind heeling lever (l_{w1}) may be accepted subject to BKI approval, as an equivalent to calculation in C.2. When such alternative tests are carried out, reference shall be made based on the Guidelines developed by the Organization IMO[4]. 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 BKI.

4. The angle of roll (φ_1)[5] referred to in C.1.2 shall be calculated as follows:

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

where:

[3] For Range of Service refer to BKI Rules for The Classification and Construction of Seagoing Steel Ships, Part I. Seagoing Ships, Volume I, Rules for Classification and Surveys.

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

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

X_1 = factor as shown in table 2.1

X_2 = factor as shown in table 2.2

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 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 2.4, 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 2.1, 2.2, 2.3 and 2.4 and the formula for the rolling period are defined as follows :

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

B = moulded breadth of the ship (m)

d = mean moulded draught of the ship (m)

C_B = block coefficient

A_k = total overall area of bilge keels, or area of the lateral projection of the bar keel, or sum of these areas (m²)

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

Table 2.1 – Values of factor X_1

B/d	≤ 2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.4	≥ 3.5
X_1	1	0.98	0.96	0.95	0.93	0.91	0.90	0.88	0.86	0.82	0.80

Table 2.2 – Values of factor X_2

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

Table 2.3 – Values of factor *k*

$\frac{A_k * 100}{L_{wl} * B}$	0	1.0	1.5	2.0	2.5	3.0	3.5	≥ 4.0
k	1	0.98	0.95	0.88	0.79	0.74	0.72	0.70

Table 2.4 – Values of factor *s*

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

(In applying tables 2.1 to 2.4, intermediate values shall be obtained by linear interpolation)

5. The tables and formulae described in 4 are based on data from ships having:

5.1 *B/d* smaller than 3.5;

5.2 (KG/d-1) between -0.3 and 0.5; and

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, BKI may accept such alternative determinations for any ship, if deemed appropriate.

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Section 3
Special Criteria for Certain Types of Ships

A. Passenger ships

Passenger ships shall comply with the requirements of Section 2, B and Section 2, C.

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

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 BKI. In addition, the mass and distribution of the luggage shall be approved by BKI.

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

1.2.1. 1 m above deck level for passengers standing upright. Account may be taken, if necessary, of camber and sheer of deck; and

1.2.2. 0.3 m above the seat in respect of seated passengers.

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 Section 2, B.1 to B.4.

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 A.1 and A.2, respectively. In this connection, a value higher than four persons per square metre is not necessary.

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)

B. Oil tankers of 5,000 dwt and above

Oil tankers, as defined in the Section 1, C, shall comply with regulation 27 of Annex I to MARPOL 73/78.

C. Cargo ships carrying timber deck cargoes

Cargo ships carrying timber deck cargoes shall comply with the requirements of Section 2, B and Section 2, C unless BKI is satisfied with the application of alternative provision C.2.

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 and the Protocol of 1988 relating thereto.

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)[1] 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 :

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°.

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

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 Section 6 (Icing considerations)).

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.

D. 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)[2].

E. High-speed craft

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

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

[2] Refer to part C of chapter VI of the 1974 SOLAS Convention as amended

constructed on or after 1 July 2002, shall comply with stability requirements of the 2000 HSC Code (resolution MSC.97(73)).

F. Fishing Vessel

1. Scope

The provisions given hereunder apply to decked seagoing fishing vessels as defined in Definitions. The stability criteria given in F.2 and F.3 below shall be complied with for all conditions of loading as specified in Section 4, D.1.6, unless BKI is satisfied that operating experience justifies departures therefrom.

2. Criteria[3]

2.1. The general intact stability criteria given in Section 2, A, Section 2, B and Section 2, C shall apply to fishing vessels, with the exception of requirements on the initial metacentric height GM, (Section 2, B.4), which, for fishing vessels, shall 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 BKI but in no case shall be less than 0.15 m.

2.2. 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.

2.3. Where arrangements other than bilge keels are provided to limit the angle of roll, BKI shall be satisfied that the stability criteria referred to in F.2.1 are maintained in all operating conditions.

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

3.1. The provisions of Section 2, C shall apply to fishing vessels of 45 m length and over.

3.2. For fishing vessels of less than 45 m length, BKI may apply the provisions of Section 2, C Alternatively the values of wind pressure (see Section 2, C.2) may be taken from the following table:

h (m)	1	2	3	4	5	6
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.

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

4.1. 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 shall 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)

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

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

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

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

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

The formula is applicable for vessels having:

4.1.1. f/B between 0.02 and 0.20;

4.1.2. ls/L smaller than 0.60;

4.1.3. B/D between 1.75 and 2.15;

4.1.4. 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

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

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

4.2. The above formula is not intended as a replacement for the basic criteria given in F.2 and F.3 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.

4.3. The calculated value of GM, shall 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 shall be added to the calculated GM_{min}.

G. Pontoons

1. Application

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

1.1. non self-propelled;

1.2. unmanned;

1.3. carrying only deck cargo;

1.4. having a block coefficient of 0.9 or greater;

1.5. having a breadth/depth ratio of greater than 3.0; and

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

2. Stability drawings and calculations

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

2.1. lines drawing;

2.2. hydrostatic curves;

2.3. cross curves of stability;

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

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

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

3. Concerning the performance of calculations

The following guidance is suggested:

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

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

3..3 in performing wind heel calculations:

3.3.1. the wind pressure shall 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;

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

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

3.4. calculations shall be performed covering the full range of operating draughts; and

3.5. the down-flooding angle shall 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.

4. Intact stability criteria

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

4.2. The static angle of heel due to a uniformly distributed wind load of 540 Pa (wind speed 30 m/s) shall 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.

4.3. The minimum range of stability shall be:

For $L \leq 100$ m 20°

For $L \geq 150$ m 15°

For intermediate length by interpolation.

H. Containerships greater than 100 m

1. Application

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. BKI may apply the following criteria instead of those in Section 2, B

2. Intact stability

2.1. The area under the righting lever curve (GZ curve) shall not be less than 0.009/C metre-radians up to $\varphi = 30^\circ$ angle of heel, and not less than 0.016/C metre-radians up to $\varphi = 40^\circ$ or the angle of flooding φ_f (as defined inSection 2, B) if this angle is less than 40°.

