

Guidance on the Approval of the Stability of Ships

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1 Introduction

- 1 The Danish Maritime Authority applies this guidance when approving the stability of ships. When a recognized organization approves the stability of ships on behalf of the Danish Maritime Authority, the organization need not apply this guidance, but may instead apply its own corresponding guidelines. In such cases, the material shall be sent directly to the relevant, recognized organization, and when it has been approved, a copy hereof shall be sent to the Danish Maritime Authority.
- 2 Danish regulations on stability correspond, to a wide extent, to international regulations. Thus, Notice from the Danish Maritime Authority B and D refer to the Code on Intact Stability, Res. A.749(18), as amended, whereas the regulations stipulated in the Notice from the Danish Maritime Authority E and F predominantly correspond to Chapter III in the Annex to the Torremolinos International Convention for the Safety of Fishing Vessels, 1977. The regulations often refer to this guidance, thus offering supplementary details that would have made the Notices from the Danish Maritime Authority too voluminous.
- 3 The guidance contains references to the guidelines mentioned below, which have been drawn up by the International Maritime Organization, IMO. They address naval architects to whom English is a convenient working language, and a possible translation might cause doubt about the interpretation as a consequence of slight linguistic differences. Therefore, the Danish Maritime Authority has chosen to refer to the original English source texts rather than to have them translated into Danish. The texts are available from Iver C. Weilbach & Co. A/S, Toldbodgade 35, 1253 Copenhagen K, Denmark.
 - .1 Res. A.749(18), Code on Intact Stability.
 - .2 Res. MSC.75(69), amending Res. A.749(18).
 - .3 MSC/Circ.920, Model Loading and Stability Manual.
 - .4 Res. MSC.23(59), International Code for the Safe Carriage of Grain in Bulk.
 - .5 MSC/Circ.919, Guidelines for Damage Control Plans.

.6 MSC/Circ.854, Guidelines for Shipboard Loading and Stability Computer Programs.

4 Guidance no. 2 of 1 February 1989 of the Danish Maritime Authority on the approval of intact stability is hereby revoked.

2 **Inclining Test**

1 When, according to the regulations, a lightweight survey and an inclining test are to be made to determine the lightship displacement and the centre of gravity, they can be approved if they have been carried out in accordance with the guidelines stipulated in the Code on Intact Stability, Res. A.749(18), Annex I, as amended. A standard form, cf. item 4.3.6 of the code, is available from the Danish Maritime Authority.

2 Lightweight surveys and inclining tests shall be carried out under the supervision of the Danish Maritime Authority or a recognized organization authorized to carry out the supervision on behalf of the Danish Maritime Authority.

3 The Danish Maritime Authority may, in accordance with specific regulations, allow that neither a lightweight survey nor an inclining test is made for a certain ship if results from a lightweight survey and inclining test carried out on a sister ship are available and if it is shown that reliable stability information can be deducted from these data. Such exemptions are administered according to the following guidelines:

.1 Passenger ships can be exempted from neither a lightweight survey nor an inclining test.

.2 With regard to other ships, a lightweight survey and an inclining test shall normally be carried out for the first two ships in a series of sister ships built at the same yard.

.3 If the results of the first two sister ships are well in line, the two succeeding sister ships may be exempted from the inclining test if a lightweight survey for these ships is well in line with the results of the first two sister ships.

.4 With regard to the fifth sister ship, and subsequently with regard to every third sister ship in a series, a lightweight survey shall be carried out to check that the results are in accordance with the original data. In case of accordance, the subsequent two sister ships may be exempted from a lightweight survey and an inclining test. If the results are not in accordance with the original data, an inclining test shall be carried out on the ship in question, and the Danish Maritime Authority shall decide whether further stability examinations shall be carried out on the sister ships that have been exempted in the meantime pursuant to the above provisions.

.5 A possible request for exemption shall be submitted on a standard form available from the Danish Maritime Authority.

