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COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels,  
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Draft

**COMMISSION DIRECTIVE 2008/.../EC**

**of [...]**

**amending Directive 2003/25/EC on specific stability requirements for ro-ro passenger ships**

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Draft

**COMMISSION DIRECTIVE 2008/.../EC**

**of [...]**

**amending Directive 2003/25/EC on specific stability requirements for ro-ro passenger ships**

**(Text with EEA relevance)**

THE COMMISSION OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Community,

Having regard to 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<sup>1</sup>, and in particular Article 10 thereof,

Whereas:

- (1) Annex 2 of Resolution MSC.216(82) of the International Maritime Organisation (IMO) introduces new ship damage stability regulations into the Convention on the Safety of Life at Sea, (hereinafter 'SOLAS'), with effect from 1 January 2009. These new regulations, (hereinafter 'SOLAS 2009'), will replace SOLAS Chapter II-1, part A and B.
- (2) Article 4 of Regulation (EC) No 2099/2002 of the European Parliament and of the Council of 5 November 2002 establishing a Committee on Safe Seas and the Prevention of Pollution from Ships (COSS) and amending the Regulations on maritime safety and the prevention of pollution from ships<sup>2</sup> stipulates that for the purposes of Community maritime legislation, the applicable international instruments shall be those which have entered into force, including the most recent amendments thereto, with the exception of the amendments excluded from the scope of the Community maritime legislation resulting from the conformity checking procedure. Article 1 of Commission Regulation (EC) No 415/2004 of 5 March 2004 amending Regulation (EC) No 2099/2002 of the European Parliament and of the Council establishing a Committee on Safe Seas and the Prevention of Pollution from Ships (COSS) and amending the regulations on maritime safety and the prevention of pollution from ships adds Directive 2003/25/EC on specific stability requirements for ro-ro passenger ships to the list of those Community legal instruments to which Regulation (EC) No 2099/2002 applies.
- (3) Therefore, the reference in Article 6(1) of Directive 2003/25/EC to Regulation 8 of Chapter II-1, part B of SOLAS (hereinafter referred to as 'SOLAS 90') should be construed as a reference to the relevant provisions of SOLAS 2009 as from their entry into force.

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<sup>1</sup> OJ L 123, 17.5.2003, p. 22. Directive 2003/25/EC

<sup>2</sup> OJ L 324, 29.11.2002, p. 1. Regulation (EC) 2099/2002

- (4) It is recognized that the SOLAS 2009 regulations are considered to be more comprehensive and generally provide a higher level of safety than the rules they replace. This notwithstanding, the conclusions of specialised studies carried out in the United Kingdom and in Finland, along with an examination of the way in which the matter was considered during the drafting of SOLAS 2009, raise reasonable doubt as to whether the SOLAS 2009 rules take sufficiently into account the effects of the ingress of water on the vehicle deck of ro-ro passenger ships. Hence, as regards this specific problem, the level of safety provided by these new IMO regulations may not be as high as that currently in force in the Community through the application of the current SOLAS 90 regulations and that of the specific requirements set out in the Annex to Directive 2003/25/EC.
- (5) In May 2008, at the request of the Member States and the Commission, the IMO's 84th Maritime Safety Committee (MSC) agreed to include a new item in the work programme of the Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety (SLF) on the possibilities of revising SOLAS regulation II-1/8 and II-1/7-2 to satisfactorily address the issue of water on deck for ro-ro passenger ships.
- (6) Pending the conclusion of the work at the IMO, all necessary measures should be taken to ensure that, in terms of requirements concerning water on deck, the level of safety provided by Community legislation for new build ro-ro passenger ships is not diminished upon the entry into force of the SOLAS 2009 regulations.
- (7) The direct combination of the requirements of the SOLAS 2009 regulations and the requirements contained in Annex I to Directive 2003/25/EC is not possible due to their different mathematical bases so this has to be achieved indirectly. It is therefore necessary to adapt the requirements of Annex I to Directive 2003/25/EC by retaining their essential elements and laying down a method for their implementation.
- (8) The measures provided for in this Directive are in accordance with the opinion of the Committee on Safe Seas and the Prevention of Pollution from Ships (COSS) and should be adopted and transposed as quickly as possible to ensure coherence of Community rules with the SOLAS 2009 regulations.

HAS ADOPTED THIS DIRECTIVE:

#### *Article 1*

Annexes I and II of Directive 2003/25/EC are replaced by the Annexes to this Directive.

References within provisions of national law giving effect to the Annexes to Directive 2003/25/EC shall be construed as references to the Annexes to this Directive.

#### *Article 2*

##### *Transposition*

1. Member States shall adopt and publish, by 1 January 2009 at the latest, the laws, regulations and administrative provisions necessary to comply with this Directive. They shall forthwith communicate to the Commission the text of those provisions and a correlation table between those provisions and this Directive.

They shall apply those provisions from 1 January 2009.

When Member States adopt those provisions, they shall contain a reference to this Directive or be accompanied by such a reference on the occasion of their official publication. Member States shall determine how such reference is to be made.

