Directive 2003/25/EC of the European Parliament and of the Council of 14 April 2003
on specific stability requirements for ro-ro passenger ships (Text with EEA relevance)

ANNEX I

SPECIFIC STABILITY REQUIREMENTS FOR RO-RO PASSENGER SHIPS
as referred to in Article 6

1.   In addition to the requirements of Regulation II-1/B/8 of the SOLAS Convention relating to watertight subdivision and stability in damaged condition, all ro-ro passenger ships referred to in Article 3(1) shall comply with the requirements of this Annex.

1.1.   The provisions of Regulation II-1/B/8.2.3 shall be complied with when taking into account the effect of a hypothetical amount of sea water which is assumed to have accumulated on the first deck above the design waterline of the ro-ro cargo space or the special cargo space as defined in Regulation II-2/3 assumed to be damaged (hereinafter referred to as 'the damaged ro-ro deck'). The other requirements of Regulation II-1/B/8 need not be complied with in the application of the stability standard contained in this Annex. The amount of assumed accumulated sea water shall be calculated on the basis of a water surface having a fixed height above:

(a)   the lowest point of the deck edge of the damaged compartment of the ro-ro deck; or

(b)   when the deck edge of the damaged compartment is submerged then the calculation is based on a fixed height above the still water surface at all heel and trim angles;

as follows:

    0,5 m if the residual freeboard (f_r) is 0,3 m or less,

    0,0 m if the residual freeboard (f_r) is 2,0 m or more, and

    intermediate values to be determined by linear interpolation, if the residual freeboard (f_r) is 0,3 m or more but less than 2,0 m,

where the residual freeboard (f_r) is the minimum distance between the damaged ro-ro deck and the final waterline at the location of the damage in the damage case being considered without taking into account the effect of the volume of assumed accumulated water on the damaged ro-ro deck,

1.2.   When a high-efficiency drainage system is installed, the administration of the flag State may allow a reduction in the height of the water surface.

1.3.   For ships in geographically defined restricted areas of operation, the administration of the flag State may reduce the height of the water surface prescribed in accordance with point 1.1 by substituting such height of the water surface by the following:

1.3.1. 0,0 m if the significant wave height (h_s) defining the area concerned is 1,5 m or less;

1.3.2. the value determined in accordance with paragraph 1.1 if the significant wave height (h_s) defining the area concerned is 4,0 m or above;

1.3.3. intermediate values to be determined by linear interpolation if the significant wave height (h_s) defining the area concerned is 1,5 m or more but less than 4,0 m,

        provided that the following conditions are fulfilled:

1.3.4. the flag State administration is satisfied that the defined area is represented by the significant wave height (hs) which is not exceeded with a probability of more than 10 %; and

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1.3.5.   the area of operation and, if applicable, the part of the year for which a certain value of the significant wave height (h_s) has been established are entered on the certificates.

1.4.   As an alternative to the requirements of paragraph 1.1 or 1.3, the flag State administration may exempt application of the requirements of paragraph 1.1 or 1.3 and accept proof, established by model tests carried out for an individual ship in accordance with the model test method, which appears in the Appendix, justifying that the ship will not capsize with the assumed extent of damage as provided in Regulation II-1/B/8.4 in the worst location being considered under paragraph 1.1, in an irregular seaway, and

1.5.   reference to acceptance of the results of the model test as an equivalence to compliance with paragraph 1.1 or 1.3 and the value of the significant wave height (hs) used in the model tests shall be entered on the ship's certificates.

1.6.   the information supplied to the master in accordance with Regulations II-1/B/8.7.1 and II-1/B/8.7.2, as developed for compliance with Regulations II-1/B/8.2.3 to II-1/B/8.2.3.4, shall apply unchanged for ro-ro passenger ships approved according to these requirements.

2.   For assessing the effect of the volume of the assumed accumulated sea water on the damaged ro-ro deck in paragraph 1, the following provisions shall prevail:

2.1.   a transverse or longitudinal bulkhead shall be considered intact if all parts of it lie inboard of vertical surfaces on both sides of the ship, which are situated at a distance from the shell plating equal to one-fifth of the breadth of the ship, as defined in Regulation II-1/2, and measured at right angles to the centreline at the level of the deepest subdivision load line;

2.2.   in cases where the ship's hull is structurally partly widened for compliance with the provisions of this Annex, the resulting increase of the value of one fifth of the breadth of it is to be used throughout, but shall not govern the location of existing bulkhead penetrations, piping systems, etc., which were acceptable prior to the widening;

[^{F1}2.3.   the tightness of transverse or longitudinal bulkheads which are taken into account as effective to confine the assumed accumulated sea water in the compartment concerned in the damaged ro-ro deck shall be commensurate with the drainage system, and shall withstand hydrostatic pressure in accordance with the results of the damage calculation. Such bulkheads shall be at least 4 m in height unless the height of water is less than 0,5 m. In such cases the height of the bulkhead may be calculated in accordance with the following:
Bh = 8hw

where:
   Bh is the bulkhead height;
   and hw is the height of water.

