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RECOMMENDATION ON INTACT STABILITY FOR PASSENGER AND CARGO SHIPS UNDER 100 METRES IN LENGTH

RESOLUTION A.167(ES.IV)

adopted on 28 November 1968

THE ASSEMBLY,

NOTING Article 16(i) of the IMCO Convention concerning the function of the Assembly,

NOTING ALSO Recommendation 7 of the International Conference on Safety of Life at Sea, 1960,

RECOGNIZING the need to establish international standards for intact stability of passenger ships and cargo ships,

HAVING CONSIDERED the Recommendation adopted by the Maritime Safety Committee at its seventeenth session,

ADOPTS the Recommendation on Intact Stability for Passenger and Cargo Ships under 100 metres in length, the text of which is set out in the Annex to this Resolution,

INVITES all governments concerned to take steps to give effect to the Recommendation as soon as possible, unless they are fully satisfied that their national stability requirements supported by long operating experience ensure adequate stability for particular types and sizes of ships,

REQUESTS the Maritime Safety Committee to continue the study on this subject and to develop improved stability criteria,

AUTHORIZES the Maritime Safety Committee to amend the Recommendation as necessary in the light of further studies.

ANNEX

RECOMMENDATION ON INTACT STABILITY
FOR PASSENGER AND CARGO SHIPS
UNDER 100 METRES IN LENGTH

1. Scope

1.1 The provisions given hereunder are recommended for new decked sea-going passenger and cargo ships (other than fishing vessels* and ships carrying timber deck cargoes) under 100 metres in length.

1.2 Administrations are invited to adopt, for all conditions of loading, the stability criteria given in paragraph 5 unless they are satisfied that operating experience justifies departures therefrom.

2. General Precautions against Capsizing

2.1 Compliance with the stability criteria does not ensure immunity against capsizing regardless of the circumstances or absolve the master from his responsibilities. Masters should therefore exercise prudence and good seamanship having regard to the season of the year, weather forecasts and the navigational zone and should take the appropriate action as to speed and course warranted by the prevailing circumstances.

2.2 Care should be taken that the cargo allocated to the ship is capable of being stowed so that compliance with the criteria can be achieved. If necessary the amount should be limited to the extent that ballast weight may be required.

2.3 Before a voyage commences care should be taken to ensure that the cargo and sizeable pieces of equipment have been properly

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* A separate recommendation is issued for fishing vessels.

stowed or lashed so as to minimize the possibility of both longitudinal and lateral shifting while at sea, under the effect of acceleration caused by rolling and pitching.

3. Calculation of Stability Curves

The methods and procedures employed for calculating stability righting arms should be in accordance with Appendix I, and the degree of accuracy obtained should be acceptable to the Administration.

4. Assessment of Compliance with Criteria

4.1 For the purpose of assessing in general whether the criteria are met, stability curves should be drawn for the main loading conditions intended by the owner in respect of the ship's operations.

4.2 If the owner does not supply sufficiently detailed information regarding such loading conditions, calculations should be made for the standard conditions given in Appendix II.

4.3 In all cases calculations should be based on the assumptions shown in Appendix II.

5. Recommended Criteria

5.1 The following criteria are recommended for passenger and cargo ships:

(a) The area under the righting lever curve (GZ curve) should not be less than 0.055 metre-radians up to $\theta = 30^{\circ}$ angle of heel and not less than 0.09 metre-radians up to $\theta = 40^{\circ}$ or the angle of flooding θ_f* if this angle is less than 40°.

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* θ_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.

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

(b) The righting lever GZ should be at least 0.20 m. at an angle of heel equal to or greater than 30°.

(c) The maximum righting arm should occur at an angle of heel preferably exceeding 30° but not less than 25°.

(d) The initial metacentric height GM_o should not be less than 0.15 m.

5.2 The following additional criteria are recommended for passenger ships:

(a) The angle of heel on account of crowding of passengers to one side as defined in Appendix II 2.(9) should not exceed 10°.

