

BIRO KLASIFIKASI INDONESIA

Guidelines for the Preparation of Damage Stability Calculations and Damage Control Documentation on Board



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Section 1

Guidelines for the Preparation of Subdivision and Damage Stability Calculations

A. General

1. Purpose of the Guidelines

- 1.1** These guidelines serve the purpose of simplifying the process of the damage stability analysis as experience has shown that a systematic and complete presentation of the particulars results in considerable saving of time during the approval process.
- 1.2** A damage stability analysis serves the purpose to provide proof of the damage stability standard required for the respective ship type. At present, two different calculation methods, the deterministic concept and the probabilistic concept are applied.

2. Analysis concepts

2.1 Deterministic concept

The deterministic concept applies for the time being to passenger ships, oil, chemical and liquefied gas tankers, bulk carriers, offshore supply vessels, high speed craft and special-purpose ships. The deterministic concept is based on given damage assumptions (damage length, transverse extent, vertical extent). Depending on the ship type, number of passengers or potential risk to the environment by the cargo carried, compliance with a required compartment status is to be proved. In the case of passenger ships this can easily be achieved as only small differences of loading and a small range of draughts needs to be considered. In the case of tankers, on the other hand, the large variety of substances to be carried and their distribution in the ship require performance of an extensive, systematic analysis in order to get as many allowed service conditions as possible. For this type of vessel, experience has shown that a recalculation of representative loading conditions is inadequate, as divergent conditions are not admissible. With a few exceptions, this procedure will be adequate only, if an approved

computer is available on board, using a verified damage stability calculation program.

2.2 Probabilistic concept

The probabilistic concept acc. to **SOLAS II-1, Reg. 25-1** applies to all other cargo ships having a subdivision length exceeding 80 m and for passenger vessels in accordance with **IMO Resolution A.265 (VIII)**. In the case of the probabilistic concept a required subdivision index dependent on the ship's length respectively on the ship's length and the number of persons to be on board is required. Any assumed damage of arbitrary extent can make a contribution towards establishing this subdivision index. Thus, favourable subdivision and utilization of all possible alternatives will enable optimization of the attainable subdivision index. Since the requirements for floatability of a ship in damaged condition essentially contribute to determining its service conditions, it is imperative that the limitations are defined at an early stage of design.

2.3 Calculation method

For both analysis concepts the damage stability calculation is to be performed according to the method of lost buoyancy.

3. Scope of analysis and documentation on board

The scope of subdivision and damage stability analysis is determined by the required damage stability standard and aims at providing the ships master with clear intact-stability requirements. In general, this is achieved by determining VCG-respective GM-limit curves, containing the admissible stability values for the draught range to be covered. Within the scope of the analysis thus defined all potential or necessary damage conditions will be determined, taking into account the damage stability criteria, in order to obtain the required damage stability standard. Depending on the type and size of ship, this may involve a considerable amount of analyses. Referring to **SOLAS II-1, B-1, Reg. 23** and **Reg. 23-1** the necessity to provide the crew with the relevant information regarding the subdivision of the vessel is expressed, therefore plans shall be provided and permanently exhibited for the guidance of the officer in charge. These plans shall clearly show for each deck and hold the boundaries of the watertight compartments, the openings therein with means of closure and position of any controls thereof, and the arrangements for the correction of any list due to flooding. In

addition, Damage Control Booklets containing the aforementioned information shall be available.

B. Documents for Submission

1. Presentation of documents

The documentation shall begin with the following details: Principal dimensions, international rules applied such as **SOLAS-** or **MARPOL-** Conventions, IBC-, IGC-Codes ship type, Character of Classification, damage stability marking according to Volume I Rules for Classification & Surveys, Section 2, C. 2.5.1 designation of intact conditions, designation of damage conditions and pertinent damaged compartments, VCG-respective GM-limit curve.