3 **Dynamometer Test**

1 In a few cases, the regulations for smaller vessels allow the inclining test to be replaced by a so-called dynamometer test. In such cases, the Danish Maritime Authority may approve dynamometer tests that have been carried out in accordance with the following guidelines:

- .1 The test shall be carried out in the operating condition required by the regulations. Normally, this means the most severe actual operating condition. If there is doubt about which is the most severe actual operating condition, the test may be carried out in more than one operating condition.
- .2 The weight displacement of the ship Δ (kg) shall be determined on an authorized scale or by use of a crane and a dynamometer with a calibration certificate.
- .3 A pendulum or a similar instrument shall be set up in order to determine the angles of heel.
- .4 A crane wire or a similar arrangement with an inserted dynamometer with a calibration certificate shall be attached to the vessel in order to make it possible to incline it by a minimum of 30°. The weight P (kg) used for the inclination shall be read at intervals of 5° up to 30° or the flooding angle if this is below 30°. The test shall be continued with larger inclinations if practicable.
- .5 The distance a (m) from the estimated centre of gravity of the vessel to the pull wire shall be measured perpendicularly.
- .6 The righting lever GZ (m) is calculated by using the following formula and shall be plotted versus the inclination:

$$GZ = \frac{P * a}{\Delta - P}$$

- .7 In order for the stability to be considered satisfactory, the area below the GZ curve shall comply with the relevant stability criteria in the regulations.
- .8 The test shall be carried out under the supervision of the Danish Maritime Authority, and the results shall be filled into a standard form available from the Danish Maritime Authority.

4 Stability Information

- 1 With regard to new-built ships, the shipyard or the consultant shall as soon as possible forward preliminary stability information in duplicate to the Danish Maritime Authority for approval. The preliminary stability information contains, on the whole, the same data as the final stability information, but it is based on a calculation of the lightweight data of the ship rather than on the result of an inclining test. If the vertical centre of gravity, KG, does not exceed what has been calculated preliminarily, and if the lightweight does not diverge by more than 2%, the preliminary stability information may be approved for preliminary use on-board with a demand that final stability information is forwarded within one month. In this case, the shipmaster shall be informed that the preliminary information is not final. If the preliminary stability information cannot be approved, the ship cannot receive a permit to operate, but a trial trip authorization may be issued based on the current loading condition of the ship and the result of the inclining test.
- 2 Final stability information shall also be forwarded to the Danish Maritime Authority for approval. In case of ships in class, at least

three copies shall be submitted, and in case of ships not in class, at least two copies shall be submitted.

- 3 All calculations of hydrostatic data, isocline data, angle of flooding, and data on the stability limit shall be carried out using a computer programme approved by the Danish Maritime Authority. A list of such approved programmes as well as the criteria that form the basis of the approval is available from the Danish Maritime Authority.
- 4 The Danish Maritime Authority may approve stability information drawn up in accordance with the guidelines stipulated in MSC/Circ.920, Model Loading and Stability Manual. In this connection, the following remarks shall be taken into consideration:
 - .1 According to Paragraph 1.2.6 of this Circular, the principal dimensions of the ship shall be indicated in the first paragraph. The maximum permissible draught shall be indicated, and it shall correspond to the deepest draught in the approved loading conditions. In this connection, all other draught limitations shall be taken into consideration, including possible load lines and subdivision load lines as well as the scantling draught. In case of fishing vessels, the equivalent, maximum permissible dead weight and the minimum freeboard shall be indicated.
 - .2 In Paragraph 2.5.1 of the Circular, a number of typical loading conditions are indicated. The conditions mentioned do not replace the conditions given in the regulations applicable to the ships.
 - .3 According to Paragraph 2.5.5.3 of the Circular, each loading condition shall be related to a GZ curve. When the GZ curve, according to the regulations, shall be cut at the angle where flooding will occur through openings that have not been closed weathertight, this shall be illustrated on the curve for every loading condition.
 - .4 With reference to Paragraph 3.7.1 of the Circular, the maximum permissible centre of gravity or, alternatively, the minimum permissible metacentric height of the ship shall be shown in a table versus its draught or displacement. Furthermore, the relevant data shall be illustrated graphically in a so-called limit curve diagram where the calculated conditions are shown as well. The limit curve diagram shall describe the entire operational range of the ship.
 - .5 Paragraph 3.8 of the Circular on the limits of the ship's strength may be omitted.
- 5 Stability information about existing ships shall, as far as certain types of ships are concerned, be checked periodically through a lightweight survey. If such a lightweight survey reveals a change in the lightweight of the ship of more than 2% or a difference of more than 1% of L of the longitudinal centre of gravity, a new inclining test shall also be carried out. If such an inclining test reveals a change in the lightweight of the ship of more than 2% or that the vertical centre of gravity, KG, has become greater, the existing stability information shall be corrected.
- 6 In case of a rebuilding, stability information on existing ships shall normally be updated in accordance with the following guidelines:
 - .1 In case of a rebuilding that changes the principal dimensions of the ship, a new inclining test shall be carried out, and the