(b) The angle of heel on account of turning should not exceed 10° when calculated using the following formula:

$$M_R = 0.02 \frac{V_o^2}{L} \Delta (KG - \frac{d}{2})$$

where:

M_R = heeling moment in metre-tons,

V_o = service speed in m./sec,

L = length of ship at waterline in m.,

Δ = displacement in metric tons,

d = mean draught in m.,

KG = height of centre of gravity above keel in m.

5.3 The criteria mentioned in 5.1 and 5.2 fix minimum values, but no maximum values are recommended. It is advisable to avoid excessive values, since these might lead to acceleration forces which could be prejudicial to the ship, its complement, its equipment and to the safe carriage of the cargo.

5.4 Where anti-rolling devices are installed in a ship the Administration should be satisfied that the above criteria can be maintained when the devices are in operation.

5.5 A number of influences such as beam wind on ships with large windage area, icing of topsides, water trapped on deck, rolling characteristics, following seas, etc. adversely affect stability and the Administration is advised to take these into account so far as is deemed necessary.

5.6 Regard should be paid to the possible adverse effects on stability where certain bulk cargoes are carried. In this connexion attention should be paid to the Code of Safe Practice for Bulk Cargoes. Ships carrying grain in bulk should comply with the criteria mentioned in 5.1 in addition to the stability requirements in Chapter VI of the International Convention for the Safety of Life at Sea, 1960.

6. Inclining Test

6.1 When construction is finished, each ship should undergo an inclining test, actual displacement and co-ordinates of the centre of gravity being determined for the light ship condition.

6.2 The Administration may allow the inclining test of an individual ship to be dispensed with, provided basic stability data are available from the inclining test of a sister ship.

7. Stability Information

7.1 The master of any ship to which the present Recommendation applies should receive information which will enable him to assess with ease and certainty the stability of his ship in different service conditions. A duplicate of this information should be communicated to the Administration.

7.2 Stability information should comprise:

(i) Stability characteristics of typical loading conditions;

(ii) Information in the form of tables or diagrams which will enable the master to assess the stability of his ship and verify whether it is sufficient in all loading conditions differing from the standard ones. This information should include, in particular, a curve or table giving, as a function of the draughts, the required initial metacentric height GM_o (or any other stability parameter) which ensures that the stability is in compliance with the criteria given in 5.1 above;

(iii) Information on the proper use of anti-rolling devices if these are installed in the ship;

(iv) Additionally, information enabling the ship's master to determine the initial metacentric height GM_o by means of rolling test as described in the Appendix to the Memorandum to Administrations reproduced at Appendix III would be desirable;

(v) Notes on the corrections to be made to the initial metacentric height GM_o to take account of free surface liquids.

APPENDIX I

CALCULATION OF STABILITY CURVES

General

(1) Hydrostatic and stability curves should normally be prepared on a designed trim basis. However, where the operating trim or the form and arrangement of the ship are such that change in trim has an appreciable effect on righting arms, such change in trim should be taken into account.

(2) The calculations should take into account the volume to the upper surface of the deck sheathing. In the case of wood ships the dimensions should be taken to the outside of the hull planking.

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

(3) Enclosed superstructures complying with Regulation 3(10)(b) of the 1966 Load Line Convention may be taken into account.

(4) The second tier of similarly enclosed superstructures may also be taken into account.

(5) Deckhouses on the freeboard deck may be taken into account, provided that they comply with the conditions for enclosed superstructures laid down in Regulation 3(10)(b) of the 1966 Load Line Convention.

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

(7) Deckhouses, the doors of which do not comply with the requirements of Regulation 12 of the 1966 Load Line Convention, should not be taken into account; however, any deck openings inside the deckhouse are regarded as closed where their means of closure comply with the requirements of Regulations 15, 17 or 18 of the 1966 Load Line Convention.

(8) Deckhouses on decks above the freeboard deck should not be taken into account, but openings within them may be regarded as closed.

(9) 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 statical stability curve should show one or more steps, and in subsequent computations the flooded space should be considered non-existent.)

(10) In cases where the ship would sink due to flooding through any openings, the stability curve should be cut short at the corresponding angle of flooding and the ship should be considered to have entirely lost her stability.

