Institute of
Ship Design and Ship Safety

Exercise
Ship Design
RoPax and Pax

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Exercise 10

1. Which damage stability rules are valid for passenger ships with keel laying after 01.01.2009? Which rule has to be especially focused on?

2. What is the difference concerning the attained subdivision index for passenger ships compared to cargo ships?

3. What is the difference concerning the required subdivision index for passenger ships compared to cargo ships?

4. What has to be especially considered for ro-ro passenger ships operating in Europe?

5. What is the assumed extent of the penetration depth following from the special requirements for passenger vessels with keel laying after 01.01.2009? What is a reasonable constructional element following from this?

6. Which damage stability rules are valid for passenger vessels with keel laying before 1.1.2009?

7. What is the assumed extent of the penetration depth following from the special requirements for passenger vessels with keel laying before 1.1.2009? What is a reasonable construction element following from this?

8. What is the consequence if a compartment does not contain the above mentioned construction element?

9. What is the maximum length of a Main-Fire-Zone and by what constructional elements are MFZ separated?

10. Which rule do all passenger ships built after 01.07.2010 have to fulfill, that have a length as defined in SOLAS Rule II-1/2.5 of 120 m or more or three or more vertical main fire zones?

11. What is the margin line and for what kind of ships is it relevant?

12. Please explain a typical propulsion concept for a passenger ship.

13. Please mark the following in the general arrangement plan of the cruise vessel: bulkhead deck, all main fire zones as well as the watertight transverse bulkheads.

14. Please explain a typical propulsion concept for a ro-ro passenger ship.

15. Which intact stability criterions do passenger ships have to fulfill?
SOLAS Chapter II-1 - Construction - Structure, subdivision and stability, machinery and electrical installations
Part B-1 - Stability

Regulation 8 - Special requirements concerning passenger ship stability

1 A passenger ship intended to carry 400 or more persons shall have watertight subdivision abaft the collision bulkhead so that $s_i = 1$ for the three loading conditions on which is based the calculation of the subdivision index and for a damage involving all the compartments within $0.08L$ measured from the forward perpendicular.

2 A passenger ship intended to carry 36 or more persons is to be capable of withstanding damage along the side shell to an extent specified in paragraph 3. Compliance with this regulation is to be achieved by demonstrating that $s_i$, as defined in regulation 7-2, is not less than 0.9 for the three loading conditions on which is based the calculation of the subdivision index.

3 The damage extent to be assumed when demonstrating compliance with paragraph 2, is to be dependent on both $N$ as defined in regulation 6, and $L_s$ as defined in regulation 2, such that:

- the vertical extent of damage is to extend from the ship’s moulded baseline to a position up to 12.5 m above the position of the deepest subdivision draught as defined in regulation 2, unless a lesser vertical extent of damage were to give a lower value of $s_i$, in which case this reduced extent is to be used;

- where 400 or more persons are to be carried, a damage length of $0.03L_s$ but not less than 3 m is to be assumed at any position along the side shell, in conjunction with a penetration inboard of $0.1B$ but not less than 0.75 m measured inboard from the ship side, at right angle to the centreline at the level of the deepest subdivision draught;

- where less than 400 persons are carried, damage length is to be assumed at any position along the shell side between transverse watertight bulkheads provided that the distance between two adjacent transverse watertight bulkheads is not less than the assumed damage length. If the distance between adjacent transverse watertight bulkheads is less than the assumed damage length, only one of these bulkheads shall be
considered effective for the purpose of demonstrating compliance with paragraph 2;
where 36 persons are carried, a damage length of $0.015L_s$ but not less than 3 m is to be assumed, in conjunction with a penetration inboard of $0.05B$ but not less than 0.75 m; and
where more than 36, but fewer than 400 persons are carried the values of damage length and penetration inboard, used in the determination of the assumed extent of damage, are to be obtained by linear interpolation between the values of damage length and penetration which apply for ships carrying 36 persons and 400 persons as specified in subparagraphs .4 and .2.
9 Where the required factor of subdivision is 0.5 or less, the combined length of any two adjacent compartments shall not exceed the floodable length.

Regulation 8
Stability of passenger ships in damaged condition*

(Subject to the provisions of regulation 8-1, paragraphs 2.3.1 to 2.3.4, 2.4, 5 and 6.2 apply to passenger ships constructed on or after 29 April 1990. Paragraphs 7.2, 7.3 and 7.4 apply to all passenger ships)

1.1 Sufficient intact stability shall be provided in all service conditions so as to enable the ship to withstand the final stage of flooding of any one main compartment which is required to be within the floodable length.

1.2 Where two adjacent main compartments are separated by a bulkhead which is stepped under the conditions of regulation 7.5.1 the intact stability shall be adequate to withstand the flooding of those two adjacent main compartments.

1.3 Where the required factor of subdivision is 0.5 or less but more than 0.33 intact stability shall be adequate to withstand the flooding of any two adjacent main compartments.

1.4 Where the required factor of subdivision is 0.33 or less the intact stability shall be adequate to withstand the flooding of any three adjacent main compartments.

2.1 The requirements of paragraph 1 shall be determined by calculations which are in accordance with paragraphs 3, 4 and 6 and which take into consideration the proportions and design characteristics of the ship and the arrangement and configuration of the damaged compartments. In making these calculations the ship is to be assumed in the worst anticipated service condition as regards stability.

2.2 Where it is proposed to fit decks, inner skins or longitudinal bulkheads of sufficient tightness to seriously restrict the flow of water, the Administration shall be satisfied that proper consideration is given to such restrictions in the calculations.

* Refer to MSC/Circ.541 (as may be revised): Guidance notes on the integrity of flooding boundaries above the bulkhead deck of passenger ships for proper application of regulations II-1/8 and 20, paragraph 1, of SOLAS 1974, as amended.
The stability required in the final condition after damage, and after equalization where provided, shall be determined as follows:

2.3.1 The positive residual righting lever curve shall have a minimum range of $15^\circ$ beyond the angle of equilibrium. This range may be reduced to a minimum of $10^\circ$, in the case where the area under the righting lever curve is that specified in paragraph 2.3.2, increased by the ratio:

$$\frac{15}{\text{range}}$$

where the range is expressed in degrees.

2.3.2 The area under the righting lever curve shall be at least 0.015 metre-radians, measured from the angle of equilibrium to the lesser of:

1. the angle at which progressive flooding occurs;
2. $22^\circ$ (measured from the upright) in the case of one-compartment flooding, or $27^\circ$ (measured from the upright) in the case of the simultaneous flooding of two or more adjacent compartments.

2.3.3 A residual righting lever is to be obtained within the range of positive stability, taking into account the greatest of the following heeling moments:

1. the crowding of all passengers towards one side;
2. the launching of all fully loaded davit-launched survival craft on one side;
3. due to wind pressure;

as calculated by the formula:

$$GZ \text{ (in metres)} = \frac{\text{heeling moment}}{\text{displacement}} + 0.04$$

However, in no case is this righting lever to be less than 0.1 m.

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 muster stations are located and in such a way that they produce the most adverse heeling moment.
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 liferaft 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.

Moments due to wind pressure:

3.1 a wind pressure of 120 N/m² 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.

In intermediate stages of flooding, the maximum righting lever shall be at least 0.05 m and the range of positive righting levers shall be at least 7°. In all cases, only one breach in the hull and only one free surface need be assumed.

For the purpose of making damage stability calculations the volume and surface permeabilities shall be in general as follows:

<table>
<thead>
<tr>
<th>Spaces</th>
<th>Permeability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriated to cargo, coal or stores</td>
<td>60</td>
</tr>
<tr>
<td>Occupied by accommodation</td>
<td>95</td>
</tr>
<tr>
<td>Occupied by machinery</td>
<td>85</td>
</tr>
<tr>
<td>Intended for liquids</td>
<td>0 or 95*</td>
</tr>
</tbody>
</table>

Higher surface permeabilities are to be assumed in respect of spaces which, in the vicinity of the damage waterplane, contain no substantial quantity of

* Whichever results in the more severe requirements.
accommodation or machinery and spaces which are not generally occupied by any substantial quantity of cargo or stores.

4 Assumed extent of damage shall be as follows:

1. longitudinal extent: 3 m plus 3% of the length of the ship, or 11 m, whichever is the 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, as defined in regulation 2; and

3. vertical extent: from the base line upwards without limit;

4. if any damage of lesser extent than that indicated in paragraphs 4.1, 4.2 and 4.3 would result in a more severe condition regarding heel or loss of metacentric height, such damage shall be assumed in the calculations.