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°, shall not be less than 0.006/*C* metre-radians.

2.3. The righting lever GZ shall be at least 0.033/*C* m at an angle of heel equal or greater than 30°.

2.4. The maximum righting lever GZ shall be at least 0.042/*C* m.

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

2.6. In the above criteria the form factor *C* shall be calculated using the formula and Fig. 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:

$$D' = D + h\left(\frac{2b - B_D}{B_D}\right)\left(\frac{2\sum l_H}{L}\right)$$ as defined in Fig. 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 Fig. 3.1);

b = mean width of hatch coamings within L/4 forward and aft from amidships (m) (see Fig. 3.1);

h = mean height of hatch coamings within L/4 forward and aft from amidships (m) (see Fig. 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).

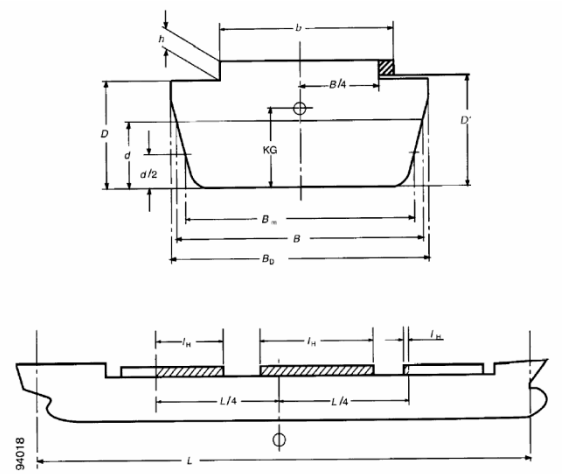

Fig. 3.1

The shaded areas in Fig. 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.

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

I. Offshore Supply Vessel

1. Application

1.1. The provisions given hereunder apply to offshore supply vessels, as defined in Section 1, C. The alternative stability criteria contained in I.3 apply to vessels of not more than 100 m in length.

1.2. Where a ship other than an offshore supply vessel, as defined in Definitions, is employed on a similar service, BKI shall be informed to determine the extent to which compliance with the provisions of the Guidelines is required.

2. Constructional precautions against capsizing

2.1. Access to the machinery space should, if possible, be arranged within the forecastle. Any access to the machinery space from the exposed cargo deck shall 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.

2.2. The area of freeing ports in the side bulwarks of the cargo deck shall at least meet the requirements of applicable load line regulations. The disposition of the freeing ports shall 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 shall be fitted in the freeing ports.

2.3. Special attention to be given 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 shall be in excess of the required freeing port area in the cargo deck bulwarks and shall not be fitted with shutters.

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

3. Stability criteria

3.1. The stability criteria given in Section 2, B shall apply to all offshore supply vessels except those having characteristics which render compliance with Section 2, B impracticable.

3.2. The following equivalent criteria shall be applied where a vessel's characteristics render compliance with Section 2, B impracticable:

3.2.1. the area under the curve of righting levers (GZ curve) shall 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 shall be:

$$0.055 + 0.001\ (30° - \varphi_{max})\ \text{metre-radians}^4.$$

3.2.2. 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°, shall be not less than 0.03 metre-radians;

3.2.3. the righting lever (GZ) shall be at least 0.20 m at an angle of heel equal to or greater than 30°;

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

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

3.2.6. reference is made also to Section 2, A.3 to A.5 and BKI Guidance on Intact Stability, Section 1, A.

J. Special Purpose Ships

1. Application

The provisions given hereunder apply to special purpose ships, as defined in Definitions (Section 1, C.6), of not less than 500 gross tonnage. BKI may also apply these provisions as far as reasonable and practicable to special purpose ships of less than 500 gross tonnage.

2. Stability criteria

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

The intact stability of special purpose ships shall comply with the provisions given in Section 2, B except that the alternative criteria given in I.3 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.

K. Mobile Offshore Drilling Unit (MODU)

For MODUs, constructed:

.1 on or after 1 January 2012, the provisions chapter 3 of the 2009 MODU Code, adopted by resolution A.1023(26), shall apply;

.2 before 1 January 2012, but on or after 1 May 1991, the provisions of chapter 3 of the 1989 MODU Code, adopted by resolution A.649(16), shall apply; and

.3 before 1 May 1991, the provisions of chapter 3 of the 1979 MODU Code, adopted by resolution A.414(XI), shall apply.

L. Tug

1. The intact stability shall comply with the following requirements:

1.1. the intact stability requirement of Section 2, B and Section 2, C of this guideline.

1.2. Additionally, the intact stability shall comply with one of the following requirements:

.1 The residual area between a righting lever curve and a heeling lever curve developed from 70% of the maximum bollard pull force acting in 90° to the shiplength direction shall not be less than 0,09 m.rad. The area has to be determined between the first interception of the two curves and the second interception or the angle of down flooding whichever is less. (See Fig.3.2)

.2 Alternatively, the area under a righting lever curve shall not be less than 1,4 times the area under a heeling lever curve developed from 70% of the maximum bollard pull force acting in 90° to shiplength direction. The areas to be determined between 0° and the 2nd interception or the angle of downflooding whichever is less.

Where heeling lever curve are defined as :

$$b_h = \frac{0.071.T.z_h.\cos\theta}{D}$$

Where :

b_h = heeling arm (m)

T = maximum bollard pull (kN)

zh = vertical distance [m] between the working point of the towrope and the centre of buoyancy

D = loading condition displacement (ton)

θ = heeling angle (°)