2. General documents

For checking of the input data, the following is to be submitted:

- main dimensions
- lines plan, plotted or numerically
- hydrostatic data and cross curves of stability (incl. drawing of the buoyant hull)
- definition of sub- compartments with moulded volumes, centres of gravity and permeability- lay out plan for the sub-compartments with all internal and external opening points including their connected sub-compartments, and particulars used in measuring the spaces, such as general arrangement plan and tank plan
- lightship data
- load line draught
- co-ordinates of opening points with their level of tightness (e.g. weathertight, unprotected)
- watertight doors location with pressure calculation
- coordinates of margin line, respective deck contour

- side contour and wind profile
- cross- and downflooding devices and the calculations thereof according to IMO Res. A.266 with information about diameter, valves, pipes length and coordinates of inlet/outlet
- pipes in damaged area when the destruction of these pipes results in progressive flooding
- damage extensions and definition of damage cases

Additionally a Watertight Integrity Plan is to be prepared showing the subdivision of the vessel. The drawing shall describe the assumption for the damage stability calculation and is to be submitted at the earliest possible date together with the damage stability calculation. The drawing should contain the main- and local internal subdivision of the hull as well as information about arrangements of watertight longitudinal and transverse bulkheads, cargo hold entrances, air ventilation ducts, down- and crossflooding ducts etc.

3. Special documents

Dependent on the applicable concept of the damage stability calculation the following documentation of results is to be submitted.

3.1 For deterministic calculations:

It is to be distinguished between the calculation of limit curves (e.g. for passenger vessels) or the proof of compliance for distinctive loading conditions (e.g. for tank vessels).

3.1.1 Limit curve calculation

Initial condition with:

- draught, trim, GM, respective displacement with centres of gravity
- permanent solid or liquid ballast or min./max. quantities in tanks

Result list with:

- table with permissible VCG-respective GM values for

the observed range of draughts

Results for each damage case:

- draught, trim, heel, GM in damaged condition
- righting lever curve (incl. GZ_{max} and range)
- critical weathertight and unprotected openings with their angle of immersion
- dimension of the damage and details of subcompartments with amount of inflooded water/ lost buoyancy and outflooded liquids with their centres of gravity

3.1.2 Calculation of distinctive loading conditions

Loading condition with:

- draught, trim, GM
- displacement of the ship and solid cargo plus consumables with centres of gravity
- liquid cargo with density, filling ratio and centres of gravity,
- filled tanks with density, filling ratio and centres of gravity

Results for each damage case:

- draught, trim, heel, GM in damaged condition
- righting lever curve (incl. GZ_{max} and range)
- critical weathertight and unprotected openings with their angle of immersion
- dimension of the damage and details of sub compartments with amount of inflooded water/ lost buoyancy and outflooded liquids with their centres of gravity

3.1.3 Special documents for passenger vessels

For passenger vessels for which the deterministic concept is applicable, the calculation of the floodable length curve acc. to SOLAS II-1, Reg. 4 to 7 is to be submitted including the factor of sub division F and criterion numeral C_s including intermediate results.

3.2 For probabilistic calculations

Initial data:

- subdivision length L_s
- initial draughts and the corresponding GM- values
- required subdivision index R
- attained subdivision index A with a summary table for all contributions for all damaged zones

Results for each damage case which contributes to the index A:

- draught, trim, heel, GM in damaged condition
- dimension of the damage with probabilistic values p and v furthermore the documentation of the b-value calculation
- righting lever curve (incl. GZ_{max} and range) with factor of survivability s
- critical weathertight and unprotected openings with their angle of immersion
- details of sub-compartments with amount of inflooded water/lost buoyancy with their centres of gravity

3.3 Special consideration

For intermediate conditions such as stages before crossflooding or before progressive flooding an appropriate scope of the documentation covering the a.m. items is needed in addition. Furthermore, in cases of inconsistencies, BKI reserves the right to

request a more detailed representation of results and the documentation of interim results.

C. Documents on Board

For the on-board documentation Damage Control Plans and Damage Control Booklets are to be prepared. These documents are intended to provide the ship's officer in charge with clear information on the ship's watertight compartmentation and equipment related to maintaining the boundaries and effectiveness of the compartmentation so that, in the event of damage to the ship, proper precautions can be taken to prevent progressive flooding through openings therein and effective action can be taken to quickly mitigate and, where possible, recover the ship's loss of stability.

