

MSC/Circ.456

GUIDELINES FOR THE PREPARATION OF INTACT STABILITY INFORMATION

- 1 The Maritime Safety Committee at its fifty-third session, adopted Guidelines for the preparation of intact stability information for the master which are set out in the annex.
- 2 Member Governments are invited to ensure their widespread circulation and in particular to:
 - .1 utilize these guidelines to decide the extent of intact stability information necessary and appropriate to the type of ship and mode of operation;
 - .2 encourage designers and owners to use these guidelines in the preparation of all necessary documentation for the proper operation of the ship;
 - .3 encourage designers to provide a simplified but meaningful summary of the intact stability information, derived from data collected under the preceding paragraph to assist the master in the routine operation of his ship and to provide him with the means of evaluating the stability of his ship in other conditions;
 - .4 acknowledge the availability of electronic aids and their use in the more complicated operating conditions as a supplement to the information otherwise provided.

ANNEX

GUIDELINES FOR THE PREPARATION OF INTACT STABILITY INFORMATION

1 INTRODUCTION

Intact stability information covering the general operation of the ship is required for most ships by regulation II-1/22 of the International Convention for the Safety of Life at Sea, 1974, as amended, and by regulation 10 of the International Convention on Load Lines, 1966. Additional specific intact stability information is recommended by other international instruments. The following guidelines are offered to assist Administrations, ship designers, ship owners, masters and all others concerned with the proper design, construction and operation of ships to decide the proper extent of stability information required and necessary.

2 CATEGORIES OF INFORMATION

Information included in a stability document should be classified as follows:

2.1 Category 1A

Information which includes all basic data necessary to obtain the trim and stability characteristics of the ship. It may be necessary however to supplement this information to meet current requirements of the Administration concerned.

2.2 Category 1B

Optional information which is deemed by owners to be useful material appropriate to the operation of the ship.

2.3 Category 2

Information which provides the master with ready means of ensuring that the ship's stability parameters for a given service and condition of loading lie within the limits dictated by the Administration. Included also in this category is information which will enable the master by using data provided under category 1 to obtain further information as may be required by the Administration or by himself for the proper working of the ship. Information within this category may be simplified if in the opinion of the Administration, or government recognized organization, the ship is not critical in terms of the required stability criteria within the range and type of loading conditions and for the service intended.

3 GENERAL

- 3.1 An index of contents should precede all information in the document.
- 3.2 The pages of the stability document should be numbered to facilitate access to data in association with the index of contents and appropriate reference.
- 3.3 Units of measurement should be consistent throughout the stability document. The main units of measurement may however be transposed to other units for reference purposes provided this does not conflict with consistent use of the data provided. All units of measurement should be clearly and unambiguously stated.
- 3.4 Computations which support the data included under categories 1 and 2 should not be included in the stability document.
- 3.5 The accuracy and correctness of the information included in the document under category 1B should be the responsibility of the owners.
- 3.6 Information provided under different categories need not be physically separated within the document, however, any information provided under category 1B should be clearly identified.
- 3.7 Longitudinal, vertical and transverse centres of mass, volume, buoyancy and flotation should be given relative to common reference planes.
- 3.8 A description of each category should be included in the stability document. (see section 2)

4 CATEGORY 1A

Information under this category should include the following:

4.1 General information

- .1 ship's name;
- .2 type of ship (e.g. general cargo ship, container ship, oil tanker etc.);

- .3 name of builders and yard number;
- .4 date of build/conversion;
- .5 particulars of classification;
- .6 nationality, port of registry and official number;
- .7 principal dimensions (length, breadth and depth);
- .8 maximum mean permissible draught corresponding to the summer freeboard assigned;
- .9 maximum mean permissible draught corresponding to the summer timber freeboard (if appropriate);
- .10 displacement in salt water (at stated density) corresponding to .8 and .9 at the designed trim;
- .11 the minimum recommended draught at the forward perpendicular for any sailing condition.

4.2 Arrangement drawing

A scaled drawing showing clearly the use and distribution of the various cargo compartments, tanks, stores as well as machinery, crew and passenger accommodation spaces. Names of compartments used in the text of the document should be clearly indicated.