(11) Small openings such as those for passing wires or chains, tackle and anchors, and also holes of scuppers, discharge and sanitary pipes should not be considered as open if they submerge at an angle of inclination more than 30°. If they submerge at an angle of 30° or less, these openings should be assumed open if the Administration considers this to be a source of significant flooding.

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

Effect of liquid in tanks

(13) For all conditions, the initial metacentric height and the stability curves should be corrected for the effect of free surfaces of liquids in tanks in accordance with the following assumptions:

(i) Tanks which are taken into consideration when determining the effect of liquids on the stability at all angles of inclination should include single tanks or combinations of tanks for each kind of liquid (including those for water ballast) which according to the service conditions can simultaneously have free surfaces.

(ii) For the purpose of determining this free surface correction, the tanks assumed slack should be those which develop the greatest free surface moment, $M_{f,s.}$ at a 30° inclination, when in the 50 per cent full condition.

(iii) The value of $M_{f.s.}$ for each tank may be derived from the formula

$$M_{f.s.} = vb\gamma k\sqrt{\delta}$$

where:

$M_{f.s.}$ = the free surface moment at a 30° inclination in metre-tons,

v = the tank total capacity in m^3,

b = the tank maximum breadth in m,

γ = the specific weight of liquid in the tank in t/m^3,

$\delta = \frac{v}{blh}$ = the tank block coefficient

h = the tank maximum height in m,

l = the tank maximum length in m,

k = dimensionless coefficient to be determined from the following table according to the ratio b/h. The intermediate values are determined by interpolation (linear or graphic).

(iv) Small tanks, which satisfy the following condition using the value of k corresponding to the angle of inclination of 30°, need not be included in computation:

$$vb\gamma k\sqrt{\delta} < 0.01\Delta_{min}$$

where:

Δ_{min} = minimum ship displacement in tons (metric tons).

(v) The usual remainder of liquids in the empty tanks is not taken into account in computation.

TABLE OF VALUES FOR COEFFICIENT "K" FOR CALCULATING FREE SURFACE CORRECTIONS

$k = \frac{\sin\theta}{2}\left(1 + \frac{\tan^2}{2}\right) \times b/h$ where $\cot\theta \geq b/h$

$k = \frac{\cos\theta}{8}\left(1 + \frac{\tan\theta}{b/h}\right) - \frac{\cos\theta}{12(b/h)}\,2\left(1 + \frac{\cot^2\theta}{2}\right)$ where $\cot\theta < b/h$

θ / b/h	5°	10°	15°	20°	30°	40°	45°	50°	60°	70°	75°	80°	90°	θ / b/h
20	0.11	0.12	0.12	0.12	0.11	0.10	0.09	0.09	0.07	0.05	0.04	0.03	0.01	20
10	0.07	0.11	0.12	0.12	0.11	0.10	0.10	0.09	0.07	0.05	0.04	0.03	0.01	10
5	0.04	0.07	0.10	0.11	0.11	0.11	0.10	0.10	0.08	0.07	0.06	0.05	0.03	5
3	0.02	0.04	0.07	0.09	0.11	0.11	0.11	0.10	0.09	0.08	0.07	0.06	0.04	3
2	0.01	0.03	0.04	0.06	0.09	0.11	0.11	0.11	0.10	0.09	0.09	0.08	0.06	2
1.5	0.01	0.02	0.03	0.05	0.07	0.10	0.11	0.11	0.11	0.11	0.10	0.10	0.08	1.5
1	0.01	0.01	0.02	0.03	0.05	0.07	0.09	0.10	0.12	0.13	0.13	0.13	0.13	1
0.75	0.01	0.01	0.02	0.02	0.04	0.05	0.07	0.08	0.12	0.15	0.16	0.16	0.17	0.75
0.5	0.00	0.01	0.01	0.02	0.02	0.04	0.04	0.05	0.09	0.16	0.18	0.21	0.25	0.5
0.3	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.03	0.05	0.11	0.19	0.27	0.42	0.3
0.2	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.04	0.07	0.13	0.27	0.63	0.2
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.04	0.06	0.14	1.25	0.1