2. Member States shall communicate to the Commission the text of the main provisions of national law which they adopt in the field covered by this Directive.

*Article 3*

This Directive shall enter into force on the day following that of its publication in the *Official Journal of the European Union*.

*Article 4*

This Directive is addressed to the Member States.

Done at Brussels, [...]

*For the Commission*

[...]

*Member of the Commission*

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## ANNEX I

As referred to in Article 6

### PART A - SPECIFIC STABILITY REQUIREMENTS FOR RO-RO PASSENGER SHIPS CONSTRUCTED BEFORE 1 JANUARY 2009

1. Annex I, Part A is applicable to all ro-ro passenger ships the keel of which was laid or which was at a similar stage of construction before 1 January 2009

References within Annex I, Part A to the regulations under the SOLAS Convention concern only those regulations in force prior to 1 January 2009.

In addition to the requirements of regulation II-1/B/8 of the SOLAS Convention ('SOLAS 90') 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 of the SOLAS Convention ('SOLAS 90') 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 of the SOLAS Convention assumed to be damaged (referred to as "the damaged ro-ro deck" hereinafter). The other requirements of regulation II-1/B/8 of the SOLAS Convention ('SOLAS 90') 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 (fr) is 0.3 m or less;

0.0 m if the residual freeboard (fr) is 2.0 m or more; and

intermediate values to be determined by linear interpolation, if the residual freeboard (fr) is 0.3 m or more but less than 2.0 m;

where the residual freeboard (fr) 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 paragraph 1.1 by substituting such height of the water surface by the following:
  - 1.3.1 0.0 m if the significant wave height (hs) defining the area concerned is 1.5 m or less;

- 1.3.2 the value determined in accordance with 1.1 if the significant wave height (hs) 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 (hs) 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
  - 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 (hs) has been established are entered into the certificates.
- 1.4 as an alternative to the requirements of subparagraphs 1.1 or 1.3, the flag State Administration may exempt application of the requirements of subparagraphs 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 Appendix 1, justifying that the ship will not capsize with the assumed extent of damage as provided in SOLAS regulation II-1/8.4 in the worst location being considered under 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 paragraphs 1.1 or 1.3 and the value of the significant wave height (hs) used in the model tests shall be entered into the ship's certificates.
- 1.6 the information supplied to the master in accordance with SOLAS regulations II-1/8.7.1 and II-1/8.7.2, as developed for compliance with regulations II-1/8.2.3 to II-1/8.2.3.4, 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.
  - 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 0,5m. 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 based on 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<sup>2</sup>; 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 paragraphs 1.1 or 1.3 above.
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.

## 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 4.1 hereunder in the worst-damage-case scenario.

#### 2. Definitions

LBP is the length between perpendiculars

Hs is the significant wave height

B is the moulded breadth of the ship

TP is the peak period

TZ 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  $\pm 35\%$  LBP from midship;

3.1.2 an additional test will be required for the worst damage within  $\pm 10\%$  LBP from midship if the damage case referred to in .1 is outside of  $\pm 10\%$  LBP from midship.

3.2. The model should comply with the following:

3.2.1 length between perpendiculars (LBP) 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 3 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 (TA, TM, TF, 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<sup>2</sup>;
- 3.2.7. the shape of the damage opening should be as follows:
- 1 trapezoidal profile with side at 15° 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 1° 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 1°.

#### 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  $H_s$ , a peak enhancement factor  $\gamma = 3.3$  and a peak period  $TP = 4\sqrt{H_s}$  ( $TZ = TP / 1.285$ ).  $H_s$  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  $LBP + 2$  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 3 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;
  - 4.1.5 variation in  $H_s$  and  $TP$  should be within  $\pm 5\%$  for the three locations; and
  - 4.1.6 during the tests, for approval purposes, a tolerance of  $+2.5\%$  in  $H_s$ ,  $\pm 2.5\%$  in  $TP$  and  $\pm 5\%$  in  $TZ$  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° 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  $90^\circ$  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 ship 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  $30^\circ$  to the vertical axis or steady (average) heel greater than  $20^\circ$  for a period longer than 3 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 ( $H_s$ , TP, TZ) of the wave elevation at the 3 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.



However, in no case is the righting lever to be less than 0.1 metres.

.2.3.4 For the purpose of calculating the heeling moments in paragraph .2.3.3 the following assumptions shall be made:

- .1 Moments due to crowding of passengers:
  - .1.1 four persons per square metre;
  - .1.2 a mass of 75 kg for each passenger;
  - .1.3 passengers shall be distributed on available deck areas towards one side of the ship on the decks where assembly stations are located and in such a way that they produce the most adverse heeling moment.
- .2 Moments due to launching of all fully loaded davit-launched survival craft on one side:
  - .2.1 all lifeboats and rescue boats fitted on the side to which the ship has heeled after having sustained damage shall be assumed to be swung out fully loaded and ready for lowering;
  - .2.2 for lifeboats which are arranged to be launched fully loaded from the stowed position, the maximum heeling moment during launching shall be taken;
  - .2.3 a fully loaded davit-launched life-raft attached to each davit on the side to which the ship has heeled after having sustained damage shall be assumed to be swung out ready for lowering;
  - .2.4 persons not in the life-saving appliances which are swung out shall not provide either additional heeling or righting moment;
  - .2.5 life-saving appliances on the side of the ship opposite to the side to which the ship has heeled shall be assumed to be in a stowed position.
- .3 Moments due to wind pressure:
  - .3.1 a wind pressure of 120 N/m<sup>2</sup> to be applied;
  - .3.2 the area applicable shall be the projected lateral area of the ship above the waterline corresponding to the intact condition;
  - .3.3 the moment arm shall be the vertical distance from a point at one half of the mean draught corresponding to the intact condition to the centre of gravity of the lateral area.

8.4 Assumed extent of damage shall be as follows:

- .1 longitudinal extent: 3 metres plus 3 % of the length of the ship, or 11 metres, whichever is less. Where the required factor of subdivision is 0.33 or less the assumed longitudinal extent of damage shall be increased as necessary so as to include any two consecutive main transverse watertight bulkheads;
- .2 transverse extent (measured inboard from the ship's side, at right angles to the centreline at the level of the deepest subdivision load line): a distance of one fifth of the breadth of the ship, being the extreme width from outside of frame to outside of frame at or below the deepest subdivision load line.; and

- .3 vertical extent: from the base line upwards without limit;
  - .4 if any damage of lesser extent than that indicated in .4.1, .4.2, .4.3 would result in a more severe condition regarding heel or loss of metacentric height, such damage shall be assumed in the calculations.'
4. 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 (fr) is 0.3 m or less;

0.0 m if the residual freeboard (fr) is 2.0 m or more; and

intermediate values to be determined by linear interpolation, if the residual freeboard (fr) is 0.3 m or more but less than 2.0 m;

where the residual freeboard (fr) 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;

- 4.1 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 paragraph 4 by substituting such height of the water surface by the following:
  - 4.1.1 0.0 m if the significant wave height (hs) defining the area concerned is 1.5 m or less;
  - 4.1.2 the value determined in accordance with paragraph 4 if the significant wave height (hs) defining the area concerned is 4.0 m or above;
  - 4.1.3 intermediate values to be determined by linear interpolation if the significant wave height (hs) defining the area concerned is 1.5 m or more but less than 4.0 m;
    - provided that the following conditions are fulfilled:
      - 4.1.4 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
      - 4.1.5 the area of operation and, if applicable, the part of the year for which a certain value of the significant wave height (hs) has been established are entered into the certificates.
- 5. 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.
  - 5.1 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.

6. Further to the requirements of paragraph 3 to this Annex, the obtained results have to be verified with new calculations according to the requirements of Ch.II-1, Pt.B, Reg. 7 and 8 of SOLAS 2009. They have to comply Ch.II-1, Pt.B, Reg. 6.1 of paragraph 2 to this Annex.



## ANNEX II

As referred to in Article 6(3)

### PART A - INDICATIVE GUIDELINES TO NATIONAL ADMINISTRATIONS CONCERNING THOSE SHIPS TO WHICH ANNEX I, PART A APPLIES

#### SECTION I

##### Application

In line with the provisions of Article 6(3), these guidelines shall be used by the national administrations of Member States in the application of the specific stability requirements set out in Annex I, Part A, in so far this is practicable and compatible with the design of the ship in question. The paragraph numbers appearing below correspond to those in Annex I, Part A.

##### Para 1

As a first step all ro-ro passenger ships referred to in Article 3 (1) must comply with the “SOLAS ‘90” standard of residual stability as it applies to all passenger ships constructed on or after 29 April 1990. It is the application of this requirement that defines the residual freeboard (fr), necessary for the calculations required in paragraph 1.1.

##### Para 1.1

1. This paragraph addresses the application of a hypothetical amount of water accumulated on the bulkhead (ro-ro) deck. The water is assumed to have entered the deck via a damage opening. This paragraph requires that the vessel in addition to complying with the full requirements of the SOLAS '90 further complies with that part of the SOLAS '90 criteria contained in paragraphs 2.3 to 2.3.4. of regulation 8 of Chapter II-1 Part B of SOLAS with the defined amount of water on deck. For this calculation no other requirements of Chapter II-1 regulation 8 need be taken into account. For example the vessel does not, for this calculation, need to comply with the requirements for the angles of equilibrium or non-submergence of the margin line.
2. The accumulated water is added as a liquid load with one common surface inside all compartments which are assumed flooded on the car deck. The height (hw) of water on deck is dependent on the residual freeboard (fr) after damage, and is measured in way of the damage (see fig 1). The residual freeboard, is the minimum distance between the damaged ro-ro deck and the final waterline (after equalisation measures if any have been taken) in way of the assumed damage after examining all possible damage scenarios in determining the compliance with SOLAS '90 as required in para 1 of Annex I. No account should be taken of the effect of the hypothetical volume of water assumed to have accumulated on the damaged ro-ro deck when calculating fr.
3. If fr is 2.0m or more, no water is assumed to accumulate on the ro-ro deck. If fr is 0.3m or less, then height hw is assumed to be 0.5 metres. Intermediate heights of water are obtained by linear interpolation (see fig 2).