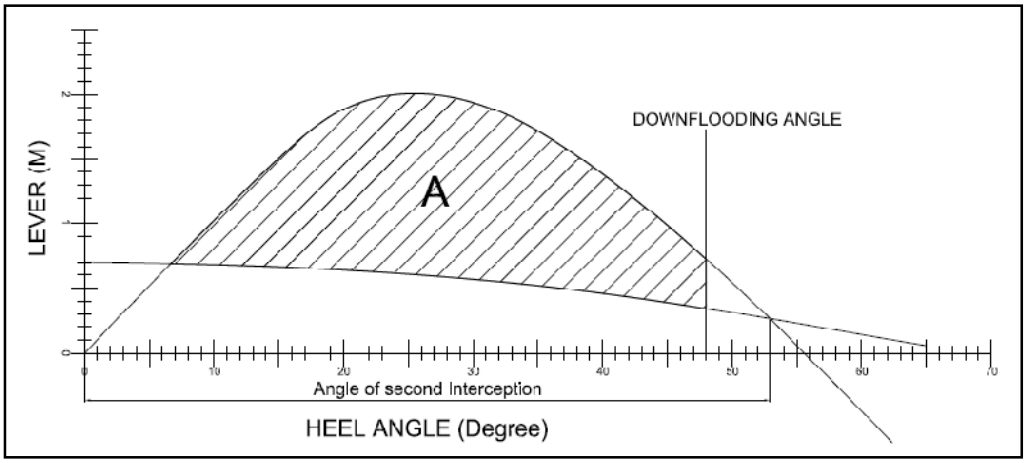

Fig.3.2

M. Floating Crane

1. Application

The requirements apply to bargeswith notation **Floating Crane** and specify the criteria these barges are to satisfy during cargo lifting in addition to those in G.4.

2. Intact stability criteria during cargo lifting

The following intact stability criteria are to be complied with:

- $\theta_C <= 15°$
- $GZ_C <= 0{,}6\ GZ_{MAX}$
- $A_1 >= 0{,}4\ A_{tot}$

where:

θ_C : Heeling angle of equilibrium, corresponding to the first intersection between heeling and righting arms (see Fig.3.3)

GZ_C, GZ_{MAX} : Defined in Fig.3.3

A_1 : Area, in m·rad, contained between the righting lever and the heeling arm curves, measured from the heeling angle θ_C to the heeling angle equal to the lesser of:

- heeling angle θ_R of loss of stability, corresponding to the second intersection between heeling and righting arms (see Fig.3.3)
- heeling angle θ_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 (see Fig.3.3)

A_{TOT} : Total area, in m·rad, below the righting lever curve.

In the above formula, the heeling arm, corresponding to the cargo lifting, is to be obtained, in m, from the following formula:

$$b = \frac{P.d - Z \cdot z}{\Delta}$$

where:

P : Cargo lifting weight, in t

d : Transversal distance, in m, of lifting cargo to the longitudinal plane (see Fig.3.3)

Z : Weight, in t, of ballast used for righting the pontoon, if applicable (see Fig.3.3)

z : Transversal distance, in m, of the centre of gravity of Z to the longitudinal plane (see Fig.3.3

Δ : Displacement, in t, at the loading condition considered.

The above check is to be carried out considering the most unfavourable situations of cargo lifting combined with the lesser initial metacentric height GM, corrected according to the requirements in Section 4, A. The residual freeboard of the unit during lifting operations in the most unfavourable stability condition is to be not less than 0,30 m. However, the heeling of the unit is not to produce in the lifting devices higher loads than those envisaged by the Manufacturer, generally expected to be 5° in the boom plane and 2° transversally in the case of a crane. The vertical position of the centre of gravity of cargo lifting is to be assumed in correspondence of the suspension point.

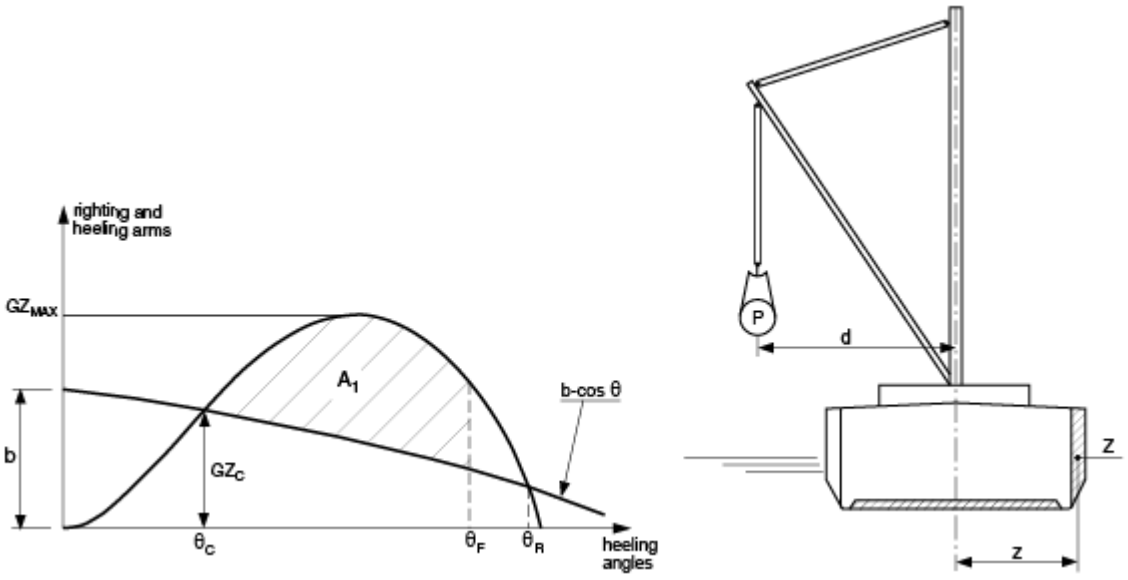

Fig.3.3

3. Intact stability criteria in the event of sudden loss of cargo during lifting

This additional requirement is compulsory when counterweights or ballasting of the ship are necessary or when deemed necessary by the Society taking into account the ship dimensions and the weights lifted.
The case of a hypothetical loss of cargo during lifting due to a break of the lifting cable is to be considered. In this case, the following intact stability criteria are to be complied with:

- $\frac{A_2}{A_1} \geq 1$

- $\theta_2 - \theta_3 >= 20°$

where:

A_1 : Area, in m·rad, contained between the righting lever and the heeling arm curves, measured from the heeling angle θ_1 to the heeling angle θ_C (see Fig.3.4)

A_2 : Area, in m·rad, contained between the righting lever and the heeling arm curves, measured from the heeling angle θ_C to the heeling angle θ_2 (see Fig.3.4)

A_3 : Area, in m·rad, contained between the righting lever and the heeling arm curves, measured from the heeling angle θ_C to the heeling angle θ_3 (see Fig.3.4)