APPENDIX II

STANDARD CONDITIONS OF LOADING TO BE EXAMINED

1. Loading Conditions

The standard loading conditions referred to in 4.2 of the Recommendation are as follows:

(1) Passenger ship

(i) ship in the fully loaded departure condition with full stores and fuel and with the full number of passengers with their luggage;

(ii) ship in the fully loaded arrival condition, with the full number of passengers and their luggage but with only 10 per cent stores and fuel remaining;

(iii) ship without cargo, but with full stores and fuel and the full number of passengers and their luggage;

(iv) ship in the same condition as at (iii) above but with only 10 per cent stores and fuel remaining.

(2) Cargo ship

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

(ii) ship in the fully loaded arrival condition with cargo homogeneously distributed throughout all cargo spaces and with 10 per cent stores and fuel remaining;

(iii) ship in ballast in the departure condition, without cargo but with full stores and fuel;

(iv) ship in ballast in the arrival condition, without cargo and with 10 per cent stores and fuel remaining.

2. Assumptions for Calculating Loading Conditions

(1) For fully loaded conditions mentioned in 1.(2)(i) and (2)(ii) of this Appendix if a dry cargo ship has tanks for liquid cargo, the effective deadweight in the loading conditions therein described should be distributed according to two assumptions, i.e. (i) cargo tanks full, and (ii) cargo tanks empty.

(2) In conditions mentioned in 1.(1)(i) and (2)(i) of this Appendix, it should be assumed that the ship is loaded to her subdivision load line or summer load line with water ballast tanks empty.

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

(4) In all cases the cargo is assumed to be fully homogeneous unless this condition is inconsistent with the practical service of the ship.

(5) In all cases when deck cargo is carried a realistic stowage weight should be assumed and stated, including the height of cargo.

(6) A weight of 75 kg. should be assumed for each passenger except that this value may be reduced to not less than 60 kg. where this can be justified. In addition the weight and distribution of the luggage should be determined by the Administration.

(7) The height of the centre of gravity for passengers should be assumed equal to:

(i) 1.0 metres above deck level for passengers standing upright. Account may be taken, if necessary, of camber and sheer of deck;

(ii) 0.30 metres above the seat in respect of seated passengers.

(8) Passengers and luggage should be considered to be in the spaces normally at their disposal, when assessing compliance with the criteria at 5.1(a), (b), (c) and (d) of the Recommendation.

(9) Passengers without luggage should 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 at 5.2(a) and (b) of the Recommendation respectively. In this connexion it is anticipated that a value higher than 4 persons per square metre will not be necessary.

APPENDIX III

MEMORANDUM TO ADMINISTRATIONS ON AN APPROXIMATE DETERMINATION OF SHIP'S STABILITY BY MEANS OF THE ROLLING PERIOD TESTS (for ships up to 70 m in length)*

1. Recognizing the desirability of supplying to Masters of small ships instructions for a simplified determination of initial stability, attention was given to the rolling period tests. Studies on this matter have now been completed with the result that the rolling period test may be recommended as a useful means of approximately determining the initial stability of small ships when it is not practicable to give approved loading conditions or other stability information, or as a supplement to such information.

2. Investigations comprising the evaluation of a number of inclining and rolling tests according to various formulae showed that the following formula gave the best results and it has the advantage of being the simplest:

$$GM_o = \left(\frac{fB}{T_r}\right)^2,$$

where:

f = factor for the rolling period (different for feet and metric system),

B = breadth of the ship in feet or metric units,

T_r = time for a full rolling period in seconds (i.e. for one oscillation "to and fro" port - starboard - port, or vice versa).

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* Extract from MSC/Circ.30 distributed on 14 February 1966.

3. The factor "f" is of the greatest importance and the data from the above tests were used for assessing the influence of the distribution of the various masses in the whole body of the loaded ship.