##### Para 1.2

Means for drainage of water can only be considered as effective if these means are of a capacity to prevent large amounts of water from accumulating on the deck ie many thousand of tonnes per hour which is far beyond the capacities fitted at the time of the adoption of these regulations. Such high efficiency drainage systems may be developed and approved in the future (based on guidelines to be developed by the International Maritime Organisation)

### Para 1.3

1. The amount of assumed accumulated water-on –deck may, in addition to any reduction in accordance with paragraph 1.1, be reduced for operations in geographically defined restricted areas, These areas are designated in accordance with the significant wave height ( $h_s$ ) defining the area in line with the provisions of Article 5.
2. If the significant wave height ( $h_s$ ), in the area concerned , is 1.5m or less then no additional water is assumed to accumulate on the damaged ro-ro deck. If the significant wave height in the area concerned is 4.0m or more then the height of the assumed accumulated water shall be the value calculated in accordance with paragraph 1.1. Intermediate values to be determined by linear interpolation (see fig 3).
3. The height  $h_w$  is kept constant, therefore the amount of added water is variable as it is dependent upon the heeling angle and whether at any particular heeling angle the deck edge is immersed or not. (see fig 4). It should be noted that the assumed permeability of the car deck spaces is to be taken as 90% (MSC/Circ.649 refers), whereas other assumed flooded spaces permeabilities are to be those prescribed in SOLAS.
4. If the calculations to demonstrate compliance with the Directive relate to a significant wave height less than 4.0m that restricting significant wave height must be recorded on the vessel's passenger ship safety certificate.

### Para 1.4 / 1.5

As an alternative to complying with the new stability requirements in paragraphs 1.1 or 1.3 an Administration may accept proof of compliance via model tests. The model test requirements are detailed in the Appendix to Annex I. Guidance notes on the model tests are contained in part II of this Annex.

### Para 1.6

Conventionally derived SOLAS '90 limiting operational curve(s) (KG or GM) may not remain applicable in cases where “water on deck” is assumed under the terms of the Directive and it may be necessary to determine revised limiting curve(s) which take into account the effects of this added water. To this effect sufficient calculations corresponding to an adequate number of operational draughts and trims must be carried out.

Note: Revised limiting operational KG/GM Curves may be derived by iteration, whereby the minimum excess GM resulting from damage stability calculations with water on deck is added to the input KG (or deducted from the GM) used to determine the damaged freeboards ( $fr$ ), upon which the quantities of water on deck are based, this process being repeated until the excess GM becomes negligible.

It is anticipated that operators would begin such an iteration with the maximum KG/minimum GM which could reasonably be sustained in service and would seek to manipulate the resulting deck bulkhead arrangement to minimise the excess GM derived from damage stability calculations with water on deck.

### Para 2.1

As for conventional SOLAS damage requirements bulkheads inboard of the B/5 line are considered intact in the event of side collision damage.

### Para 2.2

If side structural sponsons are fitted to enable compliance with this directive, and as a consequence there is an increase in the breadth (B) of the ship and hence the vessel's B/5 distance from the ship's side, such modification shall not cause the relocation of any existing structural parts or any existing penetrations of the main transverse watertight bulkheads below the bulkhead deck. (see fig 5)

#### Para 2.3

1. Transverse or longitudinal bulkheads/barriers which are fitted and taken into account to confine the movement of assumed accumulated water on the damaged ro-ro deck need not be strictly "watertight". Small amounts of leakage may be permitted subject to the drainage provisions being capable of preventing an accumulation of water on the "other side" of the bulkhead/barrier. In such cases where scuppers become inoperative as a result of a loss of positive difference of water levels other means of passive drainage must be provided.
2. The height (Bh) of transverse and longitudinal bulkheads/barriers shall be not less than  $(8 \times h_w)$  metres, where  $h_w$  is the height of the accumulated water as calculated by application of the residual freeboard and significant wave height (paras 1.1. and 1.3. refers). However in no case is the height of the bulkhead/barrier to be less than the greatest of:
  - a) 2.2 metres; or
  - b) the height between the bulkhead deck and the lower point of the underside structure of the intermediate or hanging car decks, when these are in their lowered position. It should be noted that any gaps between the top edge of the bulkhead and the underside of the plating must be "plated-in" in the transverse or longitudinal direction as appropriate. (see fig 6).

Bulkheads/barriers with a height less than that specified above, may be accepted if model tests are carried out in accordance with Part II of this Annex to confirm that the alternative design ensures appropriate standard of survivability. Care needs to be taken when fixing the height of the bulkhead/barrier such that the height shall also be sufficient to prevent progressive flooding within the required stability range. This range is not to be prejudiced by model tests.