θ_1 : Heeling angle of equilibrium during lifting (see Fig.3.4)

θ_C : Heeling angle of equilibrium, corresponding to the first intersection between heeling and righting arms (see Fig.3.4)

θ_2 : Heeling angle corresponding to the lesser of θ_R and θ_F

θ_3 : Maximum heeling angle due to roll, at which $A_3 = A_1$, to be taken not greater than 30° (angle in correspondence of which the loaded cargo on deck is assumed to shift (see Fig.3.4)

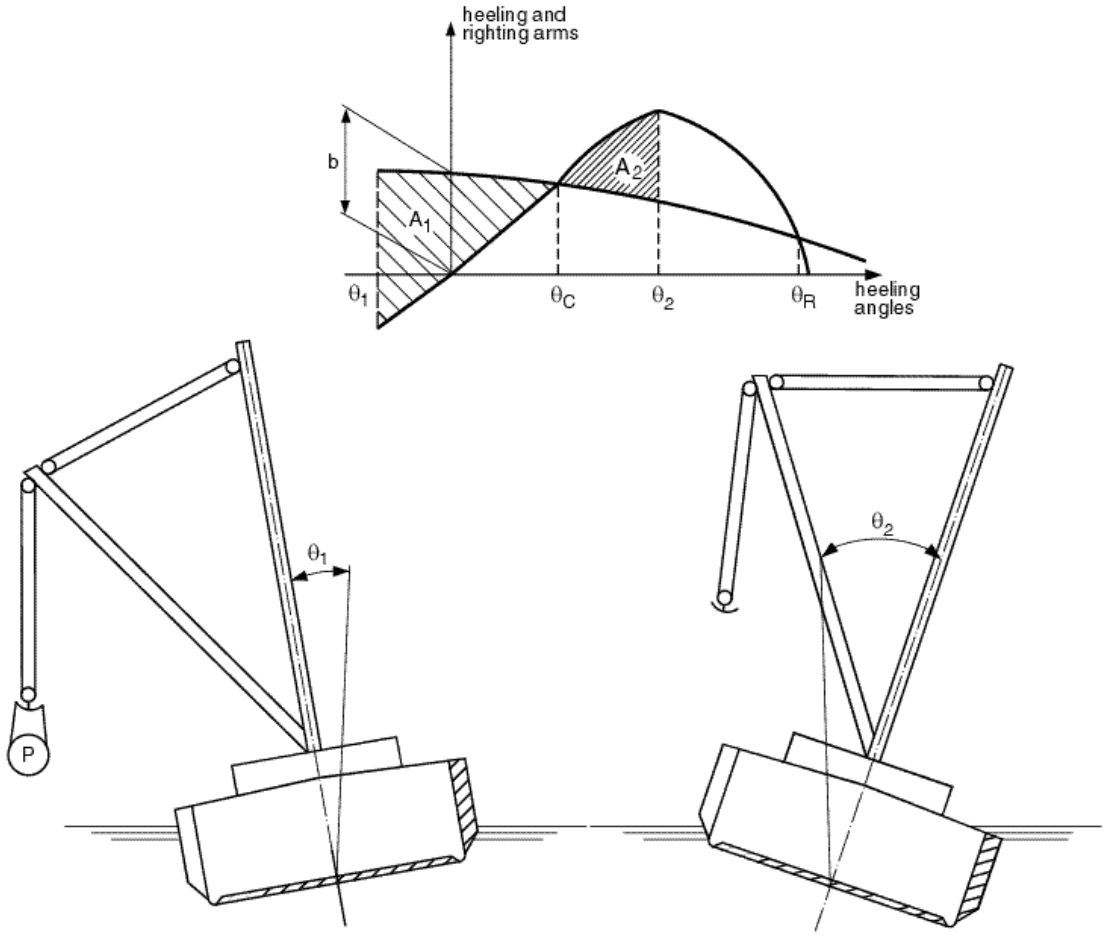

Fig.3.4

A_1 : Area between θ_1 and θ_C

A_2 : Area between θ_C and θ_2 (in the Fig.3.4, $\theta_2 = \theta_F$)

A_3 : Area between θ_C and θ_3

$A_3 = A_1$

θ_R : Heeling angle of loss of stability, corresponding to the second intersection between heeling and righting arms (see Fig.3.4)

θ_F : Heeling angle at which progressive flooding may occur (see Fig.3.4).

In the above formulae, the heeling arm, induced on the ship by the cargo loss, is to be obtained, in m, from the following formula:

$$b = \frac{Z \cdot z}{\Delta} \cos\theta$$

where Z, z and θ are defined in M.2.

N. Fire Fighting Ships

1. Application

The requirements apply to ships with notation FF1, FF2, FF3, FF1/2 and FF1/3 and specify the criteria these ships are to satisfy in addition to those in Section 2, B and Section 2, C.

2. Additional Criteria During Fire Fighting Operation

All the loading condition reported in the trim and stability booklet, with the exception of lightship, are also to be checked in order to investigate the ship's capability to support the effect of the reaction force of the water jet in the beam direction due to the monitors fitted on board.

A fire-fighting ship may be considered as having sufficient stability, according to the effect of the reaction force of the water jet in the beam direction due to the monitors fitted on board, if the heeling angle of static equilibrium θ_0, corresponding to the first intersection between heeling and righting arms (see Fig.3.5), is less than 5°.

The heeling arm shall be calculated as follows :

$$b_h = \frac{\Sigma . R_i . h_i + S.(T/2 - e)}{9{,}81 . \Delta} . \cos\theta$$

Where :

b_h : Heeling arm, in m, relevant to the reaction force of the water jet of the monitors fitted on board, and to the effect of the transversal manouvering thrusters. The monitors are assumed to be oriented in beam direction parallel to the sea surface, so as to consider the most severe situation.

R_i : Reaction force, in kN, of the water jet of each monitor fitted on board (see Fig.3.6)

h_i : Vertical distance, in m, between the location of each monitor and half draught (see Fig.3.6)

S : Thrust, in kN, relevant to manouvering thrusters (s), if applicable (see Fig.3.6)

e : Vertical distance, in m, between the manouvering thrusters axis and keel (see Fig.3.6)

Δ : Displacement, in ton, relevant to the loading condition under consideration

T : Draught, in m, corresponding to Δ (see Fig.3.6).