4. For coasters of normal size (excluding tankers), the following average values were observed:

		metric system	feet system
(a)	empty ship or ship carrying ballast	f ~0.88	f ~0.49
(b)	ship fully loaded and with liquids in tanks comprising the following percentage of the total load on board (i.e. cargo, liquids, stores, etc.)		
	1. 20% of total load	f ~0.78	f ~0.435
	2. 10% of total load	f ~0.75	f ~0.415
	3. 5% of total load	f ~0.73	f ~0.405

The stated values are mean values. Generally, observed f-values were within $\pm$0.05 of those given above.

5. These f-values were based upon a series of limited tests and, therefore, Administrations should re-examine these in the light of any different circumstances applying to their own ships.

6. It must be noted that the greater the distance of masses from the rolling axis, the greater the rolling coefficient will be.

Therefore it can be expected that:

- the rolling coefficient for an unloaded ship, i.e. for a hollow body, will be higher than that for a loaded ship;

- the rolling coefficient for a ship carrying a great amount of bunkers and ballast - both groups are usually located in the double bottom, i.e. far away from the rolling axis - will be higher than that of the same ship having an empty double bottom.

7. The above recommended rolling coefficients were determined by tests with vessels in port and with their consumable liquids at normal working levels; thus, the influences exerted by the vicinity of the quay, the limited depth of water and the free surfaces of liquids in service tanks are covered.

8. Experiments have shown that the results of the rolling test method get increasingly less reliable the nearer they approach GM-values of 0.20 m. and below.

9. For the following reasons, it is not generally recommended that results be obtained from rolling oscillations taken in a seaway:

(a) Exact coefficients for tests in open waters are not available.

(b) The rolling periods observed may be not free oscillations but forced oscillations due to seaway.

(c) Frequently, oscillations are either irregular or only regular for too short an interval of time to allow accurate measurements to be observed.

(d) Specialized recording equipment is necessary.

10. However, sometimes it may be desirable to use the vessels period of roll as a means of approximately judging the stability at sea. If this is done, care should be taken to discard readings which depart appreciably from the majority of other observations. Forced oscillations corresponding to the sea

period and differing from the natural period at which the vessel seems to move should be disregarded. In order to obtain satisfactory results, it may be necessary to select intervals when the sea action is least violent, and it may be necessary to discard a considerable number of observations.

11. In view of the foregoing circumstances, it needs to be recognized that the determination of the stability by means of the rolling test in disturbed waters should only be regarded as a very approximate estimation.

12. The formula given in paragraph 2 can be reduced to

$$GM_o = \frac{F}{T_r^2}$$

and the Administration should determine the F value(s) for each vessel.