5 Unsymmetrical flooding is to be kept to a minimum consistent with efficient arrangements. Where it is necessary to correct large angles of heel, the means adopted shall, where practicable, be self-acting, but in any case where controls to cross-flooding fittings are provided they shall be operable from above the bulkhead deck. These fittings together with their controls shall be acceptable to the Administration. The maximum angle of heel after flooding but before equalization shall not exceed 15°. Where cross-flooding fittings are required the time for equalization shall not exceed 15 min. Suitable information concerning the use of cross-flooding fittings shall be supplied to the master of the ship.*

6 The final conditions of the ship after damage and, in the case of unsymmetrical flooding, after equalization measures have been taken shall be as follows:

1. in the case of symmetrical flooding there shall be a positive residual metacentric height of at least 50 mm as calculated by the constant displacement method;

2. in the case of unsymmetrical flooding, the angle of heel for one-compartment flooding shall not exceed 7°. For the simultaneous flooding of two or more adjacent compartments, a heel of 12° may be permitted by the Administration;

* Refer to the Recommendation on a standard method for establishing compliance with the requirements for cross-flooding arrangements in passenger ships adopted by the Organization by resolution A.266(VIII).
in no case shall the margin line be submerged in the final stage of flooding. If it is considered that the margin line may become submerged during an intermediate stage of flooding, the Administration may require such investigations and arrangements as it considers necessary for the safety of the ship.

7.1 The master of the ship shall be supplied with the data necessary to maintain sufficient intact stability under service conditions to enable the ship to withstand the critical damage. In the case of ships requiring cross-flooding the master of the ship shall be informed of the conditions of stability on which the calculations of heel are based and be warned that excessive heeling might result should the ship sustain damage when in a less favourable condition.

7.2 The data referred to in paragraph 7.1 to enable the master to maintain sufficient intact stability shall include information which indicates the maximum permissible height of the ship’s centre of gravity above keel (KG), or alternatively the minimum permissible metacentric height (GM), for a range of draughts or displacements sufficient to include all service conditions. The information shall show the influence of various trims taking into account the operational limits.

7.3 Each ship shall have scales of draughts marked clearly at the bow and stern. In the case where the draught marks are not located where they are easily readable, or operational constraints for a particular trade make it difficult to read the draught marks, then the ship shall also be fitted with a reliable draught indicating system by which the bow and stern draughts can be determined.

7.4 On completion of loading of the ship and prior to its departure, the master shall determine the ship’s trim and stability and also ascertain and record that the ship is in compliance with stability criteria in the relevant regulations. The determination of the ship’s stability shall always be made by calculation. The Administration may accept the use of an electronic loading and stability computer or equivalent means for this purpose.

8.1 No relaxation from the requirements for damage stability may be considered by the Administration unless it is shown that the intact metacentric height in any service condition necessary to meet these requirements is excessive for the service intended.

8.2 Relaxations from the requirements for damage stability shall be permitted only in exceptional cases and subject to the condition that the Administration is to be satisfied that the proportions, arrangements and other characteristics of the ship are the most favourable to stability after damage which can practically and reasonably be adopted in the particular circumstances.
**Regulation 8-1**  
*Stability of ro–ro passenger ships in damaged condition*

Ro–ro passenger ships constructed before 1 July 1997 shall comply with regulation 8, as amended by resolution MSC.12(56), not later than the date of the first periodical survey after the date of compliance prescribed below, according to the value of $A/A_{\text{max}}$ as defined in the annex of the Calculation Procedure to assess the survivability characteristics of existing ro–ro passenger ships when using a simplified method based upon resolution A.265(VIII), developed by the Maritime Safety Committee at its fifty-ninth session in June 1991 (MSC/Circ.574).

<table>
<thead>
<tr>
<th>Value of $A/A_{\text{max}}$</th>
<th>Date of compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 85%</td>
<td>1 October 1998</td>
</tr>
<tr>
<td>85% or more but less than 90%</td>
<td>1 October 2000</td>
</tr>
<tr>
<td>90% or more but less than 95%</td>
<td>1 October 2002</td>
</tr>
<tr>
<td>95% or more but less than 97.5%</td>
<td>1 October 2004</td>
</tr>
<tr>
<td>97.5% or more</td>
<td>1 October 2005</td>
</tr>
</tbody>
</table>

**Regulation 8-2**  
*Special requirements for ro–ro passenger ships carrying 400 persons or more*

Notwithstanding the provisions of regulations 8 and 8-1:

.1 Ro–ro passenger ships certified to carry 400 persons or more constructed on or after 1 July 1997 shall comply with the provisions of paragraph 2.3 of regulation 8, assuming the damage applied anywhere within the ship’s length $L$; and

.2 Ro–ro passenger ships certified to carry 400 persons or more constructed before 1 July 1997 shall comply with the requirements of subparagraph .1 not later than the date of the first periodical survey after the date of compliance prescribed in subparagraph .2.1, .2.2 or .2.3 which occurs the latest:

<table>
<thead>
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<th>Value of $A/A_{\text{max}}$</th>
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<tr>
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<td>1 October 2004</td>
</tr>
<tr>
<td>97.5% or more</td>
<td>1 October 2010</td>
</tr>
</tbody>
</table>

* For the application of specific stability requirements to ro–ro passenger ships, refer to resolution 14 of the 1995 SOLAS Conference and resolution MSC.141(76), Revised model test method under resolution 14 of the 1995 SOLAS Conference.

† Refer to MSC/Circ.649, Interpretations of provisions of resolution MSC.26(60) and MSC/Circ.574.
Regulation 8-3
Special requirements for passenger ships, other than ro–ro passenger ships, carrying 400 persons or more

Notwithstanding the provisions of regulation 8, passenger ships, other than ro–ro passenger ships, certified to carry 400 persons or more constructed on or after 1 July 2002 shall comply with the provisions of paragraphs 2.3 and 2.4 of regulation 8, assuming the damage applied anywhere within the ship’s length L.

Regulation 9
Ballasting of passenger ships

1 Water ballast should not in general be carried in tanks intended for oil fuel. In ships in which it is not practicable to avoid putting water in oil fuel tanks, oily-water separating equipment to the satisfaction of the Administration shall be fitted, or other alternative means, such as discharge to shore facilities, acceptable to the Administration shall be provided for disposing of the oily-water ballast.

2 The provisions of this regulation are without prejudice to the provisions of the International Convention for the Prevention of Pollution from Ships in force.

Regulation 10
Peak and machinery space bulkheads, shaft tunnels, etc., in passenger ships*

1 A forepeak or collision bulkhead shall be fitted which shall be watertight up to the bulkhead deck. This bulkhead shall be located at a

* Refer to MSC/Circ.855, Interpretation of the position of the forward perpendicular for the purpose of SOLAS regulation II-1/10.
27 *Helicopter facility* is a helideck including any refuelling and hangar facilities.

28 *Lightweight* is the displacement of a ship in tonnes without cargo, fuel, lubricating oil, ballast water, fresh water and feedwater in tanks, consumable stores, and passengers and crew and their effects.

29 *Low flame-spread* means that the surface thus described will adequately restrict the spread of flame, this being determined in accordance with the Fire Test Procedures Code.

30 *Machinery spaces* are machinery spaces of category A and other spaces containing propulsion machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces.

31 *Machinery spaces of category A* are those spaces and trunks to such spaces which contain either:

.1 internal combustion machinery used for main propulsion;

.2 internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or

.3 any oil-fired boiler or oil fuel unit, or any oil-fired equipment other than boilers, such as inert gas generators, incinerators, etc.

32 *Main vertical zones* are those sections into which the hull, superstructure and deckhouses are divided by "A" class divisions, the mean length and width of which on any deck does not in general exceed 40 m.

33 *Non-combustible material* is a material which neither burns nor gives off flammable vapours in sufficient quantity for self-ignition when heated to approximately 750°C, this being determined in accordance with the Fire Test Procedures Code.

34 *Oil fuel unit* is the equipment used for the preparation of oil fuel for delivery to an oil-fired boiler, or equipment used for the preparation for delivery of heated oil to an internal combustion engine, and includes any oil pressure pumps, filters and heaters dealing with oil at a pressure of more than 0.18 N/mm².
Regulation 9 - Containment of fire

1 Purpose

The purpose of this regulation is to contain a fire in the space of origin. For this purpose, the following functional requirements shall be met:

.1 the ship shall be subdivided by thermal and structural boundaries;

.2 thermal insulation of boundaries shall have due regard to the fire risk of the space and adjacent spaces; and

.3 the fire integrity of the divisions shall be maintained at openings and penetrations.

2 Thermal and structural boundaries

2.1 Thermal and structural subdivision

Ships of all types shall be subdivided into spaces by thermal and structural divisions having regard to the fire risks of the spaces.

2.2 Passenger ships

2.2.1 Main vertical zones and horizontal zones

2.2.1.1 In ships carrying more than 36 passengers, the hull, superstructure and deckhouses shall be subdivided into main vertical zones by "A-60" class divisions. Steps and recesses shall be kept to a minimum, but where they are necessary they shall also be "A-60" class divisions. Where a category (5), (9) or (10) space defined in paragraph 2.2.3.2.2 is on one side or where fuel oil tanks are on both sides of the division the standard may be reduced to "A-0".

2.2.1.2 In ships carrying not more than 36 passengers, the hull, superstructure and deckhouses in way of accommodation and service spaces shall be subdivided into main vertical zones by "A" class divisions. These divisions shall have insulation values in accordance with tables in paragraph 2.2.4.