1. Damage Control Plan

For each ship for which a damage stability calculation is to be performed a Damage Control Plan is to be prepared, containing the following information if applicable and partly beyond the requirements of MSC/ Circ. 919:

- ship's name
- shipyard and hull no.
- BKI-register-no, Character of Classification and damage stability marking
- principal dimensions
- permissible number of persons to be carried
- subdivision index R
- main and local watertight subdivision
- numbering of compartments
- frame numbers and spacing
- penetration lines (e.g. B/5 or 760 mm-line) in each deck view
- simplified instructions in case of damage in order to prevent

- progressive flooding
- emergency exits
- watertight door location with control stations
- position of weathertight and unprotected opening points
- pipes in damaged area when the destruction of these pipes results in progressive flooding
- valves at bulkheads penetrations
- cross- and downflooding arrangement
- permanent solid or liquid ballast or min./max. quantities in tanks For the sake of clarity, unnecessary details, such as accommodation details or decks not considered in the damage stability calculation, are to be deleted from the Damage Control Plan.

2. Damage Control Booklet

In addition to the aforementioned, booklets shall be made available according to MSC/Circ. 434 and MSC/ Circ. 919 containing the following information:

- introduction and description of this manual
- principal dimensions and main data
- stability limiting values (VCG/GM limit curve)
- ship's watertight arrangement
- position of watertight doors and hatches with information about operational instructions
- position of all weathertight and unprotected openings
- piping arrangement incl. available pumps and valve arrangement
- cross- and downflooding arrangement
- summary of the damage stability calculation with description of the

- analysis concept and damage stability criteria
- information of the damage control locations
- position of sounding devices

All given information shall correspond with the Damage Control Plan.

The main purpose of such a document is to stipulate appropriate action in case of damage. The chapter for damage control should include information such as:

- workflow of damage scenario
- closing of watertight and weather tight openings
- check of the extent of damage and sounding of compartments
- use of pumps
- use of loading computer
- liquid transfer operations
- information to external authorities and emergency response group

The booklet should be supplemented with copies of the general arrangement plan, tank capacity plan and piping diagram as well as information about used abbreviations and the definition of the co-ordinate system. According to MSC/Circ. 434 for dry cargo vessels a limited number of damage cases shall be provided to inform the master about capabilities of his ship in the case of flooding. At least the flooding of the machinery space and each cargo compartment are to be shown. For the initial condition the ship should be assumed on even keel at least for two separate draughts (full load and partial load). The vertical centre of gravity (VCG) should be taken either from intact stability information or should correspond to the assumed load condition. The permeabilities correspond to the applicable Regulations.

The results of these flooding investigations should be presented in a form according to B. Additional guidance should be provided to ensure that the ship's officers referring to that information are aware that the results are included only to assist them in estimating the ship's relative survivability. The guidance should identify criteria on which the analyses were based and clearly indicate that the initial conditions of the ship's loading extents

and locations of damage, permeabilities, assumed for the analyses may have no correlation with the actual damaged condition of the ship.

D. On-Board Damage Control Computer Program

The use of on-board computers for stability calculations is not a requirement of Class. However, a stability software installed onboard shall cover all stability requirements applicable to the ship.

The scope of stability calculation software shall be in accordance with the information as approved by the administration and shall at least include all information and perform all calculations or checks as necessary to ensure compliance with the applicable stability requirements. Approved stability software is not a substitute for the approved stability information, and is used as a supplement to facilitate stability calculations. The input/output information should, as far as practicable, be easily comparable with approved stability information so as to avoid confusion and possible misinterpretation by the operator. An operation manual is to be provided for the on-board computer stability software. The language in which the stability information is displayed and printed as well as the operation manual should be the same as used in the ship's approved stability information. General approval of a program will be granted upon examination of the program on the basis of selected damage conditions of a test ship specified by BKI. The part of the program related to a specific ship will be checked by re-calculation of a given selection of damage conditions submitted, and approval for use on board the ship will be granted upon satisfactory compliance having been established.