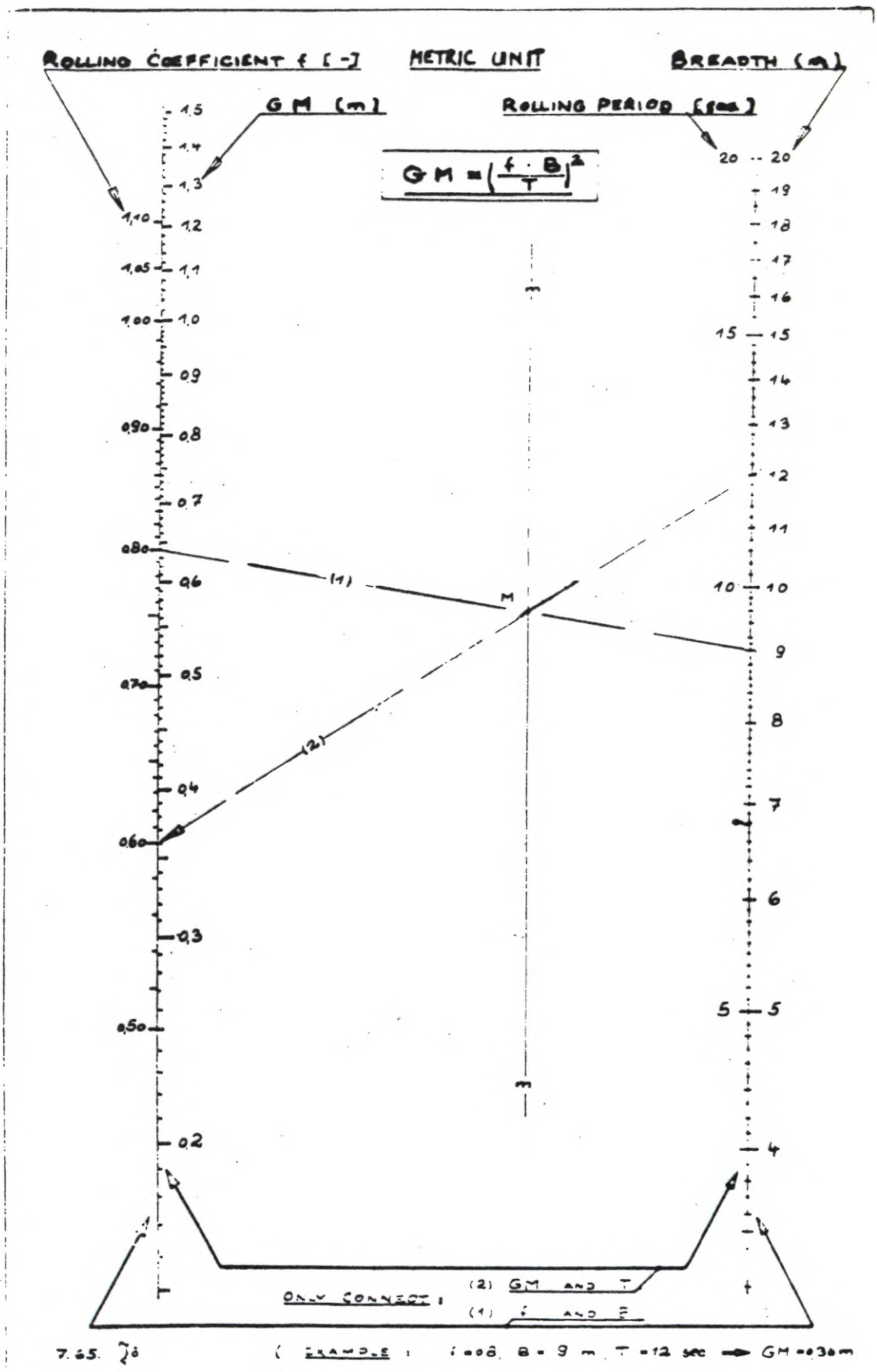
13. The determination of the stability can be simplified by giving the master permissible rolling periods, in relation to the draughts, for the appropriate value(s) of F considered necessary.