Note: The range may be reduced to 10 degrees provided the corresponding area under the curve is increased (MSC 64/22 refers)

#### Para 2.5.1

The area "A" relates to permanent openings. It should be noted that the "freeing ports" option is not suitable for ships which require the buoyancy of the whole or part of the superstructure in order to meet the criteria. The requirement is that the freeing ports shall be fitted with closing flaps to prevent water entering, but allowing water to drain.

These flaps must not rely on active means. They must be self-operating and it must be shown that they do not restrict outflow to a significant degree. Any significant efficiency reduction must be compensated by the fitting of additional openings so that the required area is maintained.

#### Para 2.5.2

For the freeing ports to be considered effective the minimum distance from the lower edge of the freeing port to the damaged waterline shall be at least 1.0m. The calculation of the

minimum distance shall not take into account the effect of any additional water on deck. (see fig 7)

#### Para 2.5.3

Freeing ports must be sited as low as possible in the side bulwark or shell plating. The lower edge of the freeing port opening must be no higher than 2cm above the bulkhead deck and the upper edge of the opening no higher than 0.6m. (see fig 8)

Note: Spaces to which paragraph 2.5 applies, ie those spaces fitted with freeing ports or similar openings, shall not be included as intact spaces in the derivation of the intact and damage stability curves.

#### Para 2.6

1. The statutory extent of damage is to be applied along the length of the ship. Depending on the subdivision standard the damage may not affect any bulkhead or may only affect a bulkhead below the bulkhead deck or only bulkhead above the bulkhead deck or various combinations.
2. All transverse and longitudinal bulkheads/barriers which constrain the assumed accumulated amount of water must be in place and secured at all times when the ship is at sea.
3. In those cases where the transverse bulkhead/barrier is damaged the accumulated water-on-deck shall have a common surface level on both sides of the damaged bulkhead/barrier at the height  $h_w$  (see fig 9).

## SECTION II

### MODEL TESTING

The purpose of these guidelines is to ensure uniformity in the methods employed in the construction and verification of the model as well as in the undertaking and analyses of the model tests.

The contents of paragraphs 1 and 2 of the Appendix to Annex I are considered self-explanatory.

#### Paragraph 3 — Ship model

- 3.1. The material of which the model is made is not important in itself, provided that the model both in the intact and damaged condition is sufficiently rigid to ensure that its hydrostatic properties are the same as those of the actual ship and also that the flexural response of the hull in waves is negligible.

It is also important to ensure that the damaged compartments are modelled as accurately as practicably possible to ensure that the correct volume of flood water is represented.

Since ingress of water (even small amounts) into the intact parts of the model will affect its behaviour, measures must be taken to ensure that this ingress does not occur.

In model tests involving worst SOLAS damages near the ship ends, it has been observed that progressive flooding was not possible because of the tendency of the water on deck to accumulate near the damage opening and hence flow out. As such models were able to survive very high sea states, while they capsized in lesser sea states with less onerous SOLAS damages, away from the ends, the limit  $\pm 35\%$  was introduced to prevent this.

Extensive research carried out for the purpose of developing appropriate criteria for new vessels has clearly shown that in addition to the GM and freeboard being important parameters in the survivability of passenger ships, the area under the residual stability curve is also another major factor. Consequently in choosing the worst SOLAS damage for compliance with the requirement of paragraph 3.1 the worst damage is to be taken as that which gives the least area under the residual stability curve.

#### 3.2. Model particulars

- 3.2.1. In recognising that scale effects play an important role in the behaviour of the model during tests, it is important to ensure that these effects are minimised as much as practically possible. The model should be as large as possible since details of damaged compartments are easier constructed in larger models and the scale effects are reduced. It is therefore required that the model length is not less than that corresponding to 1:40 scale or 3 m, whichever is greater.

It has been found during tests that the vertical extent of the model can affect the results when tested dynamically. It is therefore required that the ship is modelled to at least three super structure standard heights above the bulkhead (freeboard) deck so that the large waves of the wave train do not break over the model.

- 3.2.2. The model in way of the assumed damages must be as thin as practically possible to ensure that the amount of flood water and its centre of gravity is adequately represented. The hull thickness should not exceed 4 mm. It is recognised that it may

not be possible for the model hull and the elements of primary and secondary subdivision in way of the damage to be constructed with sufficient detail and due to these constructional limitations it may not be possible to calculate accurately the assumed permeability of the space.

- 3.2.3 It is important that not only the draughts in the intact condition are verified, but also that the draughts of the damaged model are accurately measured for correlation with those derived from the damaged stability calculation. For practical reasons a tolerance of +2 mm in any draught is accepted.
- 3.2.4. After measuring the damaged draughts it may be found necessary to make adjustments to the permeability of the damaged compartment by either introducing intact volumes or by adding weights. However it is also important to ensure that the centre of gravity of the flood water is accurately represented. In this case any adjustments made must err on the side of safety.

If the model is required to be fitted with barriers on deck and the barriers are less than the bulkhead height indicated below, the model is to be fitted with CCTV so that any 'splashing over' and any accumulation of water on the undamaged area of the deck can be monitored. In this case a video recording of the event is to form part of the test records.