4.3 Weights and centres of mass

Estimated total weight and centre of mass of items such as:

- .1 passengers and their effects;
- .2 crew and their effects;
- .3 vehicles in the case of car ferries;
- .4 deck cargoes;
- .5 hanging loads;
- .6 container cargoes.

In the case of ships intended for the carriage of containers, a container stowage plan should be included using a numbering system to enable the weight and centre of every container on board to be obtained. The maximum and minimum (unladen) weight of all containers should be given. Where necessary, guidance should be given as to the methods used in assessing weights and centres of mass.

4.4 Volumes and centres of volume

A table of capacities with centres of volume (longitudinal, vertical and transverse) for every compartment available for the carriage of cargo, fuel, stores, feed water, domestic water and water ballast. Where applicable, tables or curves giving capacity and centre of volume as functions of compartment depth or ullage should be included. When ullage is used, the ullage reference point should be stated.

4.5 Free surface effects

Tables and/or curves for every tank as a function of volume showing the effect on the stability of the ship of liquids in partially filled tanks. These tables/curves should give the free surface moments necessary to correct the initial metacentric height and those to correct the righting lever values when the ship is inclined.

4.5.1 In the case of tanks containing liquids which may be consumed, discharged or transferred to and from other compartments while the ship is at sea, including anti-rolling tanks and/or heeling tanks, the maximum free surface moments which may be developed should be given. For the purpose of correcting the initial metacentric height, the data provided for such tanks should be a function of the maximum attainable second moment of liquid surface area about the principal axis of rotation parallel to the centerline of the ship when not inclined. Corresponding data for correcting the righting lever values may be computed using the method described in section 3 of appendix I to [resolution A.167\(ES.IV\)](#). This method provides a means for calculating the maximum free surface moments of tanks which are approximately trapezoidal in cross-section. In the case of irregularly shaped tanks such free surface moments should be obtained independently by direct calculation.

4.5.2 When holds or deep tanks containing liquids are maintained partially filled whilst the ship is at sea, the free surface moments used may be based upon the actual quantity of fluid contained. If due to the service of the ship different amounts of liquids are carried, the free surface moments for such a space may be calibrated against volume and depth of filling. Alternatively, the method described in 4.5.1 may be used.

4.5.3 Where it can be shown that by using methods which do not correctly obtain the free surface moments for a particular space but which nevertheless show the ship's critical stability parameters to be more onerous than they are in practice, such methods may be used subject to agreement by the Administration.

4.6 Lightship particulars and rolling coefficient

Details resulting from the inclining experiment as follows:

- .1 lightship weight;
- .2 longitudinal centre of gravity of lightship;
- .3 vertical centre of gravity of lightship;
- .4 transverse centre of gravity of lightship if necessary;

.5 place at and date on which inclining experiment was conducted;

.6 name of organization responsible for the approval of results obtained during the inclining experiment.

The position of the reference planes should be stated for items specified in .2, .3 and .4. If dispensation from carrying out an inclining experiment has been given, the name of the authority and the reasons should be stated. If details of the lightship have been based on a sister ship, the builder and builders number of the sister ship should be stated together with items specified in .1 to .6. In such a case details corresponding to .1, .2, .4, .5 and .6 which apply to the lightship check should be given. If differences in values of items specified in .1 to .4 from the sister ship have been used and there are known reasons, these should be stated together with a summary showing how the adopted values have arisen. If permanent ballast is included in the lightship particulars, a description of such ballast should be included giving the material, its mass and distribution relative to the common reference planes. A sketch showing the distribution of such ballast should be included. If a rolling period test is required by the Administration, details of the result should be given.