2.2.1.2 As far as practicable, the bulkheads forming the boundaries of the main vertical zones above the bulkhead
deck shall be in line with watertight subdivision bulkheads situated immediately below the bulkhead deck. The length and width of main vertical zones may be extended to a maximum of 48 m in order to bring the ends of main vertical zones to coincide with watertight subdivision bulkheads or in order to accommodate a large public space extending for the whole length of the main vertical zone provided that the total area of the main vertical zone is not greater than 1,600 m$^2$ on any deck. The length or width of a main vertical zone is the maximum distance between the furthestmost points of the bulkheads bounding it.

2.2.1.3 Such bulkheads shall extend from deck to deck and to the shell or other boundaries.

2.2.1.4 Where a main vertical zone is subdivided by horizontal "A" class divisions into horizontal zones for the purpose of providing an appropriate barrier between a zone with sprinklers and a zone without sprinklers, the divisions shall extend between adjacent main vertical zone bulkheads and to the shell or exterior boundaries of the ship and shall be insulated in accordance with the fire insulation and integrity values given in table 9.4.

2.2.1.5.1 On ships designed for special purposes, such as automobile or railroad car ferries, where the provision of main vertical zone bulkheads would defeat the purpose for which the ship is intended, equivalent means for controlling and limiting a fire shall be substituted and specifically approved by the Administration. Service spaces and ship stores shall not be located on ro-ro decks unless protected in accordance with the applicable regulations.

2.2.1.5.2 However, in a ship with special category spaces, such spaces shall comply with the applicable provisions of regulation 20 and, where such compliance would be inconsistent with other requirements for passenger ships specified in this chapter, the requirements of regulation 20 shall prevail.

2.2.2 Bulkheads within a main vertical zone

2.2.2.1 For ships carrying more than 36 passengers, bulkheads which are not required to be "A" class divisions shall be at least "B" class or "C" class divisions as prescribed in the tables in paragraph 2.2.3.

2.2.2.2 For ships carrying not more than 36 passengers, bulkheads within accommodation and service spaces which are not required to be "A" class divisions shall be at least "B" class or "C" class divisions as prescribed in the tables in paragraph 2.2.4. In addition, corridor bulkheads, where not required to be "A" class, shall be "B" class divisions which
shall extend from deck to deck except:

.1 when continuous "B" class ceilings or linings are fitted on both sides of the bulkhead, the portion of the bulkhead behind the continuous ceiling or lining shall be of material which, in thickness and composition, is acceptable in the construction of "B" class divisions, but which shall be required to meet "B" class integrity standards only in so far as is reasonable and practicable in the opinion of the Administration; and

.2 in the case of a ship protected by an automatic sprinkler system complying with the provisions of the Fire Safety Systems Code, the corridor bulkheads may terminate at a ceiling in the corridor provided such bulkheads and ceilings are of "B" class standard in compliance with paragraph 2.2.4. All doors and frames in such bulkheads shall be of non-combustible materials and shall have the same fire integrity as the bulkhead in which they are fitted.

2.2.2.3 Bulkheads required to be "B" class divisions, except corridor bulkheads as prescribed in paragraph 2.2.2.2, shall extend from deck to deck and to the shell or other boundaries. However, where a continuous "B" class ceiling or lining is fitted on both sides of a bulkhead which is at least of the same fire resistance as the adjoining bulkhead, the bulkhead may terminate at the continuous ceiling or lining.

2.2.3 Fire integrity of bulkheads and decks in ships carrying more than 36 passengers

2.2.3.1 In addition to complying with the specific provisions for fire integrity of bulkheads and decks of passenger ships, the minimum fire integrity of all bulkheads and decks shall be as prescribed in tables 9.1 and 9.2. Where, due to any particular structural arrangements in the ship, difficulty is experienced in determining from the tables the minimum fire integrity value of any divisions, such values shall be determined to the satisfaction of the Administration.

2.2.3.2 The following requirements shall govern application of the tables:

.1 Table 9.1 shall apply to bulkheads not bounding either main vertical zones or horizontal zones. Table 9.2 shall apply to decks not forming steps in main vertical zones.
Regulation 21 - Casualty threshold, safe return to port and safe areas

1 Application

Passenger ships constructed on or after 1 July 2010 having length, as defined in regulation II-1/2.5, of 120 m or more or having three or more main vertical zones shall comply with the provisions of this regulation.

2 Purpose

The purpose of this regulation is to establish design criteria for a ship's safe return to port under its own propulsion after a casualty that does not exceed the casualty threshold stipulated in paragraph 3 and also provides functional requirements and performance standards for safe areas.

3 Casualty threshold

The casualty threshold, in the context of a fire, includes:

.1 loss of space of origin up to the nearest "A" class boundaries, which may be a part of the space of origin, if the space of origin is protected by a fixed fire extinguishing system; or

.2 loss of the space of origin and adjacent spaces up to the nearest "A" class boundaries, which are not part of the space of origin.

4 Safe return to port*
When fire damage does not exceed the casualty threshold indicated in paragraph 3, the ship shall be capable of returning to port while providing a safe area as defined in regulation 3. To be deemed capable of returning to port, the following systems shall remain operational in the remaining part of the ship not affected by fire:

.1 propulsion;
.2 steering systems and steering-control systems;
.3 navigational systems;
.4 systems for fill, transfer and service of fuel oil;
.5 internal communication between the bridge, engineering spaces, safety centre, fire-fighting and damage control teams, and as required for passenger and crew notification and mustering;
.6 external communication;
.7 fire main system;
.8 fixed fire-extinguishing systems;
.9 fire and smoke detection system;
.10 bilge and ballast system;
.11 power-operated watertight and semi-watertight doors;
.12 systems intended to support "safe areas" as indicated in paragraph 5.1.2;
.13 flooding detection systems; and
.14 other systems determined by the Administration to be vital to damage control efforts.

5 Safe area(s)

5.1 Functional requirements:

.1 the safe area(s) shall generally be internal space(s); however, the use of an external space as a safe area may be allowed by the Administration taking into account any restriction due to the area of operation and relevant expected environmental
.2 the safe area(s) shall provide all occupants with the following basic services* to ensure that the health of passengers and crew is maintained:

.1 sanitation;
.2 water;
.3 food;
.4 alternate space for medical care;
.5 shelter from the weather;
.6 means of preventing heat stress and hypothermia;
.7 light; and
.8 ventilation;

.3 ventilation design shall reduce the risk that smoke and hot gases could affect the use of the safe area(s); and

.4 means of access to life-saving appliances shall be provided from each area identified or used as a safe area, taking into account that a main vertical zone may not be available for internal transit.

5.2 Alternate space for medical care

Alternate space for medical care shall conform to a standard acceptable to the Administration.**

* Refer to the Performance standards for the systems and services to remain operational on passenger ships for safe return to port and orderly evacuation and abandonment after a casualty (MSC.1/Circ.1214).

** Refer to the Guidance on the establishment of medical and sanitation related programmes for passenger.

Regulation 22 - Design criteria for systems to remain operational after a fire casualty
1 Application

Passenger ships constructed on or after 1 July 2010 having length, as defined in regulation II-1/2.2, of 120 m or more or having three or more main vertical zones shall comply with the provisions of this regulation.

2 Purpose

The purpose of this regulation is to provide design criteria for systems required to remain operational for supporting the orderly evacuation and abandonment of a ship, if the casualty threshold, as defined in regulation 21.3, is exceeded.

3 Systems*

3.1 In case any one main vertical zone is unserviceable due to fire, the following systems shall be so arranged and segregated as to remain operational:

1. fire main;

2. internal communications (in support of fire-fighting as required for passenger and crew notification and evacuation);

3. means of external communications;

4. bilge systems for removal of fire-fighting water;

5. lighting along escape routes, at assembly stations and at embarkation stations of life-saving appliances; and

6. guidance systems for evacuation shall be available.

3.2 The above systems shall be capable of operation for at least 3 h based on the assumption of no damage outside the unserviceable main vertical zone. These systems are not required to remain operational within the unserviceable main vertical zones.

3.3 Cabling and piping within a trunk constructed to an "A-60" standard shall be deemed to remain intact and serviceable while passing through the unserviceable main vertical zone for the purposes of paragraph 3.1. An equivalent degree of protection for cabling and piping may be approved by the Administration.

* Refer to the Performance standards for the systems and
services to remain operational on passenger ships for safe return to port and orderly evacuation and abandonment after a casualty (MSC.1/Circ.1214).

**Regulation 23 - Safety centre on passenger ships**

**1 Application**

Passenger ships constructed on or after 1 July 2010 shall have on board a safety centre complying with the requirements of this regulation.

**2 Purpose**

The purpose of this regulation is to provide a space to assist with the management of emergency situations.

**3 Location and arrangement**

The safety centre shall either be a part of the navigation bridge or be located in a separate space adjacent to and having direct access to the navigation bridge, so that the management of emergencies can be performed without distracting watch officers from their navigational duties.

**4 Layout and ergonomic design**

The layout and ergonomic design of the safety centre shall take into account the guidelines developed by the Organization*, as appropriate.

**5 Communications**

Means of communication between the safety centre, the central control station, the navigation bridge, the engine control room, the storage room(s) for fire extinguishing system(s) and fire equipment lockers shall be provided.