The height 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 should 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 the case of a ship with hanging car decks, the minimum height of the bulkhead should be not less than the height to the underside of the hanging car deck when in its lowered position.

- 3.2.5. In order to ensure that the model motion characteristics represent those of the actual ship it is important that the model is both inclined and rolled in the intact condition so that the intact GM and the mass distribution are verified. The mass distribution should be measured in air. The transverse radius of gyration of the actual ship should be in the range 0.35B to 0.4B and the longitudinal radius of gyration should be in the range 0.2L to 0.25L.

Note: While inclining and rolling the model in the damaged condition may be accepted as a check for the purpose of verifying the residual stability curve, such tests should not be accepted in lieu of the intact tests.

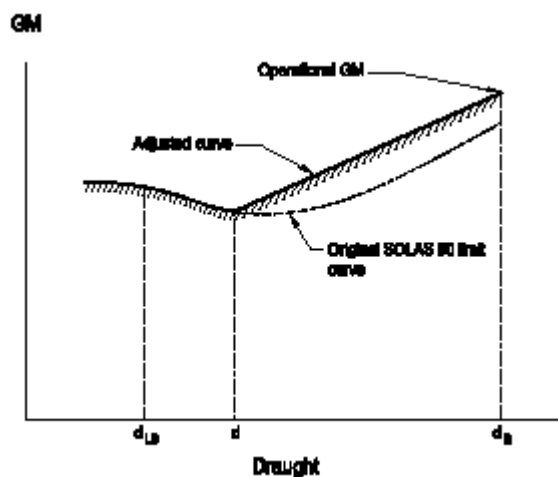
- 3.2.6. It is assumed that the ventilators of the damage compartment of the actual ship are adequate for unhindered flooding and movement of the flood water. However in trying to scale down the ventilating arrangements of the actual ship undesirable scale effects may be introduced in the model. In order to ensure that no such effects occur it is recommended to construct the ventilating arrangements to a larger scale than that of the model, ensuring that this does not affect the flow of water on the car deck.

- 3.2.7. It is deemed appropriate to consider a damage shape representative of a cross section of the striking ship in the bow region. The 15° angle is based on a study of the cross section at a distance of B/5 from the bow for a representative selection of vessels of different types and sizes.

The isosceles triangular profile of the prismatic damage shape is that corresponding to the load waterline.

Additionally in cases where side casings of width less than B/5 are fitted and in order to avoid any possible scale effects, the damage length in way of the side casings must not be less than 25 mm.

- 3.3 In the original model test method of resolution 14 of the 1995 SOLAS Conference the effect of heeling induced by the maximum moment deriving from any of passenger crowding, launching of survival craft, wind and turning was not considered even though this effect was part of SOLAS. Results from an investigation have shown, however, that it would be prudent to take these effects into account and to retain the minimum of 1° heel towards the damage for practical purposes. It is to be noted that heeling due to turning was considered not to be relevant.
- 3.4 In cases where there is a margin in GM in the actual loading conditions compared to the GM limiting curve (derived from SOLAS 90), the Administration may accept that this margin is taken advantage of in the model test. In such cases the GM limiting curve should be adjusted. This adjustment can be done as follows:



$$d = dS - 0.6 (dS - dLS)$$

where: dS is the subdivision draught; and dLS is the lightship draught.

The adjusted curve is a straight line between the GM used in the model test at the subdivision draught and the intersection of the original SOLAS 90 curve and draught d.

#### Paragraph 4 — Procedure for experiments

##### 4.1. Wave spectra

The JONSWAP spectrum should be used as this describes fetch- and duration-limited seas which correspond to the majority of conditions world wide. In this respect it is important that not only the peak period of the wave train is verified but also that the zero crossing period is correct.

It is required that for every test run the wave spectrum is recorded and documented. Measurements for this recording should be taken at the probe closest to the wave making machine.

It is also required that the model is instrumented so that its motions (roll, heave and pitch) as well as its attitude (heel, sinkage and trim) are monitored and recorded through-out the test.

It has been found that it is not practical to set absolute limits for significant wave heights, peak periods and zero crossing periods of the model wave spectra. An acceptable margin has therefore been introduced.

4.2 To avoid interference of the mooring system with the ship dynamics, the towing carriage (to which the mooring system is attached) should follow the model at its actual drifting speed. In a sea state with irregular waves the drift speed will not be constant; a constant carriage speed would result in low frequency, large amplitude drift oscillations, which may affect the model behaviour.

4.3 A sufficient number of tests in different wave trains is necessary to ensure statistical reliability, i.e. the objective is to determine with a high degree of confidence that an unsafe ship will capsize in the selected conditions. A minimum number of 10 runs is considered to provide a reasonable level of reliability.

#### Paragraph 5 — Survival criteria

The contents of this paragraph are considered self-explanatory.