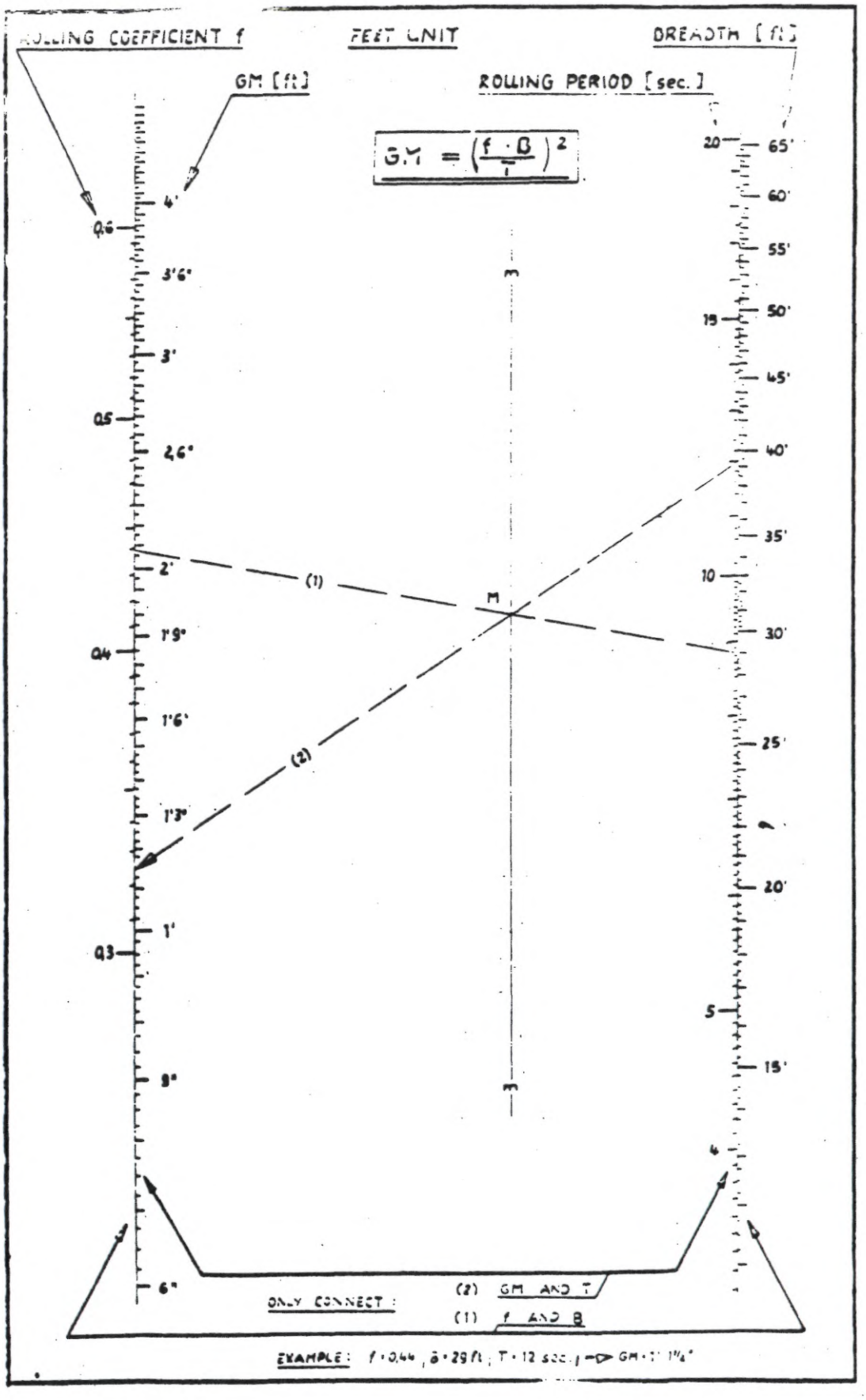
14. The initial stability may also be more easily determined graphically by using one of the attached sample nomograms for feet and/or metric units as described below:

(a) The values for B and f are marked in the relevant scales and connected by a straight line (1). This straight line intersects the vertical line (mm) in the point (M).

(b) A second straight line (2) which connects this point (M) and the point on the T_r scale corresponding with the determined rolling period, intersects the GM scale at the requested value.

15. The Appendix shows an example of a recommended form in which these instructions might be presented by each Administration to the Masters. It is considered that each Administration should recommend the F-value or values to be used.


ROLLING COEFFICIENT f [-]
METRIC UNIT
BREADTH (m)
GM (m)
ROLLING PERIOD [sec]
$GM = \left(\frac{f \cdot B}{T}\right)^2$
1,10
1,05
1,00
0,90
0,80
0,70
0,60
0,50
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
(1)
(2)
ONLY CONNECT :
(2) GM AND T
(1) f AND F
EXAMPLE : f = 0.8 B = 9 m T = 12 sec → GM = 0.30 m


ROLLING COEFFICIENT f
FEET UNIT
BREADTH [ft]
GM [ft]
ROLLING PERIOD [sec.]
$GM = \left(\frac{f \cdot B}{T}\right)^2$
0.6
0.5
0.4
0.3
4'
3'6"
3'
2'6"
2'
1'9"
1'6"
1'3"
1'
9"
6"
M
(1)
(2)
20
19
65'
60'
55'
50'
45'
40'
35'
30'
25'
20'
15'
10
5
4
ONLY CONNECT :
(2) GM AND T
(1) f AND B
EXAMPLE : f = 0,44 ; B = 29 ft ; T = 12 sec. ; ⇒ GM = 1' 1¾"

APPENDIX

SUGGESTED FORM OF GUIDANCE TO THE MASTER ON AN APPROXIMATE DETERMINATION OF SHIP'S STABILITY BY MEANS OF THE ROLLING PERIOD TEST

Introduction

1. If the following instructions are properly carried out, this method allows a reasonably quick and accurate estimation of the metacentric height, which is a measure of the ship's stability.