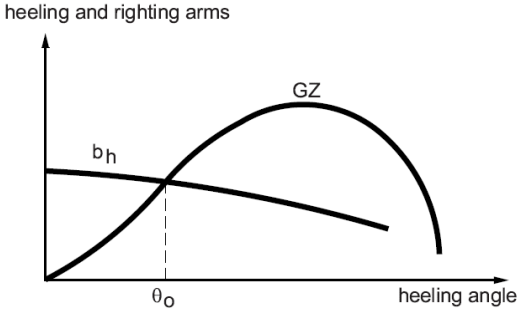

Fig.3.5

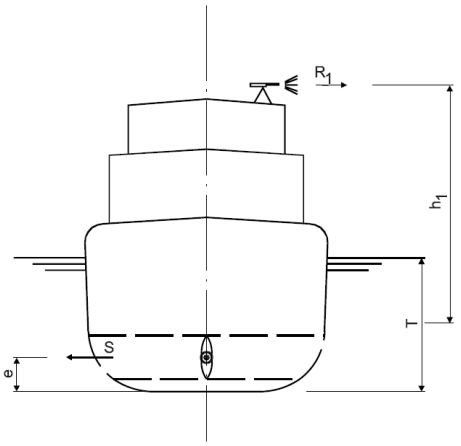

Fig.3.6

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Section 4

Guidance in Preparing Stabilty Information

A. Effect of free surfaces of liquids in tanks

1. For all loading conditions, the initial metacentric height and the righting lever curve shall be corrected for the effect of free surfaces of liquids in tanks.

2. Free surface effects shall 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 A.12[1]

But nominally full cargo tanks shall be corrected for free surface effects at 98% filling level. In doing so, the correction to initial metacentric height shall 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. Tanks which are taken into consideration when determining the free surface correction may be in one of two categories:

3.1. tanks with filling levels fixed (e.g., liquid cargo, water ballast). The free surface correction shall be defined for the actual filling level to be used in each tank; or

3.2. 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 A.5 and A.6 the free surface correction shall be the maximum value attainable between the filling limits envisaged for each tank, consistent with any operating instructions.

4. In calculating the free surface effects in tanks containing consumable liquids, it shall 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 shall be those where the effect of free surfaces is the greatest.

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 shall be calculated to take account of the most onerous transitory stage relating to such operations.

6. For ships engaged in liquid transfer operations, the free surface corrections at any stage[2] of the liquid transfer operations may be determined in accordance with the filling level in each tank at that stage of the transfer operation.

7. The corrections to the initial metacentric height and to the righting lever curve shall be addressed separately as follows.

8. In determining the correction to initial metacentric height, the transverse moments of inertia of the

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

[2] 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.

tanks shall be calculated at 0° angle of heel according to the categories indicated inA.3.

9. The righting lever curve shall be corrected by any of the following methods subject to the agreement of BKI:

9.1. correction based on the actual moment of fluid transfer for each angle of heel calculated; or

9.2. correction based on the moment of inertia, calculated at 0° angle of heel, modified at each angle of heel calculated.

10. Corrections shall be calculated according to the categories indicated in A.2.

11. Whichever method is selected for correcting the righting lever curve, only that method shall 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, shall be included.

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 dmin (t)

d_{min} is the minimum mean service draught of the ship without cargo, with 10% stores and minimum water ballast, if required (m).

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.

B. Permanent ballast

If used, permanent ballast shall be located in accordance with a plan approved by BKI and in a manner that prevents shifting of position. Permanent ballast shall not be removed from the ship or relocated within the ship without the approval of BKI. Permanent ballast particulars shall be noted in the ship's stability booklet.

C. Assessment of compliance with stability criteria[3]

1. Except as otherwise required by this Guidelines, for the purpose of assessing in general whether the stability criteria are met, stability curves using the assumptions given in this Guidelines shall be drawn for the loading conditions intended by the owner in respect of the ship's operations.

2. If the owner of the ship does not supply sufficiently detailed information regarding such loading conditions, calculations shall be made for the standard loading conditions.

[3] 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.

D. Standard conditions of loading to be examined

1. Loading conditions

The standard loading conditions referred to in the text of the present Guidlines are as follows.

1.1. For a passenger ship:

1.1.1. ship in the fully loaded departure condition with cargo, full stores and fuel and with the full number of passengers with their luggage;

1.1.2. 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;

1.1.3. ship without cargo, but with full stores and fuel and the full number of passengers and their luggage; and

1.1.4. ship in the same condition as at 0 above with only 10% stores and fuel remaining.

1.2. For a cargo ship:

1.2.1. ship in the fully loaded departure condition, with cargo homogeneously distributed throughout all cargo spaces and with full stores and fuel;

1.2.2. ship in the fully loaded arrival condition with cargo homogeneously distributed throughout all cargo spaces and with 10% stores and fuel remaining;

1.2.3. ship in ballast in the departure condition, without cargo but with full stores and fuel; and

1.2.4. ship in ballast in the arrival condition, without cargo and with 10% stores and fuel remaining

1.3. For a cargo ship intended to carry deck cargoes:

1.3.1. 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

1.3.2. 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.

1.4. For a ship intended to carry timber deck cargoes:

The loading conditions which shall be considered for ships carrying timber deck cargoes are specified in D.1.3. The stowage of timber deck cargoes shall comply with the provisions of chapter 3 of the Code of Safe Practice for Ships Carrying Timber Deck Cargoes, 1991 (resolution A.715(17)).[4]

1.5. For an offshore supply vessel the standard loading conditions shall be as follows:

1.5.1. 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;

1.5.2. vessel in fully loaded arrival condition with cargo as specified inD.1.5.1, but with 10% stores and

[4] 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).

fuel;

1.5.3. vessel in ballast departure condition, without cargo but with full stores and fuel;

1.5.4. vessel in ballast arrival condition, without cargo and with 10% stores and fuel remaining; and

1.5.5. vessel in the worst anticipated operating condition.