**6 Control and monitoring of safety systems**

Notwithstanding the requirements set out elsewhere in the Convention, the full functionality (operation, control, monitoring or any combination thereof, as required) of the safety systems listed below shall be available from the safety centre:

- .1 all powered ventilation systems;
- .2 fire doors;
.3 general emergency alarm system;
.4 public address system;
.5 electrically powered evacuation guidance systems;
.6 watertight and semi-watertight doors;
.7 indicators for shell doors, loading doors and other closing appliances;
.8 water leakage of inner/outer bow doors, stern doors and any other shell door;
.9 television surveillance system;
.10 fire detection and alarm system;
.11 fixed fire-fighting local application system(s);
.12 sprinkler and equivalent systems;
.13 water-based systems for machinery spaces;
.14 alarm to summon the crew;
.15 atrium smoke extraction system;
.16 flooding detection systems; and
.17 fire pumps and emergency fire pumps.

* Refer to guidelines to be developed by the Organization.
Part A: General
Regulation 3

3 **Breadth of the ship** is the extreme width from outside of frame to outside of frame at or below the deepest subdivision load line.

4 **Draught** is the vertical distance from the moulded base line amidships to the subdivision load line in question.

5 **Bulkhead deck** is the uppermost deck up to which the transverse watertight bulkheads are carried.

6 **Margin line** is a line drawn at least 76 mm below the upper surface of the bulkhead deck at side.

7 **Permeability of a space** is the percentage of that space which can be occupied by water. The volume of a space which extends above the margin line shall be measured only to the height of that line.

8 **Machinery space** is to be taken as extending from the moulded base line to the margin line and between the extreme main transverse watertight bulkheads, bounding the spaces containing the main and auxiliary propulsion machinery, boilers serving the needs of propulsion, and all permanent coal bunkers. In the case of unusual arrangements, the Administration may define the limits of the machinery spaces.

9 **Passenger spaces** are those spaces which are provided for the accommodation and use of passengers, excluding baggage, store, provision and mail rooms. For the purposes of regulations 5 and 6, spaces provided below the margin line for the accommodation and use of the crew shall be regarded as passenger spaces.

10 In all cases volumes and areas shall be calculated to moulded lines.

11 **Weathertight** means that in any sea conditions water will not penetrate into the ship.


13 **Ro–ro passenger ship** means a passenger ship with ro–ro cargo spaces or special category spaces as defined in regulation II-2/3.

Regulation 3
Definitions relating to parts C, D and E

For the purpose of parts C, D and E, unless expressly provided otherwise:

1 **Steering gear control system** is the equipment by which orders are transmitted from the navigation bridge to the steering gear power units.

*This relates to the chapter II-2 in force before 1 July 2002. The equivalent term in the amended chapter II-2 is “ro–ro spaces”.*
Part B

Subdivision and stability*

(Part B applies to passenger ships and to cargo ships, as indicated in the regulations)

Regulation 4

Floodable length in passenger ships

1 The floodable length at any point of the length of a ship shall be determined by a method of calculation which takes into consideration the form, draught and other characteristics of the ship in question.

2 In a ship with a continuous bulkhead deck, the floodable length at a given point is the maximum portion of the length of the ship, having its centre at the point in question, which can be flooded under the definite assumptions set forth in regulation 5 without the ship being submerged beyond the margin line.

3.1 In the case of a ship not having a continuous bulkhead deck, the floodable length at any point may be determined to an assumed continuous margin line which at no point is less than 76 mm below the top of the deck (at side) to which the bulkheads concerned and the shell are carried watertight.

3.2 Where a portion of an assumed margin line is appreciably below the deck to which bulkheads are carried, the Administration may permit a limited relaxation in the watertightness of those portions of the bulkheads which are above the margin line and immediately under the higher deck.

Regulation 5

Permeability in passenger ships

1.1 The definite assumptions referred to in regulation 4 relate to the permeability of the spaces below the margin line.

1.2 In determining the floodable length, a uniform average permeability

* Instead of the requirements in this part, the Regulations on subdivision and stability of passenger ships as an equivalent to part B of chapter II of the International Convention for the Safety of Life at Sea, 1960, adopted by the Organization by resolution A.265(VIII), may be used, if applied in their entirety.
CHAPTER 3 - SPECIAL CRITERIA FOR CERTAIN TYPES OF SHIPS

3.1 Passenger ships

Passenger ships shall comply with the requirements of 2.2 and 2.3.

3.1.1 In addition, the angle of heel on account of crowding of passengers to one side as defined below shall not exceed 10°.

3.1.1.1 A minimum weight of 75 kg shall be assumed for each passenger except that this value may be increased subject to the approval of the Administration. In addition, the mass and distribution of the luggage shall be approved by the Administration.

3.1.1.2 The height of the centre of gravity for passengers shall be assumed equal to:

.1 1 m above deck level for passengers standing upright. Account may be taken, if necessary, of camber and sheer of deck; and

.2 0.3 m above the seat in respect of seated passengers.

3.1.1.3 Passengers and luggage shall be considered to be in the spaces normally at their disposal, when assessing compliance with the criteria given in 2.2.1 to 2.2.4.

3.1.1.4 Passengers without luggage shall be considered as distributed to produce the most unfavourable combination of passenger heeling moment and/or initial metacentric height, which may be obtained in practice, when assessing compliance with the criteria given in 3.1.1 and 3.1.2, respectively. In this connection, a value higher than four persons per square metre is not necessary.

3.1.2 In addition, the angle of heel on account of turning shall not exceed 10° when calculated using the following formula:

\[ M_R = 0.200 \times \frac{V_0^2}{L_{wl}} \times \Delta \times (KG - \frac{d}{2}) \]

where:

- \( M_R \) = heeling moment (kNm)
- \( V_0 \) = service speed (m/s)
- \( L_{wl} \) = length of ship at waterline (m)
- \( \Delta \) = displacement (t)
- \( d \) = mean draught (m)
- \( KG \) = height of centre of gravity above baseline (m).
8.2 Rotational deployment of marine evacuation systems

In addition to or in conjunction with the servicing intervals of marine evacuation systems required by paragraph 8.1, each marine evacuation system shall be deployed from the ship on a rotational basis at intervals to be agreed by the Administration provided that each system is to be deployed at least once every six years.

8.3 An Administration which approves new and novel inflatable liferaft arrangements pursuant to regulation 4 may allow for extended service intervals on the following conditions:

8.3.1 The new and novel liferaft arrangement has proved to maintain the same standards, as required by testing procedure, during extended service intervals.

8.3.2 The liferaft system shall be checked on board by certified personnel according to paragraph 8.1.1.

8.3.3 Service at intervals not exceeding five years shall be carried out in accordance with the recommendations of the Organization.*

8.4 All repairs and maintenance of inflated rescue boats shall be carried out in accordance with the manufacturer's instructions. Emergency repairs may be carried out on board the ship, however, permanent repairs shall be effected at an approved servicing station.

8.5 An Administration which permits extension of liferaft service intervals in accordance with paragraph 8.3 shall notify the Organization of such action in accordance with regulation I/5(b).

9 Periodic servicing of hydrostatic release units

Hydrostatic release units, other than disposable hydrostatic release units, shall be serviced:

1. at intervals not exceeding 12 months, provided where in any case this is impracticable, the Administration may extend this period to 17 months; and

2. at a servicing station which is competent to service them, maintains proper servicing facilities and uses only properly trained personnel.

10 Marking of stowage locations

Containers, brackets, racks, and other similar stowage locations for life-saving equipment shall be marked with symbols in accordance with the recommendations of the Organization, indicating the devices stowed in that location for that purpose. If more than one device is stowed in that location, the number of devices shall also be indicated.

11 Periodic servicing of launching appliances and on-load release gear

11.1 Launching appliances shall be:

1. maintained in accordance with instructions for on-board maintenance as required by regulation 36;

2. subject to a thorough examination at the annual surveys required by regulations 1/7 or 1/8, as applicable; and

3. upon completion of the examination referred to in 2 subjected to a dynamic test of the which brake at maximum lowering speed. The load to be applied shall be the mass of the survival craft or rescue boat without persons on board, except that, at intervals not exceeding five years, the

* Refer to the Recommendation on conditions for the approval of servicing stations for inflatable liferafts adopted by the Organization by resolution A.761(18).

** Refer to MSC/Circ.958, Servicing of life-saving appliances and radiocommunication equipment under the harmonized system of survey and certification (HSSC).

*** Refer to the Symbols related to life-saving appliances and arrangements adopted by the Organization by resolution A.760(18).