4.7 Hydrostatic particulars

Hydrostatic particulars of the ship at the designed trim drawn in curves or tabulated to a base of mean draught measured to the bottom of the keel over a range covering the lightship and maximum draughts. When tabulated, these should correspond to evenly-spaced rounded units of draught at intervals appropriate to the size and type of ship. If the hydrostatic particulars are presented in the form of curves their scales and accuracy should be to the satisfaction of the Administration or government recognized organization. The particulars should include:

.1 extreme displacement in salt water at stated density;

.2 immersion (displacement per unit interval of draught);

.3 moment to change trim one unit;

.4 transverse metacentric height;

.5 longitudinal metacentric height;

.6 vertical centre of buoyancy;

.7 longitudinal centre of floatation;

.8 longitudinal centre of buoyancy.

Position of reference planes should be stated in the case of items specified in .4 to .8. Where operation of the ship results in loading conditions having significant trim, additional hydrostatic particulars should be included for a suitable range of trim.

4.8 Deadweight particulars and details of draught marks

If required by the Administration, a diagram or tabular presentation giving the relationships between:

.1 mean draught;

.2 extreme displacement;

.3 immersion (displacement per unit interval of draught);

.4 deadweight.

If desired, in lieu of the above, the deadweight information may be included in the hydrostatic particulars. If required, the positions of the draught marks should be defined in relation to the ship's perpendiculars.

4.9 Form stability particulars

Form stability data at the designed trim showing the relationship between righting lever, angle of heel and displacement drawn in curves or tabulated. The data should cover the full range of displacement extending from light to maximum draughts with a range of inclination appropriate to the type of ship and stability criteria adopted. If the data is given in the form of curves, the scale and accuracy should be to the satisfaction of the Administration or government recognized organization. Intervals of displacement and righting lever when tabulated and angles of inclination should be sufficient to meet the accuracy demanded by the stability criteria. Below 500 the intervals of inclination should not exceed 100, however, closer spacing may be required according to the ship form and proportions, also to the stability criteria adopted. A statement should be appended to the data indicating the erections and/or timber deck loads which are included. 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, additional form stability data should be included for a suitable range of trim.

5. CATEGORY 2

Information under this category should include the following:

5.1 Stability criteria

Full details of the stability criteria appropriate to the ship under all anticipated conditions of service should be clearly stated in text supplemented, as necessary, by diagrams using the nomenclature adopted for the data given in category 1. Where requirements for wind and/or wave forces and ice accretion are specified by the Administration, full details should be given.

5.2 Details relating to the assigned load line

.1 a statement giving the type of load line assigned (type A, B, etc);

.2 the displacement of the ship on the summer load waterline at the designed trim in water at a density of 1.025 metric tons per cubic metre;

.3 the maximum permissible draught at the forward perpendicular if necessary for bow height consideration;

.4 the minimum permissible freeboard at the stern if required by Administration;

.5 a diagram of the load line marks showing:

.5.1 the position of the deck line relative to the ship;

.5.2 the draught to the summer load waterline;

.5.3 the draught to the summer timber load waterline if appropriate);

.5.4 the corresponding freeboards.

5.3 Critical stability data

A pre-calculated table and/or diagram from which the master can determine if the stability of the ship is acceptable for a given loading condition under the governing stability criteria. This information should show, for example, the maximum allowable height of the loaded ship's centre of gravity or the maximum allowable static (displacement or deadweight) moment about the bottom of keel as a function of draught or displacement. The form of the data and the parameters used should be to the satisfaction of the Administration taking into account the stability criteria adopted, the ship type and the service intended. The data should extend from the lightest anticipated sea-going draught to the minimum freeboard assigned. If two or more independent governing stability parameters or conditions of service are included in the stability criteria the information should provide for any combination. Where the operating trim or the form and arrangement of the ship are such that a change in trim has an appreciable effect on righting arms additional pre-calculated tables/diagrams should be included for a suitable range of trim.

5.4 Conditions of loading

Conditions of loading appropriate to the operation of the ship should be included showing the practical limits of service for which the ship is intended and to demonstrate the stability characteristics in relation to the specified stability criteria. The following conditions of loading should also be included unless they are clearly inappropriate:

.1 light condition;

.2 docking condition;

.3 the conditions of loading stipulated in section 1 of appendix II to [resolution A.167\(ES.4\)](#);

.4 departure and arrival conditions of loading for which the ship has been specially designed (e.g. alternate hold loading, timber deck cargoes, containers on deck etc.). Where icing is likely to occur the loading conditions should take this into account.