1.6. For fishing vessels the standard loading conditions referred to in Section 3, F.1 are as follows[5]:

1.6.1. departure conditions for the fishing grounds with full fuel, stores, ice, fishing gear, etc.;

1.6.2. departure from the fishing grounds with full catch and a percentage of stores, fuel, etc., as agreed by BKI;

1.6.3. arrival at home port with 10% stores, fuel, etc. remaining and full catch; and

1.6.4. 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 BKI is satisfied that operating patterns justify such a value.

2. Assumptions for calculating loading conditions

2.1. For the fully loaded conditions mentioned in, D.1.2.1, D.1.2.2, D.1.3.1 and D.1.3.2 if a dry cargo ship has tanks for liquid cargo, the effective deadweight in the loading conditions therein described shall be distributed according to two assumptions, i.e. with cargo tanks full, and with cargo tanks empty.

2.2. In the conditions mentioned in D.1.1.1, D.1.2.1 and D.1.3.1 it shall 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.

2.3. If in any loading condition water ballast is necessary, additional diagrams shall be calculated taking into account the water ballast. Its quantity and disposition shall be stated.

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.

2.5. In all cases, when deck cargo is carried, a realistic stowage mass shall be assumed and stated, including the height of the cargo.

2.6. Considering timber deck cargo the following assumptions are to be made for calculating the loading conditions referred to in D.1.4:

2.6.1. the amount of cargo and ballast shall correspond to the worst service condition in which all the relevant stability criteria of Section 2, B or the optional criteria given inSection 3, C 2, are met. In the arrival condition, it shall be assumed that the weight of the deck cargo has increased by 10% owing to water absorption.

2.7. For offshore supply vessels the assumptions for calculating loading conditions shall be as follows:

2.7.1. if a vessel is fitted with cargo tanks, the fully loaded conditions of D.1.5.1 and D.1.5.2 shall be modified, assuming first the cargo tanks full and then the cargo tanks empty;

2.7.2. if in any loading condition water ballast is necessary, additional diagrams shall be calculated,

[5] Refer to regulation III/7 of the 1993 Torremolinos Protocol.

taking into account the water ballast, the quantity and disposition of which shall be stated in the stability information;

2.7.3. in all cases when deck cargo is carried a realistic stowage weight shall be assumed and stated in the stability information, including the height of the cargo and its centre of gravity;

2.7.4. 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 shall be assumed in and around the pipes. The net volume shall be taken as the internal volume of the pipes, plus the volume between the pipes. This percentage shall 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, BKI may take into account positive or negative sheer aft, actual trim and area of operation; or

2.7.5. if a vessel operates in zones where ice accretion is likely to occur, allowance for icing shall be made in accordance with the provisions of Section 6(Icing considerations).

2.8. For fishing vessels the assumptions for calculating loading conditions shall be as follows:

2.8.1. allowance shall be made for the weight of the wet fishing nets and tackle, etc., on deck;

2.8.2. allowance for icing, where this is anticipated to occur, shall be made in accordance with the provisions of Section 6, C;

2.8.3. in all cases the cargo shall be assumed to be homogeneous unless this is inconsistent with practice;

2.8.4. in conditions referred to in D.1.6.2 and D.1.6.3 deck cargo shall be included if such a practice is anticipated;

2.8.5. water ballast should normally only be included if carried in tanks which are specially provided for this purpose.

E. Calculation of stability curves

1. General

Hydrostatic and stability curves shall 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 shall 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 shall be used.

2. Superstructures, deckhouses, etc., which may be taken into account

2.1. Weathertight enclosed superstructures complying with load line regulations may be taken into account.

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 shall be designed with strength to sustain a safety margin[6] with regard to the required

[6] As a guidance a safety margin of 30% should be applied.

strength of the surrounding structure[7].

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 E.2.1

2.4. Where deckhouses comply with the above conditions, except that no additional exit is provided to a deck above, such deckhouses shall not be taken into account; however, any deck openings inside such deckhouses shall be considered as closed even where no means of closure are provided.

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 shall 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.

2.6. Deckhouses on decks above the freeboard deck shall not be taken into account, but openings within them may be regarded as closed.

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 shall show one or more steps, and in subsequent computations the flooded space shall be considered non-existent).

2.8. In cases where the ship would sink due to flooding through any openings, the stability curve shall be cut short at the corresponding angle of flooding and the ship shall be considered to have entirely lost its stability.

2.9. Small openings such as those for passing wires or chains, tackle and anchors, and also holes of scuppers, discharge and sanitary pipes shall 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 shall be assumed open if BKI considers this to be a source of significant flooding.

2.10. Trunks may be taken into account. Hatchways may also be taken into account having regard to the effectiveness of their closures.

3. Calculation of stability curves for ships carrying timber deck cargoes

In addition to the provisions given above, BKI 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 BKI considers it necessary to investigate the influence of different permeabilities and/or assumed effective height of the deck cargo.

F. Stability booklet

1. Stability data and associated plans shall be drawn up in the working language of the ship and any other language BKI 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 shall be approved.

2. Each ship shall be provided with a stability booklet, approved by BKI, which contains sufficient information to enable the master to operate the ship in compliance with the applicable requirements contained in the Guidelines. BKI may have additional requirements. On a mobile offshore drilling unit,

[7] IMO guidance for testing these windows is to be developed.

the stability booklet may be referred to as an operating manual. The stability booklet may include information on longitudinal strength. This Guidelines addresses only the stability-related contents of the booklet[8].

3. For ships carrying timber deck cargoes:

3.1. comprehensive stability information shall be supplied which takes into account timber deck cargo. Such information shall 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[9];

3.2. The master shall 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 E.3); and

3.3. conditions shall be shown indicating the maximum permissible amount of deck cargo having regard to the lightest stowage rate likely to be met in service.

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 shall be given to including the following information[10]:

4.1. a general description of the ship;

4.2. instructions on the use of the booklet;

4.3. general arrangement plans showing watertight compartments, closures, vents, downflooding angles, permanent ballast, allowable deck loadings and freeboard diagrams;

4.4. 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;

4.5. capacity plan or tables showing capacities and centres of gravity for each cargo stowage space;

4.6. tank sounding tables showing capacities, centres of gravity, and free surface data for each tank;

4.7. 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;

4.8. standard operating conditions and examples for developing other acceptable loading conditions using the information contained in the stability booklet;

4.9. a brief description of the stability calculations done including assumptions;

4.10. general precautions for preventing unintentional flooding;

4.11. information concerning the use of any special cross-flooding fittings with descriptions of damage conditions which may require cross-flooding;

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[8] 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.