11.2 Liferaft or rescue boat on-load release gear, including free-fall liferaft release systems, shall be:

1. maintained in accordance with instructions for on-board maintenance as required by regulation 36;

2. subject to a thorough examination and operational test during the annual surveys required by regulations 1/7 and 1/8 by properly trained personnel familiar with the system; and

3. operationally tested under a load of 1.1 times the total mass of the boat when loaded with its full complement of persons and equipment whenever the release gear is overhauled. Such over-hauling and test shall be carried out at least once every five years.*

11.3 Davis-launch automatic release hooks shall be:

1. maintained in accordance with instructions for on-board maintenance as required by regulation 36;

2. subject to a thorough examination and operational test during the annual surveys required by regulations 1/7 and 1/8 by properly trained personnel familiar with the system; and

3. operationally tested under a load of 1.1 times the total mass of the liferaft when loaded with its full complement of persons and equipment whenever the automatic release hook is overhauled. Such over-hauling and test shall be carried out at least once every five years.*

SECTION II - PASSENGER SHIPS

(Additional requirements)

Regulation 21
Survival craft and rescue boats

1 Survive craft

1.1 Passenger ships engaged on international voyages which are not short international voyages shall carry:

1. partially or totally enclosed liferafts complying with the requirements of sections 4.5 and 4.6 of the Code on each side of such aggregate capacity as will accommodate not less than 50% of the total number of persons on board. The Administration may permit the substitution of liferafts of equivalent total capacity provided that there shall never be less than sufficient by liferafts of equivalent total capacity provided that there shall never be less than 50% of the total number of persons on board of the liferaft system to accommodate 37.5% of the total number of persons on board. The inflatable or rigid liferafts shall comply with the requirements of section 4.2 or 4.3 of the Code and the Code shall be carried by launching appliances equally distributed on each side of the ship.

2. in addition, inflatable or rigid liferafts complying with the requirements of section 4.2 or 4.3 of the Code on each side of such aggregate capacity as will accommodate at least 25% of the total number of persons on board. These liferafts shall be served by at least one launching appliance on each side of the ship and which may be provided in compliance with the requirements of paragraph 11.1 or equivalent approved appliances capable of being used on both sides. However, stowage of these liferafts need not comply with the requirements of regulation 13.5.

1.2 Passenger ships engaged on short international voyages shall carry:

1. partially or totally enclosed liferafts complying with the requirements of sections 4.5 and 4.6 of the Code on each side of such aggregate capacity as will accommodate at least 30% of the total number of persons on board. The inflatable or rigid liferafts shall, as far as practicable, be equally distributed on each side of the ship on board. The liferafts shall, as far as practicable, be equally distributed on each side of the ship.

* Refer to the Recommendation on testing of life-saving appliances, as adopted by the Organization by resolution A.689(17). For
survival craft will accommodate the total number of persons on board. The liferafts shall be served by launching appliances equally distributed on each side of the ship; and

2 in addition, inflatable or rigid liferafts complying with the requirements of section 4.2 or 4.3 of the Code of such aggregate capacity as will accommodate at least 25% of the total number of persons on board. These liferafts shall be served by at least one launching appliance on each side which may be those provided in compliance with the requirements of paragraph 1.2.1 or equivalent approved appliances capable of being used on both sides. However, storage of these liferafts need not comply with the requirements of regulation 13.3.

13 All survival craft required to provide for abandonment by the total number of persons on board shall be capable of being launched with their full complement of the persons and equipment within a period of 30 min from the time the abandon ship signal is given after all persons have been assembled, with lifejackets donned.

14 In lieu of meeting the requirements of paragraph 1.1 or 1.2, passenger ships of less than 500 gross tonnage where the total number of persons on board is less than 200, may comply with the following:

1 they shall carry on each side of the ship, inflatable or rigid liferafts complying with the requirements of section 4.2 or 4.3 of the Code and of such aggregate capacity as will accommodate the total number of persons on board;

2 unless the liferafts required by paragraph 1.4.1 are stowed in a position providing for easy side-to-side transfer at a single open deck level, additional liferafts shall be provided so that the total capacity available on each side will accommodate 150% of the total number of persons on board;

3 if the rescue boat required by paragraph 2.2 is also a partially or totally enclosed lifeboat complying with the requirements of section 4.5 or 4.6 of the Code, it may be included in the aggregate capacity required by paragraph 1.4.1, provided that the total capacity available on either side of the ship is at least 150% of the total number of persons on board; and

4 in the event of any one survival craft being lost or rendered unserviceable, there shall be sufficient survival craft available for use on each side, including those which are stowed in a position providing for easy side-to-side transfer at a single open deck level, to accommodate the total number of persons on board.

15 A marine evacuation system or systems complying with section 6.2 of the Code may be substituted for the equivalent capacity of liferafts and launching appliances required by paragraph 1.1.1 or 1.2.1.

2 Rescue boats

2.1 Passenger ships of 500 gross tonnage and over shall carry at least one rescue boat complying with the requirements of section 5.1 of the Code on each side of the ship.

2.2 Passenger ships of less than 500 gross tonnage shall carry at least one rescue boat complying with the requirements of section 5.1 of the Code.

2.3 A lifeboat may be accepted as a rescue boat provided that it and its launching and recovery arrangements also comply with the requirements for a rescue boat.

3 Marshalling of liferafts

3.1 The number of lifeboats and rescue boats that are carried on passenger ships shall be sufficient to ensure that in providing for abandonment by the total number of persons on board not more than six liferafts need be marshalled by each lifeboat or rescue boat.

3.2 The number of lifeboats and rescue boats that are carried on passenger ships engaged on short international voyages shall be sufficient to ensure that in providing for abandonment by the total number of persons on board not more than nine liferafts need be marshalled by each lifeboat or rescue boat.

Regulation 22

Personal life-saving appliances

1 Lifebuoys

1.1 A passenger ship shall carry not less than the number of lifebuoys complying with the requirements of regulation 7.1 and section 2.1 of the Code prescribed in the following table:

<table>
<thead>
<tr>
<th>Length of ship in metres</th>
<th>Minimum number of lifebuoys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 60</td>
<td>8</td>
</tr>
<tr>
<td>60 and under 120</td>
<td>12</td>
</tr>
<tr>
<td>120 and under 180</td>
<td>18</td>
</tr>
<tr>
<td>180 and under 240</td>
<td>24</td>
</tr>
<tr>
<td>240 and over</td>
<td>30</td>
</tr>
</tbody>
</table>

1.2 Notwithstanding regulation 7.1.3, passenger ships of under 60 m in length shall carry not less than six lifebuoys provided with self-igniting lights.

2 Lifejackets

2.1 In addition to the lifejackets required by regulation 7.2, every passenger ship shall carry lifejackets for not less than 5% of the total number of persons on board. These lifejackets shall be stowed in conspicuous places on deck or at muster stations.

2.2 Where lifejackets for passengers are stowed in state rooms which are located remotely from direct routes between public spaces and muster stations, the additional lifejackets for these passengers required under regulation 7.2.2, shall be stowed either in the public spaces, the muster stations, or on direct routes between them. The lifejackets shall be stowed so that their distribution and donning does not impede orderly movement to muster stations and survival craft embarkation stations.

3 Lifejacket lights

3.1 On all passenger ships each lifejacket shall be fitted with a light complying with the requirements of paragraph 2.2.3 of the Code.

3.2 Lights fitted on lifejackets on board passenger ships prior to 1 July 1998 and not complying fully with paragraph 2.2.3 of the Code may be accepted by the Administration until the lifejacket light would normally be replaced or until the first periodical survey after 1 July 2002, whichever is the earliest.

4 Immersion suits and thermal protective aids

4.1 All passenger ships shall carry for each lifeboat on the ship at least three immersion suits complying with the requirements of section 2.3 of the Code and, in addition, a thermal protective aid complying with the requirements of section 2.5 of the Code for every person to be accommodated in the lifeboat and not provided with an immersion suit. These immersion suits and thermal protective aids need not be carried:

1 for persons to be accommodated in totally or partially enclosed lifeboats; or

2 if the ship is constantly engaged on voyages in warm climates* where, in the opinion of the Administration, they are unnecessary.

4.2 The provisions of paragraph 4.1.1 also apply to partially or totally enclosed lifeboats not complying with the requirements of section 4.5 or 4.6 of the Code, provided they are carried on ships constructed before 1 July 1986.

* Refer to MSC(Circ.1046), Guidelines for the assessment of thermal protection.
Regulation 23
Survival craft and rescue boat embarkation arrangements

1 On passenger ships, survival craft embarkation arrangements shall be designed for:
   .1 all lifeboats to be boarded and launched either directly from the stowed position or from an embarkation deck but not both; and
   .2 davit-launched liferafts to be boarded and launched from a position immediately adjacent to the stowed position or from a position to which, in compliance with the requirements of regulation 13.5, the liferaft is transferred prior to launching.

2 Rescue boat arrangements shall be such that the rescue boat can be boarded and launched directly from the stowed position with the number of persons assigned to crew the rescue boat on board. Notwithstanding the requirements of paragraph 1.1, if the rescue boat is also a lifeboat and the other lifeboats are boarded and launched from an embarkation deck, the arrangements shall be such that the rescue boat can also be boarded and launched from the embarkation deck.

Regulation 24
Stowage of survival craft

The stowage height of a survival craft on a passenger ship shall take into account the requirements of regulation 13.1.2, the escape provisions of regulation II-2/20, the size of the ship, and the weather conditions likely to be encountered in its intended area of operation. For a davit-launched survival craft, the height of the davit head with the survival craft in embarkation position shall, as far as practicable, not exceed 15 m to the waterline when the ship is in its lightest seagoing condition.