stability information shall comply with the requirements for stability information about an equivalent new ship.

- .2 In case of changes that, in the opinion of the Danish Maritime Authority, will have a considerable influence on the lightweight data of the ship, but which do not change the principal dimensions, a new inclining test shall be carried out, and the existing stability information shall be corrected in accordance with the results hereof.
- .3 In case of changes that, in the opinion of the Danish Maritime Authority, will not have considerable influence on the lightweight data of the ship, it may be accepted that the existing stability information of the ship is corrected on the basis of one of the following methods:
 - .1 A lightweight survey shall be carried out as well as a direct calculation of the changed displacement and the vertical centre of gravity on the basis of the weight and the moment of relocated, added, and removed weights.
 - .2 The same heeling moment shall be applied before and after the rebuilding. A possible approval presupposes that the resulting angle of heel is greatest before the rebuilding.

7 Reflagged ships shall be provided with stability information adjusted to the relevant Danish regulations and this Guidance. With regard to ships the stability of which a recognized organization approves on behalf of the Danish Maritime Authority, see Paragraph 1.1 of this Guidance. Existing stability information approved by the former flag state may be approved for preliminary use on-board for a period of six months from the conclusion of the initial survey unless major changes have been made to the ship and these have not been included. In case such changes have been made, the procedure for new-built ships shall be followed. The final stability information shall be based on lightweight data obtained according to the following guidelines:

- .1 Passenger ships shall be subjected to a lightweight survey unless existing stability information is available which has been approved by the former flag state within the last five years. If such a lightweight survey reveals a change in the lightweight of the ship of more than 2% or a difference of more than 1% of L of the longitudinal centre of gravity, a new inclining test shall be carried out.
- .2 Cargo vessels shall be subjected to a lightweight survey unless existing stability information is available which has been approved by the former flag state within the last ten years. If such a lightweight calculation reveals a change in the lightweight of the ship of more than 2% or a difference of more than 1% of L of the longitudinal centre of gravity, a new inclining test shall be carried out.
- .3 Fishing vessels shall be subjected to a new inclining test unless existing stability information is available which has been approved by the former flag state within the last five years.

5 Grain Stability Calculations

1 With regard to ships where grain stability is required, the shipyard or the consultant shall, as soon as possible, forward grain stability calculations in duplicate to the Danish Maritime

Authority for approval. Grain stability calculations do not replace ordinary stability information.

- 2 The Danish Maritime Authority may approve grain stability calculations carried out in accordance with the guidelines stipulated in Res. MSC.23(59), International Code for the Safe Carriage of Grain in Bulk.

6 Damage Stability Material

- 1 With regard to ships of which damage stability is required, the shipyard or the consultant shall, as soon as possible, forward the following damage stability material in at least two copies to the Danish Maritime Authority for approval:

- .1 Drawings and other information.
- .2 Calculations.
- .3 Report on calculations.
- .4 Certificate of control of the calculations.

- 2 The material shall be in either Danish or English, and the Danish Maritime Authority shall approve it on the basis of a certificate of control from one of the following approved institutions or recognized organizations:

- .1 Carl Bro Industri & Marine, Dwingen Marineconsult.
- .2 Knud E. Hansen.
- .3 Dansk Maritimt Institut.
- .4 American Bureau of Shipping.
- .5 Bureau Veritas.
- .6 Det norske Veritas.
- .7 Germanischer Lloyd.
- .8 Lloyd's Register of Shipping.
- .9 Nippon Kaiji Kyokai.