[9] 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.

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

4.12. any other necessary guidance for the safe operation of the ship under normal and emergency conditions;

4.13. a table of contents and index for each booklet;

4.14. inclining test report for the ship, or:

4.14.1. 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

4.14.2. 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;

4.15. recommendation for determination of ship's stability by means of an in-service inclining test.

5. As an alternative to the stability booklet mentioned in F, 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 Guidelines as may be provided at the discretion of BKI concerned.

Section 5

Stability Calculations Performed by Stability Instruments

A. Stability Instruments

For ships with stability instrument installed on board, requirements of Part 4, Vol 1, BKI Guidelines for Certification of Loading Computer System shall be applied.

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Section 6
Icing Considerations

A. General

1. For any ship operating in areas where ice accretion is likely to occur, adversely affecting a ship's stability, icing allowances shall be included in the analysis of conditions of loading.

B. Cargo ships carrying timber deck cargoes

1 The master shall establish or verify the stability of his or her 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[14].

2 When timber deck cargoes are carried and it is anticipated that some formation of ice willtake place, an allowance shall be made in the arrival condition for the additional weight.

C. Fishing vessels

The calculations of loading conditions for fishing vessels (refer to Section 4, D.2.8) shall, where appropriate, include allowance for ice accretion, in accordance with the following provisions.

1. Allowance for ice accretion[15]

For vessels operating in areas where ice accretion is likely to occur, the following icing allowance shall be made in the stability calculations:

1.1. 30 kg per square metre on exposed weather decks and gangways;

1.2. 7.5 kg per square metre for projected lateral area of each side of the vessel above the water plane;

1.3. 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 shall 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 shall be:

1.4. designed to minimize the accretion of ice; and

1.5. equipped with such means for removing ice as BKI 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.

2. Guidance relating to ice accretion

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

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

In the application of the above standards, the following icing areas shall apply:

2.1. 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;

2.2. 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;

2.3. all sea areas north of the North America, west of the areas defined in 2.1 and 2.2;

2.4. the Bering and Okhotsk Seas and the Tartary Strait during the icing season; and

2.5. 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:

2.6. within the areas defined in 2.1, 2.3, 2.4 and 2.5 known to having icing conditions significantly different from those described in 1, ice accretion requirements of one-half to twice the required allowance may be applied; and

2.7. within the area defined in 2.2, where ice accretion in excess of twice the allowance required by 1 may be expected, more severe requirements than those given in 1 may be applied.

3. Brief survey of the causes of ice formation and its influence upon the seaworthiness of the vessel

3.1. The skipper of a fishing vessel shall 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.

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.

3.3. Ice formation may sometimes be caused or accentuated by water shipped on board and retained on deck.

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.

3.5. It shall be borne in mind that the most dangerous areas as far as ice formation is concerned are the sub-Arctic regions.

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.

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 tonnes to 500 tonnes are also given. For larger vessels the weight will be correspondingly greater.

3.8. Slow accumulations of ice take place:

3.8.1. at ambient temperature from -1°C to -3°C and any wind force;

3.8.2. at ambient temperature -4°C and lower and wind force from 0 m/s to 9 m/s; and

3.8.3. 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.

3.9. At ambient temperature of -4°C to -8°C and wind force 10 m/s to 15 m/s, rapid accumulation of ice takes place. Under these conditions the intensity of ice accumulation can lie within the range 1.5 to 4 t/h.

3.10. Very fast accumulation of ice takes place:

3.10.1. at ambient temperature of -4°C and lower and wind forces of 16 m/s and over; and

3.10.2. at ambient temperature -9°C and lower and wind force 10 m/s to 15 m/s.

Under these conditions the intensity of ice accumulation can exceed 4 t/h.

3.11. The skipper shall bear in mind that ice formation adversely affects the seaworthiness of the vessel, as ice formation leads to:

3.11.1. 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;

3.11.2. 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;

3.11.3. 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;

3.11.4. a change of trim due to uneven distribution of ice along the vessel's length;

3.11.5. the development of a constant list due to uneven distribution of ice across the breadth of the vessel; and

3.11.6. impairment of the manoeuvrability and reduction of the speed of the vessel.

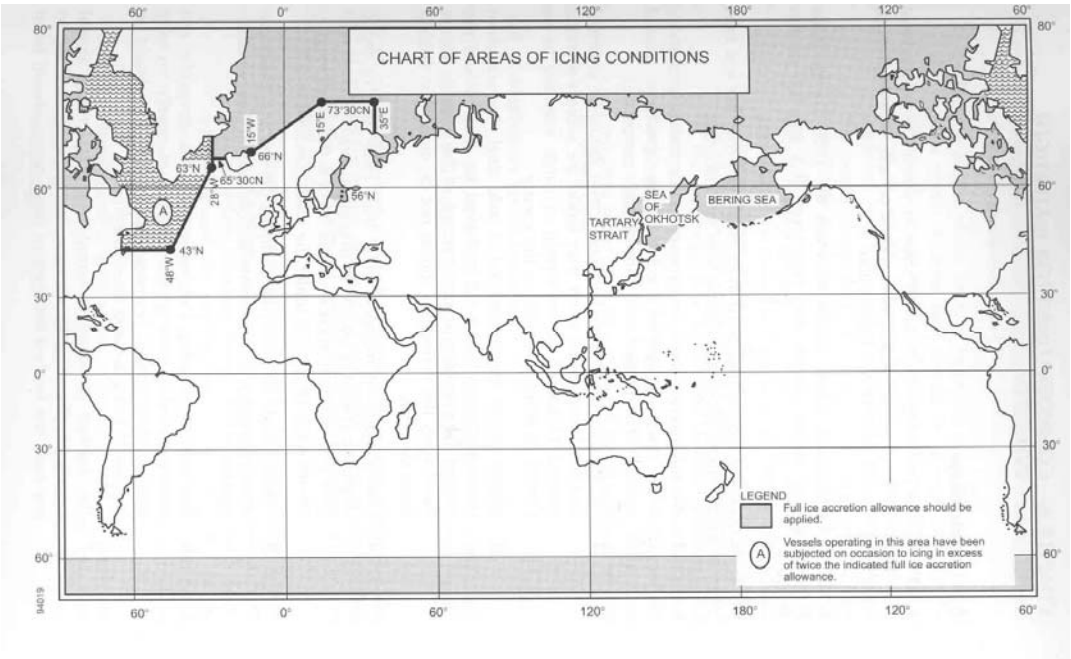
4. Recommended operational procedures related to ensuring a fishing vessel's endurance in conditions of ice formation are given in annex 1 of the BKI Guidance on Intact Stability (Recommendations for skippers of fishing vessels on ensuring a vessel's endurance in conditions of ice formation).