Regulation 25
Muster stations

Every passenger ship shall, in addition to complying with the requirements of regulation 11, have passenger muster stations which shall:
   .1 be in the vicinity of, and permit ready access for the passengers to, the embarkation stations unless in the same location; and
   .2 have ample room for marshalling and instruction of the passengers, but at least 0.35 m² per passenger.

Regulation 26
Additional requirements for ro-ro passenger ships

1 This regulation applies to all ro-ro passenger ships. Ro-ro passenger ships constructed:
   .1 on or after 1 July 1998 shall comply with the requirements of paragraphs 2.3, 2.4, 3.1, 3.2, 3.3, 4 and 5;
   .2 on or after 1 July 1986 and before 1 July 1998 shall comply with the requirements of paragraph 5 not later than the first periodical survey after 1 July 1998 and with the requirements of paragraphs 2.3, 2.4, 2.5 and 4 not later than the first periodical survey after 1 July 2000;
   .3 before 1 July 1986 shall comply with the requirements of paragraph 5 not later than the first periodical survey after 1 July 1998 and with the requirements of paragraphs 2.1, 2.2, 2.3, 2.4, 3 and 4 not later than the first periodical survey after 1 July 2000; and
   .4 before 1 July 2004 shall comply with the requirements of paragraph 2.5 not later than the first survey on or after that date.

2 Liferafts

2.1 The ro-ro passenger ship’s liferafts shall be served by marine evacuation systems complying with the requirements of section 6.2 of the Code or launching appliances complying with the requirements of paragraph 6.1.5 of the Code, equally distributed on each side of the ship.

2.2 Every liferaft on ro-ro passenger ships shall be provided with float-free stowage arrangements complying with the requirements of regulation 13.4.

2.3 Every liferaft on ro-ro passenger ships shall be of a type fitted with a boarding ramp complying with the requirements of paragraph 4.2.4.1 or 4.3.4.1 of the Code, as appropriate.

2.4 Every liferaft on ro-ro passenger ships shall either be automatically self-righting or be a canopied reversible liferaft which is stable in a seaway and is capable of operating safely whichever way up it is floating. Alternatively, the ship shall carry automatically self-righting liferafts or canopied reversible liferafts, in addition to its normal complement of liferafts, of such aggregate capacity as will accommodate at least 50% of the persons not accommodated in liferafts. This additional liferaft capacity shall be determined on the basis of the difference between the total number of persons on board and the number of persons accommodated in liferafts. Every such liferaft shall be approved by the Administration having regard to the recommendations adopted by the Organization.

2.5 Liferafts carried on ro-ro passenger ships shall be fitted with a radar transponder in the ratio of one transponder for every four liferafts. The transponder shall be mounted inside the liferaft so its antenna is more than one metre above the sea level when the liferaft is deployed, except that for canopied reversible liferafts the transponder shall be so arranged as to be readily accessed and erected by survivors. Each transponder shall be arranged to be manually erected when the liferaft is deployed. Containers of liferafts fitted with transponders shall be clearly marked.

3 Fast rescue boats

3.1 At least one of the rescue boats on a ro-ro passenger ship shall be a fast rescue boat complying with section 5.1.4 of the Code.

3.2 Each fast rescue boat shall be served by a suitable launching appliance complying with section 6.1.7 of the Code.

3.3 At least two crews of each fast rescue boat shall be trained and drilled regularly having regard to the Seafarers Training, Certification and Watchkeeping (STCW) Code and recommendations adopted by the Organization, including all aspects of rescue, handling, manoeuvring, operating these craft in various conditions, and righting them after capsize.

3.4 In the case where the arrangement or size of a ro-ro passenger ship, constructed before 1 July 1997, is such as to prevent the installation of the fast rescue boat required by paragraph 3.1, the fast rescue boat may be installed in place of an existing lifeboat which is accepted as a rescue boat or, in the case of ships constructed prior to 1 July 1986, boats for use in an emergency, provided that all of the following conditions are met:
   .1 the fast rescue boat installed is served by a launching appliance complying with the provisions of paragraph 3.2;
   .2 the capacity of the survival craft lost by the above substitution is compensated by the installation of liferafts capable of carrying at least an equal number of persons served by the lifeboat replaced; and
   .3 such liferafts are served by the existing launching appliances or marine evacuation systems.

4 Refer to MSC/Circ.809, Recommendation for canopied reversible liferafts, automatically self-righting liferafts and fast rescue boats, including testing, on ro-ro passenger ships.

5 Refer to the Performance standards for survival craft radar transponders for use in search and rescue operations, adopted by the Organization by resolution A.802(19).

6 Refer to the Recommendation on training requirements for crews of fast rescue boats adopted by the Organization by resolution A.771(19) and to section A-V/2, table A-V/2-2, "Specification of the minimum standard of competence in fast rescue boats", of the STCW Code.
Chapter III: Life-saving appliances and arrangements
Regulation 27

4 Means of rescue
4.1 Each ro-ro passenger ship shall be equipped with efficient means for rapidly recovering survivors from the water and transferring survivors from rescue units or survival craft to the ship.
4.2 The means of transfer of survivors to the ship may be part of a marine evacuation system, or may be part of a system designed for rescue purposes.
4.3 If the slide of a marine evacuation system is intended to provide the means of transfer of survivors to the deck of the ship, the slide shall be equipped with handlines or ladders to aid in climbing up the slide.

5 Lifejackets
5.1 Notwithstanding the requirements of regulations 7.2 and 22.2, a sufficient number of lifejackets shall be stowed in the vicinity of the muster stations so that passengers do not have to return to their cabins to collect their lifejackets.
5.2 In ro-ro passenger ships, each lifejacket shall be fitted with a light complying with the requirements of paragraph 2.2.3 of the Code.

Regulation 27
Information on passengers
1 All persons on board all passenger ships shall be counted prior to departure.
2 Details of persons who have declared a need for special care or assistance in emergency situations shall be recorded and communicated to the master prior to departure.
3 In addition, not later than 1 January 1999, the names and gender of all persons on board, distinguishing between adults, children and infants shall be recorded for search and rescue purposes.
4 The information required by paragraphs 1, 2 and 3 shall be kept on board and made readily available to search and rescue services when needed.
5 Administrations may exempt passenger ships from the requirements of paragraph 3, if the scheduled voyages of such ships render it impracticable for them to prepare such records.

Regulation 28
Helicopter landing and pick-up areas
1 All ro-ro passenger ships shall be provided with a helicopter pick-up area approved by the Administration having regard to the recommendations adopted by the Organization.4
2 Ro-ro passenger ships of 130 m in length and upwards, constructed on or after 1 July 1999, shall be fitted with a helicopter landing area approved by the Administration having regard to the recommendations adopted by the Organization.5

Regulation 29
Decision support system for masters of passenger ships
1 This regulation applies to all passenger ships. Passenger ships constructed before 1 July 1997 shall comply with the requirements of this regulation not later than the date of the first periodical survey after 1 July 1999.
2 In all passenger ships, a decision support system for emergency management shall be provided on the navigation bridge.

3 The system shall, as a minimum, consist of a printed emergency plan or plans. All foreseeable emergency situations shall be identified in the emergency plan or plans, including, but not limited to, the following main groups of emergencies:
1 fire;
2 damage to ship;
3 pollution;
4 unlawful acts threatening the safety of the ship and the security of its passengers and crew;
5 personnel accidents;
6 cargo-related accidents; and
7 emergency assistance to other ships.
4 The emergency procedures established in the emergency plan or plans shall provide decision support to masters for handling any combination of emergency situations.
5 The emergency plan or plans shall have a uniform structure and be easy to use. Where applicable, the actual loading condition as calculated for the passenger ship's voyage shall be used for damage control purposes.
6 In addition to the printed emergency plan or plans, the Administration may also accept the use of a computer-based decision support system on the navigation bridge which provides all the information contained in the emergency plan or plans, procedures, checklists, etc., which is able to present a list of recommended actions to be carried out in foreseeable emergencies.

Regulation 30
Drills
1 This regulation applies to all passenger ships.
2 On passenger ships, an abandon ship drill and fire drill shall take place weekly. The entire crew need not be involved in every drill, but each crew member must participate in an abandon ship drill and a fire drill each month as required in regulation 19.3.2. Passengers shall be strongly encouraged to attend these drills.

SECTION III – CARGO SHIPS
(Additional requirements)

Regulation 31
Survival craft and rescue boats
1 Survival craft
1.1 Cargo ships shall carry:
1 one or more totally enclosed lifeboats complying with the requirements of section 4.6 of the Code of such aggregate capacity on each side of the ship as will accommodate the total number of persons on board;
2 in addition, one or more inflatable or rigid liferafts, complying with the requirements of section 4.2 or 4.3 of the Code, of a mass of less than 185 kg and stowed in a position providing for easy side-to-side transfer at a single open deck level, and of such aggregate capacity as will accommodate the total number of persons on board. If the liferafts or liferafts are not of a mass of less than 185 kg and stowed.