5.4.1 Each condition of loading should include:

.1 a sketch of the ship indicating, pictorially, the main items of deadweight included in the displacement.

.2 a table showing the lightship particulars, the distribution of all components of the deadweight, the positions of their centres relative to the defined reference planes, corresponding static moments and a summation giving the result. The result should show the full weight of displacement and the position of its centre.

.3 a table listing the free surface effects of liquids in all compartments which may be partly filled.

.4 a diagram showing the curve of righting levers (GZ) plotted against angle of inclination. The righting levers are to be corrected for free surface effects (see .3). Wind and/or other heeling lever curves are to be superimposed on the diagram as appropriate and it should be demonstrated that all the stability criteria have been met. The scales used in this diagram should be the same for each loading condition.

.5 a summary of the appropriate condition giving:

.5.1 displacement;

.5.2 corresponding designed trim draught at longitudinal centre of floatation;

.5.3 moment to change trim one unit;

.5.4 longitudinal position of centre of buoyancy;

.5.5 longitudinal position of centre of gravity;

.5.6 trimming lever;

.5.7 total trim over perpendiculars;

.5.8 longitudinal position of centre of floatation;

.5.9 trim at forward perpendicular;

.5.10 trim at after perpendicular;

.5.11 draught at forward perpendicular;

.5.12 draught at after perpendicular;

- .5.13 draught at the forward draught mark (if required);
- .5.14 draught at the after draught mark (if required);
- .5.15 mean draught amidships;
- .5.16 the total free surface moment for initial stability;
- .5.17 the vertical position of the transverse metacentre;
- .5.18 the vertical position of the ship's centre of gravity uncorrected and corrected for free surface effects;
- .5.19 the transverse metacentric height (GM) uncorrected and corrected for free surface effects;
- .5.20 a statement giving the limiting value or values of stability parameters taken from the data provided under

5.1 together with corresponding values achieved.

5.2 Master's instructions

Instructions to the master in the use of the data provided under category 1 to obtain the draught, trim and stability characteristics appropriate to a loading condition meeting the requirements of 5.1 and the draught limitations in 5.2. These instructions should refer to numerical examples which may be drawn-up specifically for the purpose or to conditions of loading provided under 5.4. The instructions are to be precise and unambiguous. Sources of data within the document and other information should be clearly identified. Specific instructions should be given with regard to the following items;

- .1 calculations of displacement and centres of gravity;
- .2 calculation of draughts and trim;
- .3 correct use of the data provided under 4.5 in obtaining free surface moment data for a given loading condition;
- .4 lifting of form stability data from the information provided under 4.9 and correction to that data to account for the position of the ship's vertical centre of gravity (see .1) and for free surface effects (see .3);
- .5 calculation of initial stability parameter (GM) corrected for the initial free surface effect (see .3);
- .6 calculation of the ship's vertical centre of gravity corrected for the initial free surface effect (see .3);
- .7 construction of righting lever (GZ) curves;
- .8 construction of a heeling lever curve (as appropriate) relative to and on the same diagram as the righting lever (GZ) curve;
- .9 evaluation of the GZ curve (also the heeling lever curve if appropriate) in relation to the specified stability criteria;
- .10 evaluation of stability parameters, if appropriate, in relation to assumed wind and/or wave forces;
- .11 where ballasting during a voyage is necessary, the master should be provided with guidance to ensure the stability of the ship;
- .12 the correct operation of anti-rolling devices and/or heeling tanks and limitations on their use;
- .13 use of the data provided under 5.3;
- .14 use of any other data provided under category 1A which is required by the Administration to be included as necessary information in evaluating the stability of the ship;
- .15 if information is provided under category 1B, instructions should be given as to its use if appropriate.

6 ADDENDUM

Use of computers in assessing the stability of a loading condition. If a computer is provided for calculating stability parameters it should be regarded, unless deemed otherwise by the Administration, as an aid to the master. It should not replace approved documentation.