#### Paragraph 6 — Test approval

The following documents are to be part of the report to the administration:

- (a) damage stability calculations for worst SOLAS and mid-ship damage (if different);
- (b) general arrangement drawing of the model together with details of construction and instrumentation;
- (c) inclining experiment and measurements of radii of gyration;
- (d) nominal and measured wave spectra (at the 3 different locations for a representative realisation and for the tests with the model from the probe closest to the wave maker);
- (e) representative record of model motions, attitude and drift
- (f) relevant video recordings

Note:

All tests must be witnessed by the administration.



## PART B - INDICATIVE GUIDELINES TO NATIONAL ADMINISTRATIONS CONCERNING THOSE SHIPS TO WHICH ANNEX I, PART B APPLIES

### Application

In line with the provisions of Article 6(3) of this Directive, these guidelines shall be used by the national administrations of Member States in the application of the specific stability requirements set out in Annex I, Part B, in so far as this is practicable and compatible with the design of the ship in question.

The SOLAS 2009 standard of damage/residual stability as set out in regulations 7 and 8 of SOLAS Chapter II-1 shall apply to all those ro-ro passenger ships constructed on or after 1 January 2009. In addition certain provisions of the former SOLAS 90 set of rules as laid down in Annex I part B (Chapter II-1/8.2.3 and II-1/8.4) will remain applicable.

Administrations are recommended to use the flowchart set out below and its supporting footnotes which provides a clear methodology to apply the provisions of Annex I, part B.

# Sequence of calculation of the Water on Deck with SOLAS 2009

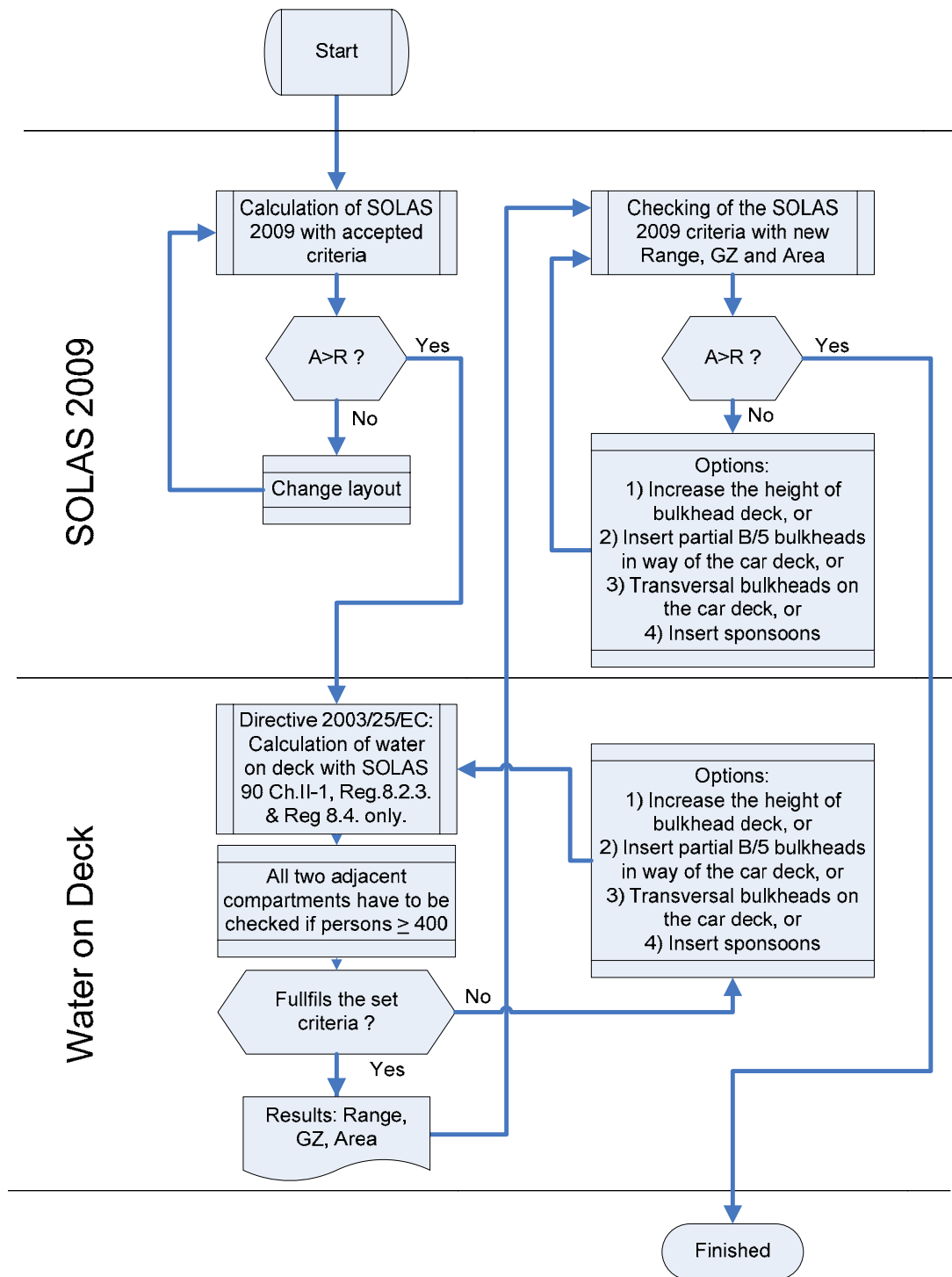


Figure 1.