4 Refer to MSC/Circ.310, Recommendation on means of rescue on ro-ro passenger ships.
5 Refer to the International Aeronautical and Maritime Search and Rescue Manual (IAMSAR Manual).
6 Refer to MSC/Circ.907, Application of SOLAS regulation III/28.2 concerning helicopter landing areas on non-ro-ro passenger ships.
7 Refer to MSC/Circ.955, Recommendation on helicopter landing areas on ro-ro passenger ships.
8 Refer to the Guidelines for a structure of an integrated system of contingency planning for shipboard emergencies adopted by the Organization by resolution A.832(20).
in a position providing for easy side-to-side transfer at a single open deck level, the total capacity available on each side shall be sufficient to accommodate the total number of persons on board.

1.2 In lieu of meeting the requirements of paragraph 1.1, cargo ships may carry:

- one or more free-fall lifeboats, complying with the requirements of section 4.7 of the Code, capable of being free-fall launched over the stern of the ship of such aggregate capacity as will accommodate the total number of persons on board; and

- in addition, one or more inflatable or rigid liferafts complying with the requirements of section 4.2 or 4.3 of the Code, on each side of the ship, of such aggregate capacity as will accommodate the total number of persons on board. The liferafts on at least one side of the ship shall be served by launching appliances.

1.3 In lieu of meeting the requirements of paragraph 1.1 or 1.2, cargo ships of less than 85 m in length other than oil tankers, chemical tankers and gas carriers, may comply with the following:

- they shall carry on each side of the ship, one or more inflatable or rigid liferafts complying with the requirements of section 4.2 or 4.3 of the Code and of such aggregate capacity as will accommodate the total number of persons on board;

- unless the liferafts required by paragraph 1.3.1 are of a mass of less than 185 kg and stowed in a position providing for easy side-to-side transfer at a single open deck level, additional liferafts shall be provided so that the total capacity available on each side will accommodate 150% of the total number of persons on board;

- if the rescue boat required by paragraph 2 is also a totally enclosed lifeboat complying with the requirements of section 4.6 of the Code, it may be included in the aggregate capacity required by paragraphs 1.3.2, provided that the total capacity available on either side of the ship is at least 150% of the total number of persons on board; and

- in the event of any one survival craft being lost or rendered unserviceable, there shall be sufficient survival craft available for use on each side, including any which are of a mass of less than 185 kg and stowed in a position providing for easy side-to-side transfer at a single open deck level, to accommodate the total number of persons on board.

1.4 Cargo ships where the horizontal distance from the extreme end of the stem or stern of the ship to the nearest end of the closest survival craft is more than 100 m shall carry, in addition to the liferafts required by paragraphs 1.1.2 and 1.2.2.2, a liferaft stowed as far forward or aft, or as far as forward and another as far aft, as is reasonable and practicable. Such liferaft or liferafts may be securely fastened so as to permit manual release and need not be of the type which can be launched from an approved launching device.

1.5 With the exception of the survival craft referred to in regulation 16.11.1, all survival craft required to provide for abandonment by the total number of persons on board shall be capable of being launched with their full complement of persons and equipment within a period of 10 min from the time the abandon ship signal is given.

1.6 Chemical tankers and gas carriers carrying cargoes emitting toxic vapours or gases shall carry, in lieu of totally enclosed lifeboats complying with the requirements of section 4.6 of the Code, lifeboats with a self-contained air support system complying with the requirements of section 4.8 of the Code.

1.7 Oil tankers, chemical tankers and gas carriers carrying cargoes having a flashpoint not exceeding 60°C (closed-cup test) shall carry, in lieu of totally enclosed lifeboats complying with the requirements of section 4.6 of the Code, fire-protected lifeboats complying with the requirements of section 4.9 of the Code.

1.8 Notwithstanding the requirements of paragraph 1.1, bulk carriers as defined in regulation IX/16 constructed on or after 1 July 2006 shall comply with the requirements of paragraph 1.2.


2 General Index

Cargo ships shall carry at least one rescue boat complying with the requirements of section 5.1 of the Code. A lifeboat may be accepted as a rescue boat, provided that it and its launching and recovery arrangements also comply with the requirements for a rescue boat.

In addition to their lifeboats, all cargo ships constructed before 1 July 1986 shall carry:

- one or more liferafts capable of being launched on either side of the ship and of such aggregate capacity as will accommodate the total number of persons on board. The liferaft or liferafts shall be equipped with a lashing or an equivalent means of securing the liferaft which will automatically release it from a striking ship; and

- where the horizontal distance from the extreme end of the stem or stern of the ship to the nearest end of the closest survival craft is more than 100 m, in addition to the liferafts required by paragraph 1.3.1, a liferaft stowed at far forward or aft, or one as far forward and another as far aft, as is reasonable and practicable. Notwithstanding the requirements of paragraph 3.1, such liferaft or liferafts may be securely fastened so as to permit manual release.

Regulation 32

Personal life-saving appliances

1 Lifebuoys

1.1 Cargo ships shall carry not less than the number of lifebuoys complying with the requirements of regulation 7.1 and section 2.1 of the Code prescribed in the following table:

<table>
<thead>
<tr>
<th>Length of ship in metres</th>
<th>Minimum number of lifebuoys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 100</td>
<td>8</td>
</tr>
<tr>
<td>and under 150</td>
<td>10</td>
</tr>
<tr>
<td>150 and under 200</td>
<td>12</td>
</tr>
<tr>
<td>200 and over</td>
<td>14</td>
</tr>
</tbody>
</table>

1.2 Self-igniting lights for lifebuoys on tankers required by regulation 7.1.3 shall be of an electric battery type.

2 Lifesaving lights

2.1 This paragraph applies to all cargo ships.

2.2 On cargo ships, each lifesaving light complying with the requirements of paragraph 2.2.2.1 of the Code.

3 Lights fitted on liferafts on board cargo ships prior to 1 July 1998 and not complying fully with paragraph 2.2.3 of the Code may be accepted by the Administration until the lifesaving light would normally be replaced or until the first periodical survey after 1 July 2001, whichever is the earliest.

3 Immersion suits

3.1 This paragraph applies to all cargo ships. However, with respect to cargo ships constructed before 1 July 2006, paragraphs 3.2 to 3.5 shall be complied with not later than the first safety equipment survey on or after 1 July 2006.

3.2 An immersion suit of an appropriate size complying with the requirements of section 2.3.1 of the Code shall be provided for every person on board the ship. However, for ships other than bulk carriers, as defined in regulation IX/1, these immersion suits need not be required if the ship is constantly engaged on voyages in warm climates® where, in the opinion of the Administration, immersion suits are unnecessary.

® Refer to the Guidelines for the assessment of thermal protection (MSC/Circ.1046).
Solution 10

1. Which damage stability rules are valid for passenger ships with keel laying after 01.01.2009? Which rule has to be especially focused on?

New probabilistic damage stability calculation acc. to SOLAS 2009 B-1 (before 2009 passenger ships with solely deterministic and cargo ships solely with outdated probabilistic approach acc. to SOLAS 90). Additionally new regulation 8 for passenger ships

2. What is the difference concerning the attained subdivision index for passenger ships compared to cargo ships?

Each of $A_s$, $A_p$ and $A_l$ minimum $0, 9 \cdot R$ for passenger ships. minimum of $0, 5 \cdot R$ for cargo ships. Different assessment of the survivability $s_i$ in calculation of $A$. For Pax: $s_i = 0$ if $\varphi_{eq} \geq 15^\circ$, for cargo: $s_i = 0$ if $\varphi_{eq} \geq 30^\circ$

3. What is the difference concerning the required subdivision index for passenger ships compared to cargo ships?

For passenger ships:

$$R = 1 - \frac{5,000}{L_s + 2,5 N + 15,225}$$

with:

$N = N_1 + 2 N_2$
$N_1 =$ number of persons (incl. crew) for whom lifeboats are provided
$N_2 =$ number of persons the ship is permitted to carry in excess of $N_1$

For cargo ships:

$$R = R(L_s)$$

4. What has to be especially considered for ro-ro passenger ships operating in Europe?

Stockholm-Agreement => damage stability acc. to SOLAS 90 Reg. 8 with additional water on the main-garage-deck and neglectation of the margin line.

5. What is the assumed extent of the penetration depth following from the special requirements for passenger vessels with keel laying after 01.01.2009? What is a reasonable constructional element following from this?

$0,1^\circ B => B/10$ longitudinal bulkhead
SOLAS Chapter II-1 - Construction - Structure, subdivision and stability, machinery and electrical installations
Part B-1 - Stability

Regulation 8 - Special requirements concerning passenger ship stability

1 A passenger ship intended to carry 400 or more persons shall have watertight subdivision abaft the collision bulkhead so that \( s_i = 1 \) for the three loading conditions on which is based the calculation of the subdivision index and for a damage involving all the compartments within \( 0.08L \) measured from the forward perpendicular.

2 A passenger ship intended to carry 36 or more persons is to be capable of withstanding damage along the side shell to an extent specified in paragraph 3. Compliance with this regulation is to be achieved by demonstrating that \( s_i \), as defined in regulation 7-2, is not less than 0.9 for the three loading conditions on which is based the calculation of the subdivision index.