In any event, the minimum height of the bulkhead should be not less than 2,2 m. However, in case of a ship with hanging car decks, the minimum height of the bulkhead shall be not less than the height to the underside of the hanging deck when in its lowered position;]

2.4.   for special arrangements such as, e.g., full-width hanging decks and wide side casings, other bulkhead heights may be accepted on the basis of detailed model tests;

2.5.   the effect of the volume of the assumed accumulated sea water need not be taken into account for any compartment of the damaged ro-ro deck, provided that such a compartment has on each side of the deck freeing ports evenly distributed along the sides of the compartment complying with the following:

2.5.1. $A \geq 0,3\, l$

where A is the total area of freeing ports on each side of the deck in m^2; and l is the length of the compartment in m;

2.5.2.   the ship shall maintain a residual freeboard of at least 1,0 m in the worst damage condition without taking into account the effect of the assumed volume of water on the damaged ro-ro deck; and

2.5.3.   such freeing ports shall be located within the height of 0,6 m above the damaged ro-ro deck, and the lower edge of the ports shall be within 2 cm above the damaged ro-ro deck; and

2.5.4.   such freeing ports shall be fitted with closing devices or flaps to prevent water entering the ro-ro deck whilst allowing water which may accumulate on the ro-ro deck to drain.

2.6.   When a bulkhead above the ro-ro deck is assumed damaged, both compartments bordering the bulkhead shall be assumed flooded to the same height of water surface as calculated in paragraph 1.1 or 1.3.

3.   When determining significant wave height, the wave heights given on the maps or list of sea areas established by Member States in line with Article 5 of this Directive shall be used.

3.1.   For ships which are to be operated only for a shorter season, the host State administration shall determine in agreement with the other country whose port is included in the ships route, the significant wave height to be used.

4.   Model tests shall be conducted in accordance with the Appendix.

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[**F1**Appendix

Model test method

1.   Objectives

This revised model test method is a revision of the method contained in the Appendix to the Annex to resolution 14 of the 1995 SOLAS Conference. Since the entry into force of the Stockholm Agreement a number of model tests has been carried out in accordance with the test method previously in force. During these tests a number of refinements in the procedures have been identified. This new model test method aims to include these refinements and, together with the appended Guidance Notes, provide a more robust procedure for the assessment of survivability of a damaged ro-ro passenger ship in a seaway. In the tests provided for in paragraph 1.4 of the stability requirements included in Annex I, the ship should be capable of withstanding a seaway as defined in paragraph 4 hereunder in the worst-damage-case scenario.

2.   Definitions

L_{BP}	is the length between perpendiculars
H_S	is the significant wave height
B	is the moulded breadth of the ship
T_P	is the peak period
T_Z	is the zero crossing period

3.   Ship model

3.1.   The model should copy the actual ship for both outer configuration and internal arrangement, in particular all damaged spaces having an effect on the process of flooding and shipping of water. Intact draught, trim, heel and limiting operational KG corresponding to the worst damage case should be used. Furthermore, the test case(s) to be considered should represent the worst damage case(s) defined in accordance with SOLAS regulation II-1/8.2.3.2 (SOLAS 90) with regard to the total area under the positive GZ curve and the centreline of the damage opening should be located within the following range:

3.1.1. ± 35 % L_{BP} from midship;

3.1.2. an additional test will be required for the worst damage within ± 10 % L_{BP} from midship if the damage case referred to in .1 is outside of ± 10 % L_{BP} from midship.