D. 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 shall 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 C.3 and in annex 1 of the BKI Guidance on Intact Stability (Recommendations for skippers of fishing vessels on ensuring a vessel's endurance in conditions of ice formation).



Section 7

Determination of Lightship Parameter

A. Application

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, shall be inclined upon its completion and the elements of its stability determined.[1]

2. BKI may allow the inclining test of an individual ship as required by paragraph 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 BKI 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^2< 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 shall 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.

3. BKI 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.

4. Where any alterations are made to a ship so as to materially affect the stability, the ship shall be re-inclined.

5. At periodic intervals not exceeding five years, a lightweight survey shall be carried out on all passenger ships to verify any changes in lightship displacement and longitudinal centre of gravity. The ship shall 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.

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.

B. Preparations for the inclining test

1. Notification ofBKI

Written notification of the inclining test shall be sent to BKI as it requires or in due time before the test. BKIrepresentative shall 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 -

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

[2] For the purpose of paragraphs 2 and 5 the length (L) means the subdivision length (LS) 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 Section 1, C.12.

arrangements may be equally efficient. However, to minimize risk of delay, it is recommended that all such variances be submitted to BKIfor review prior to the inclining test.

1.1. Details of notification

Written notification shall provide the following information as BKI may require:

1.1.1. identification of the ship by name and shipyard hull number, if applicable;

1.1.2. date, time, and location of the test;

1.1.3. inclining weight data:

1.1.3.1. type;

1.1.3.2. amount (number of units and weight of each);

1.1.3.3. certification[3];

1.1.3.4. method of handling (i.e. sliding rail or crane);

1.1.3.5. anticipated maximum angle of heel to each side;

1.1.4. measuring devices:

1.1.4.1 . pendulums - approximate location and length;

1.1.4.2. U-tubes - approximate location and length;

1.1.4.3. inclinometers - location and details of approvals and calibrations;

1.1.5. approximate trim;

1.1.6. condition of tanks;

1.1.7. estimated weights to deduct, to complete, and to relocate in order to place the ship in its true lightship condition;

1.1.8. detailed description of any computer software to be used to aid in calculations during the inclining test; and

1.1.9. name and telephone number of the person responsible for conducting the inclining test.

2. General condition of the ship

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.

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 judgementshall 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.

2.3. Temporary material, tool boxes, staging, sand, debris, etc., on board shall be reduced to absolute minimum before the inclining test. Excess crew or personnel not directly involved in the inclining test shall be removed from on board the ship before the test.

2.4. Decks shall 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 shall be removed prior to the test.

[3] If weight certification does not exist, the weight shall be verified in the presence of Surveyor using recently calibrated scale

2.5. The anticipated liquid loading for the test shall be included in the planning for the test. Preferably, all tanksshould 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 shall be such that the free surface effect can be accurately determined.

2.6. The ship shall 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 shall 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 shall be accurately recorded. The ship shall be moored in a manner to allow unrestricted heeling. The access ramps shall be removed. Power lines, hoses, etc., connected to shore shall be at a minimum, and kept slack at all times.

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 shall be checked beforehand.

2.8. The total weight used shall be sufficient to provide a minimum inclination of one degree and a maximum of four degrees of heel to each side. BKI may, however, accept a smaller inclination angle for large ships provided that the requirements on pendulum deflection or U-tube difference in height in 2.9 are complied with. Test weights shall be compact and of such a configuration that the vertical centre of gravity of the weights can be accurately determined. Each weight shall be marked with an identification number and its mass. Re-certification of the test weights shall be carried out prior to the incline. A crane of sufficient capacity and reach, or some other means, shall 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 BKI.

2.9. The use of three pendulums is recommended but a minimum of two shall 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 BKI. Alternative measuring devices shall not be used to reduce the minimum inclining angles recommended in 2.8.

The use of an inclinometer or U-tube shall 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.

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.

C. Plans Required

The person in charge of the inclining test shall 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).

D. Test Procedure

1. Procedures followed in conducting the inclining test and lightweight survey shall be in accordance with the recommendations laid out in annex 1 (Detailed guidance for the conduct of an inclining test) to this Guidelines.

1.1. Freeboard/draught readings shall 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 shall be read immediately before or immediately after the inclining test.

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 shall be repeated or explained.

2. A copy of the inclining data shall be forwarded to BKI along with the calculated results of the inclining test in an acceptable report format, if required.

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 BKI requirements.

E. Inclining Test for MODUs

1. An inclining test shall 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).

2. For successive units which are identical by design, the lightship data of the first unit of the series may be accepted by BKI 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 shall 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.

3. The results of the inclining test, or deadweight survey and inclining experiment adjusted for weight differences, shall be indicated in the Operating Manual.

4. A record of all changes to machinery, structure, outfit and equipment that affect the lightship data, shall be maintained in the Operating Manual or a lightship data alterations log and be taken into account in daily operations.

5. For column-stabilized units, a deadweight survey shall be conducted at intervals not exceeding five years. Where the deadweight survey indicates a change from the calculated lightship displacement in excess of1% of the operating displacement, an inclining test shall be conducted.

6. An inclining test or a deadweight survey shall be carried out in the presence of an BKI surveyor .

F. Stability Test for Pontoons and Barges

An inclining experiment is not normally required for a pontoon or barge, 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 shall be determined by calculation based on draught and density readings.

Annex

Detailed Guidance for The Conduct of An Inclining Test

Detailed guidance on inclining test shall refer to BKI Guidance for Inclining Test of Ships. Special attention shall be given that determination of lightship VCG by means of rolling period test is no longer to be used.

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