Explanatory detail to Figure 1 above:

1. First the vessel is planned and calculated according to S2009

2. If the vessel does not fulfil  $A > R$ , where A is the Attained Index of Subdivision and R is the Required Index of Subdivision, the layout has to be changed and the calculation restarted.
3. When the plan fulfils  $A > R$ , the Water on Deck calculation may be started.
4. The water on deck will be calculated using Annex I of Directive 2003/25/EC.
5. Within Annex I, Part B, only the provisions of SOLAS 90 Ch.II-1,Pt.B, Reg.8.2.3 and Reg.8.4. need to be fulfilled.
6. If the persons onboard are  $> 400$ , all two adjacent compartments have to be checked (to find the worst case flooding.)
7. If the set criteria are not fulfilled, a change of layout or the following options will become necessary:
  - (a) Increase the height of bulkhead deck, or
  - (b) Insert partial B/5 bulkheads in way of the car deck, or
  - (c) Insert transversal bulkheads on the car deck, or
  - (d) Insert sponsons
8. A new calculation of Water on Deck will follow.
9. When the criteria for Water on Deck have been fulfilled, the values obtained (Range, GZ and Area) will be verified by a second SOLAS 2009 calculation.
10. If the index  $A > R$  is not fulfilled, a similar set of options to the above will follow for revision, prior to recalculating.
11. When  $A > R$  , the calculation is complete.

Note: When options are entered at the Water on Deck calculation stage, they must not be removed at the second SOLAS 2009 calculation.

## PART C

### Implementation

1. Directive 2003/25/EC is subject to Article 4 of Regulation (EC) 2099/2002 which provides for an automatic update of the applicable international instruments in force, including any recent amendments. The reference to SOLAS 90 in Article 6(1) of that Directive must therefore be construed as a reference to the relevant new ship stability regulations introduced by IMO resolution MSC.216(82), more commonly referred to as SOLAS 2009, for those ships constructed after their entry into force on 1 January 2009.
2. Annexes I and II apply to two categories of ro-ro passenger ship, namely:
  - (a) Ro-ro passenger ships, whatever their flag, engaged on international voyages and operating a regular service to or from a Member State port (in accordance with Article 3(1)); and
  - (b) Ro-ro passenger ships of Class A, B and C whatever their flag, engaged on domestic voyages (in accordance with Article 6(a) of Directive 98/18/EC).
3. The distinction between Parts A and B of Annex I is based on only one criterion – the date of construction of the vessel - in terms of the specific damage stability rules to be applied to the above mentioned ro-ro passenger ships. Those ro-ro passenger ships the keel of which was laid or which was at a similar stage of construction on or after 1 January 2009 will apply the new requirements set out in Annex I B.
4. To clarify the application of Parts A and B of Annex I to the relevant ro-ro passenger ships, a summary is set out below:

Type of ro-ro passenger ship	Date of Construction	Applicable Regulations	Date of application
1. Ro-ro passenger ships engaged in international voyages, of whatever flag, and operating a regular service to or from a Member State port	Before 1 October 2004	SOLAS 90 + Annex I Part A	(a) 1 October 2010 (excluded if operating in sea areas with <1.5 metre significant wave height)  (b) 1 October 2015 (if on 17 May 2003 compliant with SOLAS 90 standard)
	Between 1 October 2004 and 31 December 2008	SOLAS 90 + Annex I Part A	Upon construction
	On or after 1 January 2009	SOLAS 2009 + Annex I , Part B)	Upon construction
2. Class A ro-ro passenger ships engaged in	Before 1 October 2004	SOLAS 90 + Annex I Part A	1 October 2010 (unless phased out after 30 years by

exclusively domestic voyages, of whatever flag			2015 at latest)
	Between 1 October 2004 and 31 December 2008	SOLAS 90 + Annex I Part A	Upon construction
	On or after 1 January 2009	SOLAS 2009 + Annex I , Part B)	Upon construction
3. Class B ro-ro passenger ships engaged in exclusively domestic voyages, of whatever flag	Before 1 October 2004	SOLAS 90 + Annex I Part A	1 October 2010 (unless phased out after 30 years by 2015 at latest)
	Between 1 October 2004 and 31 December 2008	SOLAS 90 + Annex I Part A	Upon construction
	On or after 1 January 2009	SOLAS 2009 + Annex I , Part B)	Upon construction
4. Class C ro-ro passenger ships engaged in exclusively domestic voyages, of whatever flag	Before 1 October 2004	Not applicable	Not applicable
	Between 1 October 2004 and 31 December 2008	SOLAS 90 + Annex I Part A)	Upon construction
	On or after 1 January 2009	SOLAS 2009 + Annex I , Part B)	Upon construction