3.2.   The model should comply with the following:

3.2.1. length between perpendiculars (L_{BP}) is to be at least 3 m or a length corresponding to a model scale of 1:40, whichever is greater, and the vertical extent up to at least three superstructure standard heights above the bulkhead (freeboard) deck;

3.2.2. hull thickness of flooded spaces should not exceed 4 mm;

3.2.3. in both intact and damaged conditions, the model should satisfy the correct displacement and draught marks (T_A, T_M, T_F, port and starboard) with a maximum tolerance in any one draught mark of + 2 mm. Draught marks forward and aft should be located as near FP and AP as practicable;

3.2.4. all damaged compartments and ro-ro spaces should be modelled with the correct surface and volume permeabilities (actual values and distributions) ensuring that floodwater mass and mass distribution are correctly represented;

3.2.5. the characteristics of motion of the actual ship should be modelled properly, paying particular attention to the intact GM tolerance and radii of gyration in roll and pitch motion. Both radii should be measured in air and be in the range of 0,35B to 0,4B for roll motion, and 0,2LOA to 0,25LOA for pitch motion;

3.2.6. main design features such as watertight bulkheads, air escapes, etc., above and below the bulkhead deck that can result in asymmetric flooding should be modelled properly as far as practicable to represent the real situation; Ventilating and cross-flooding arrangements should be constructed to a minimum cross section of 500 mm^2;

3.2.7. the shape of the damage opening should be as follows:

1. trapezoidal profile with side at 15o slope to the vertical and the width at the design waterline defined according to SOLAS regulation II-1/8.4.1;

2. isosceles triangular profile in the horizontal plane with the height equal to B/5 according to SOLAS regulation II-1/8.4.2. If side casings are fitted within B/5, the damaged length in way of the side casings should not be less than 25 mm;

3. notwithstanding the provisions of subparagraphs 3.2.7.1 and 3.2.7.2 above, all compartments taken as damaged in calculating the worst damage case(s) referred to in paragraph 3.1 should be flooded in the model tests;

3.3. The model in the flooded equilibrium condition should be heeled by an additional angle corresponding to that induced by the heeling moment $M_h = \max (M_{pass}; M_{launch})$-$M_{wind}$, but in no case should the final heel be less than 1o towards damage. M_{pass}, M_{launch} and M_{wind} are as specified in SOLAS regulation II-1/8.2.3.4. For existing ships this angle may be taken as 1o.

4. Procedure for experiments

4.1. The model should be tested in a long-crested irregular seaway defined by the JONSWAP spectrum with significant wave height HS, a peak enhancement factor $\gamma = 3,3$ and a peak period

$$T_P = 4\sqrt{H_S}\ (T_Z = T_P / 1,285)$$

. H_S is the significant wave height for the area of operation, which is not exceeded by a probability of more than 10 % on a yearly basis, but limited to a maximum of 4 m.

Furthermore,

4.1.1. the basin width should be sufficient to avoid contact or other interaction with the sides of the basin and is recommended not to be less than $L_{BP} + 2$ m;

4.1.2. the basin depth should be sufficient for proper wave modelling but should not be less than 1 m;

4.1.3. for a representative wave realisation to be used, measurements should be performed prior to the test at three different locations within the drift range;

4.1.4. the wave probe closer to the wave maker should be located at the position where the model is placed when the test starts;

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4.1.5. variation in H_S and T_P should be within ± 5 % for the three locations; and

4.1.6. during the tests, for approval purposes, a tolerance of + 2,5 % in H_S, ± 2,5 % in T_P and ± 5 % in T_Z should be allowed with reference to the probe closer to the wave maker.

4.2. The model should be free to drift and placed in beam seas (90*o* heading) with the damage hole facing the oncoming waves, with no mooring system permanently attached to the model used. To maintain a beam sea heading of approximately 90*o* during the model test the following requirements should be satisfied:

4.2.1. heading control lines, intended for minor adjustment, should be located at the centre line of the stem and stern, in a symmetrical fashion and at a level between the position of KG and the damaged waterline; and

4.2.2. the carriage speed should be equal to the actual drift speed of the model with speed adjustment made when necessary.

4.3. At least 10 experiments should be carried out. The test period for each experiment should be of a duration such that a stationary state is reached, but not less than 30 min in full-scale. A different wave realisation train should be used for each experiment.

5. Survival criteria

The model should be considered as surviving if a stationary state is reached for the successive test runs as required in paragraph 4.3. The model should be considered as capsized if angles of roll of more than 30*o* to the vertical axis or steady (average) heel greater than 20*o* for a period longer than three minutes full-scale occur, even if a stationary state is reached.

6. Test documentation

6.1. The model test programme should be approved by the Administration in advance.

6.2. Tests should be documented by means of a report and a video or other visual records containing all relevant information on the model and the test results, which are to be approved by the Administration. These should include, as a minimum, the theoretical and measured wave spectra and statistics (H_S, T_P, T_Z) of the wave elevation at the three different locations in the basin for a representative realisation, and for the tests with the model, the time series of main statistics of the measured wave elevation close to the wave maker and records of model roll, heave and pitch motions, and of the drift speed.**]**