2. The method depends upon the relationship between the metacentric height and the rolling period in terms of the extreme breadth of the vessel.

Test Procedure

3. The rolling period required is the time for one complete oscillation of the vessel and to ensure the most accurate results in obtaining this value the following precautions should be observed:

(a) The test should be conducted with the vessel in harbour, in smooth water with the minimum interference from wind and tide.

(b) Starting with the vessel at the extreme end of a roll to one side (say port) and the vessel about to move towards the upright, one complete oscillation will have been made when the vessel has moved right across to the other extreme side (i.e. starboard) and returned to the original starting point and is about to commence the next roll.

(c) By means of a stop-watch, the time should be taken for not less than about 5 of these complete oscillations; the counting of these oscillations should

begin when the vessel is at the extreme end of a roll. After allowing the roll to completely fade away, this operation should be repeated at least twice more. If possible, in every case the same number of complete oscillations should be timed to establish that the readings are consistent, i.e. repeating themselves within reasonable limits. Knowing the total time for the total number of oscillations made, the mean time for one complete oscillation can be calculated.

(d) The vessel can be made to roll by rhythmically lifting up and putting down a weight as far off middle-line as possible; by pulling on the mast with a rope; by people running athwartships in unison; or by any other means. However, and this is most important, as soon as this forced rolling has commenced the means by which it has been induced must be stopped and the vessel allowed to roll freely and naturally. If rolling has been induced by lowering or raising a weight it is preferable that the weight is moved by a dockside crane. If the ship's own derrick is used, the weight should be placed on the deck, at the middle-line, as soon as the rolling is established.

(e) The timing and counting of the oscillations should only begin when it is judged that the vessel is rolling freely and naturally, and only as much as is necessary to accurately count these oscillations.

(f) The moorings should be slack and the vessel "breasted off" to avoid making any contact during its rolling. To check this, and also to get some idea of the number of complete oscillations that can be reasonably counted and timed, a preliminary rolling test should be made before starting to record actual times.

(g) Care should be taken to ensure that there is a reasonable clearance of water under the keel and at the sides of the vessel.

(h) Weights of reasonable size which are liable to swing, (e.g. a lifeboat), or liable to move (e.g. a drum), should be secured against such movement. The free surface effects of slack tanks should be kept as small as is practicable during the test and the voyage.

Determination of the Initial Stability

4. Having calculated the period for one complete oscillation, say T seconds, the metacentric height GM_o can be calculated from the following formula:

$$GM_o = \frac{F}{T^2}$$

where F is .../to be determined for each particular vessel by the Administration/.

5. The calculated value of GM_o should be equal to or greater than the critical value which is ... /to be determined for each particular vessel by the Administration/.

Limitations to the Use of this Method

6. A long period of roll corresponding to a GM_o of 0.20 m. or below, indicates a condition of low stability. However, under such circumstances, accuracy in determination of the actual value of GM_o is reduced.

7. If, for some reason, these rolling tests are carried out in open, deep but smooth waters, inducing the roll, for example, by putting over the helm, then the GM_o calculated by using the method and coefficient of paragraph 3 above should be reduced by /figure to be estimated by the Administration/ to obtain the final answer.

8. The determination of stability by means of the rolling test in disturbed waters should only be regarded as a very approximate estimation. If such test is performed, care should be taken to discard readings which depart appreciably from the majority of other observations. Forced oscillations corresponding to the sea period and differing from the natural period at which the vessel seems to move should be disregarded. In order to obtain satisfactory results, it may be necessary to select intervals when the sea action is least violent, and it may be necessary to discard a considerable number of observations.