- 3 Drawings and other information that form the basis of the damage stability of the ship shall be of a standard normally used within ship-building and shall normally comprise the following:

- .1 Lines drawing.
- .2 General arrangement showing the hull, superstructures, etc.
- .3 List of openings that may, according to the calculations, limit the survival capacity of the ship as well as their location and closing devices.
- .4 Preliminary damage control plan in accordance with paragraph 7 of this Guidance.

- 4 A report on calculations shall summarize the results. Furthermore, it shall contain the following information about the legal basis, the ship, and the constructive prerequisites to the extent that it is relevant:

- .1 The title and date of the report.
- .2 The type and control number of the ship as well as its name or newbuilding number.
- .3 The principal dimensions of the ship.

- .4 Regulations according to which the ship has been built and approved.
 - .5 The name and version of the computer programme used.
 - .6 Drawings that form the basis of the calculations.
 - .7 A general description of the watertight subdivision and the watertight volumes as well as an attached calculation based on the recorded off-sets.
 - .8 A summary of all cases of damage with a description of the final condition after the damage, including draught, heeling, trim, range, area and maximum righting lever GZ for the residual stability as well as freeboard to the margin line or limiting flooding openings. Furthermore, the most limiting criteria shall be indicated.
 - .9 A list of the internal watertight doors with an indication of their location as well as the water pressure in damaged condition.
 - .10 Location and dimensions of possible cross flooding ducts, maximum heeling before equalization, as well as a calculation of the time of equalization, and the residual stability during intermediate stages.
 - .11 Special constructional and operational aspects.
 - .12 Curve of floodable length or permissible length between the bulkheads with an indication of the subdivision factor.
 - .13 Location of bulkhead deck.
 - .14 Margin line submergence and heeling.
 - .15 Draught to the subdivision load line.
 - .16 Criterion numeral.
 - .17 Weight, arm, and calculation of the heeling moment from passengers crowding, lowered fully loaded life-saving appliances, or wind. The greatest effect of such moments on the minimum requirement for the righting lever GZ shall be plotted versus draught.
 - .18 When the calculations have been made in accordance with probabilistic regulations, summarizing tables shall show the individual contributions to the attained Index A.
 - .19 An illustration of the requirements of the damage stability for maximum KG or minimum GM in intact condition versus draught or displacement. This curve shall also form part of the stability information of the ship.
- 5 A certificate of control shall show that the result of the calculations has been controlled by an approved institution on the basis of the drawings and other information that have been presented. The certificate shall contain the following:
- .1 Certificate date.
 - .2 The type and control number of the ship as well as its name or newbuilding number.
 - .3 The regulations according to which the ship has been built or controlled.
 - .4 The name and version of the computer programme used.
 - .5 Reference to controlled drawings, calculations, and reports.
 - .6 The accuracy and quality of the results.

- ..7 All preconditions of importance to the results.
- .8 The name of the person who has made the calculations as well as the name of the person who has carried out the control. Both persons may be affiliated with the same approved institution, but if so the certificate shall state that the control and calculation have been carried out independently.

6 When stability information of existing ships relating to intact stability is corrected in connection with a periodic stability control or a rebuilding, the damage stability material shall be updated to the extent needed if the preconditions that form the basis of the approval have been changed. In such cases, all changes shall be accounted for by means of a rough outline or similar. The same applies when the damage stability of existing ships is upgraded.

7 Reflagged ships shall have material on damage stability adjusted to the relevant Danish regulations.

7 Damage Control Plans

1 The shipyard or the consultant shall, as soon as possible, forward the damage control plans of the ship to the Danish Maritime Authority in three copies for approval.

2 The Danish Maritime Authority may approve damage control plans drawn up in accordance with the guidelines stipulated in MSC/Circ.919, Guidelines for Damage Control Plans.

8 Loading Computers

1 In case of ships equipped with a loading computer for calculation of stability, the Danish Maritime Authority recommends the guidelines stipulated in MSC/Circ. 854, Guidelines for Shipboard Loading and Stability Computer Programs. The Danish Maritime Authority does not approve loading computers since they are not required according to the regulations.