3 The damage extent to be assumed when demonstrating compliance with paragraph 2, is to be dependent on both \( N \) as defined in regulation 6, and \( L_s \) as defined in regulation 2, such that:

- the vertical extent of damage is to extend from the ship’s moulded baseline to a position up to 12.5 m above the position of the deepest subdivision draught as defined in regulation 2, unless a lesser vertical extent of damage were to give a lower value of \( s_i \) in which case this reduced extent is to be used;
- where 400 or more persons are to be carried, a damage length of \( 0.03L_s \) but not less than 3 m is to be assumed at any position along the side shell, in conjunction with a penetration inboard of \( 0.1B \) but not less than 0.75 m measured inboard from the ship side, at right angle to the centreline at the level of the deepest subdivision draught;
- where less than 400 persons are carried, damage length is to be assumed at any position along the shell side between transverse watertight bulkheads provided that the distance between two adjacent transverse watertight bulkheads is not less than the assumed damage length. If the distance between adjacent transverse watertight bulkheads is less than the assumed damage length, only one of these bulkheads shall be...
considered effective for the purpose of demonstrating compliance with paragraph 2;

where 36 persons are carried, a damage length of 0.015Ls but not less than 3 m is to be assumed, in conjunction with a penetration inboard of 0.05B but not less than 0.75 m; and

where more than 36, but fewer than 400 persons are carried the values of damage length and penetration inboard, used in the determination of the assumed extent of damage, are to be obtained by linear interpolation between the values of damage length and penetration which apply for ships carrying 36 persons and 400 persons as specified in subparagraphs .4 and .2.
6. Which damage stability rules are valid for passenger vessels with keel laying before 1.1.2009?

old SOLAS (2004 and older) Part B Reg. 8: subdivision and stability of passenger ships... Regel 8-
1: Ro-Pax vessels Regel 8-2: Ro-Pax vessels with 400 or more persons Regel 8-3: Passenger vessels
with 400 or more persons

7. What is the assumed extent of the penetration depth following from the special requirements
for passenger vessels with keel laying before 1.1.2009? What is a reasonable construction element
following from this?
0.2*B => B/5 longitudinal bulkhead (from obsolete SOLAS ’90)
Regulation 8

Stability of passenger ships in damaged condition

(Subject to the provisions of regulation 8.1, paragraphs 2.3.1 to 2.3.4, 2.4, 5 and 6.2 apply to passenger ships constructed on or after 29 April 1990. Paragraphs 7.2, 7.3 and 7.4 apply to all passenger ships)

1.1 Sufficient intact stability shall be provided in all service conditions so as to enable the ship to withstand the final stage of flooding of any one main compartment which is required to be within the floodable length.

1.2 Where two adjacent main compartments are separated by a bulkhead which is stepped under the conditions of regulation 7.5.1 the intact stability shall be adequate to withstand the flooding of those two adjacent main compartments.

1.3 Where the required factor of subdivision is 0.5 or less but more than 0.33 intact stability shall be adequate to withstand the flooding of any two adjacent main compartments.

1.4 Where the required factor of subdivision is 0.33 or less the intact stability shall be adequate to withstand the flooding of any three adjacent main compartments.

2.1 The requirements of paragraph 1 shall be determined by calculations which are in accordance with paragraphs 3, 4 and 6 and which take into consideration the proportions and design characteristics of the ship and the arrangement and configuration of the damaged compartments. In making these calculations the ship is to be assumed in the worst anticipated service condition as regards stability.

2.2 Where it is proposed to fit decks, inner skins or longitudinal bulkheads of sufficient tightness to seriously restrict the flow of water, the Administration shall be satisfied that proper consideration is given to such restrictions in the calculations.

* Refer to MSC/Circ.541 (as may be revised): Guidance notes on the integrity of flooding boundaries above the bulkhead deck of passenger ships for proper application of regulations II-1/8 and 20, paragraph 1, of SOLAS 1974, as amended.
2.3 The stability required in the final condition after damage, and after equalization where provided, shall be determined as follows:

2.3.1 The positive residual righting lever curve shall have a minimum range of $15^\circ$ beyond the angle of equilibrium. This range may be reduced to a minimum of $10^\circ$, in the case where the area under the righting lever curve is that specified in paragraph 2.3.2, increased by the ratio:

$$\frac{15}{\text{range}}$$

where the range is expressed in degrees.

2.3.2 The area under the righting lever curve shall be at least 0.015 metre-radians, measured from the angle of equilibrium to the lesser of:

1. the angle at which progressive flooding occurs;
2. $22^\circ$ (measured from the upright) in the case of one-compartment flooding, or $27^\circ$ (measured from the upright) in the case of the simultaneous flooding of two or more adjacent compartments.

2.3.3 A residual righting lever is to be obtained within the range of positive stability, taking into account the greatest of the following heeling moments:

1. the crowding of all passengers towards one side;
2. the launching of all fully loaded davit-launched survival craft on one side;
3. due to wind pressure;

as calculated by the formula:

$$GZ \text{ (in metres)} = \frac{\text{heeling moment}}{\text{displacement}} + 0.04$$

However, in no case is this righting lever to be less than 0.1 m.

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 muster stations are located and in such a way that they produce the most adverse heeling moment.
Chapter II-1: Construction – structure, stability, installations
Regulation 8

.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 liferaft 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/m² 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.

.2.4 In intermediate stages of flooding, the maximum righting lever shall be at least 0.05 m and the range of positive righting levers shall be at least $7^\circ$. In all cases, only one breach in the hull and only one free surface need be assumed.

.3 For the purpose of making damage stability calculations the volume and surface permeabilities shall be in general as follows:

<table>
<thead>
<tr>
<th>Spaces</th>
<th>Permeability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriated to cargo, coal or stores</td>
<td>60</td>
</tr>
<tr>
<td>Occupied by accommodation</td>
<td>95</td>
</tr>
<tr>
<td>Occupied by machinery</td>
<td>85</td>
</tr>
<tr>
<td>Intended for liquids</td>
<td>0 or 95*</td>
</tr>
</tbody>
</table>

Higher surface permeabilities are to be assumed in respect of spaces which, in the vicinity of the damage waterplane, contain no substantial quantity of

* Whichever results in the more severe requirements.
accommodation or machinery and spaces which are not generally occupied
by any substantial quantity of cargo or stores.

4 Assumed extent of damage shall be as follows:

.1 longitudinal extent: 3 m plus 3% of the length of the ship, or
    11 m, whichever is the 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, as
    defined in regulation 2; and

.3 vertical extent: from the base line upwards without limit;

.4 if any damage of lesser extent than that indicated in paragraphs
    4.1, 4.2 and 4.3 would result in a more severe condition
    regarding heel or loss of metacentric height, such damage shall
    be assumed in the calculations.

5 Unsymmetrical flooding is to be kept to a minimum consistent with
    efficient arrangements. Where it is necessary to correct large angles of heel,
    the means adopted shall, where practicable, be self-acting, but in any case
    where controls to cross-flooding fittings are provided they shall be operable
    from above the bulkhead deck. These fittings together with their controls
    shall be acceptable to the Administration. The maximum angle of heel after
    flooding but before equalization shall not exceed 15°. Where cross-flooding
    fittings are required the time for equalization shall not exceed 15 min.
    Suitable information concerning the use of cross-flooding fittings shall be
    supplied to the master of the ship.*

6 The final conditions of the ship after damage and, in the case of
    unsymmetrical flooding, after equalization measures have been taken shall
    be as follows:

.1 in the case of symmetrical flooding there shall be a positive
    residual metacentric height of at least 50 mm as calculated by the
    constant displacement method;

.2 in the case of unsymmetrical flooding, the angle of heel for one-
    compartment flooding shall not exceed 7°. For the simultaneous
    flooding of two or more adjacent compartments, a heel of 12
    may be permitted by the Administration.

* Refer to the Recommendation on a standard method for establishing compliance with the
requirements for cross-flooding arrangements in passenger ships adopted by the Organization
by resolution A.266(VIII).
in no case shall the margin line be submerged in the final stage of flooding. If it is considered that the margin line may become submerged during an intermediate stage of flooding, the Administration may require such investigations and arrangements as it considers necessary for the safety of the ship.

7.1 The master of the ship shall be supplied with the data necessary to maintain sufficient intact stability under service conditions to enable the ship to withstand the critical damage. In the case of ships requiring cross-flooding the master of the ship shall be informed of the conditions of stability on which the calculations of heel are based and be warned that excessive heeling might result should the ship sustain damage when in a less favourable condition.

7.2 The data referred to in paragraph 7.1 to enable the master to maintain sufficient intact stability shall include information which indicates the maximum permissible height of the ship’s centre of gravity above keel (KG), or alternatively the minimum permissible metacentric height (GM), for a range of draughts or displacements sufficient to include all service conditions. The information shall show the influence of various trims taking into account the operational limits.

7.3 Each ship shall have scales of draughts marked clearly at the bow and stern. In the case where the draught marks are not located where they are easily readable, or operational constraints for a particular trade make it difficult to read the draught marks, then the ship shall also be fitted with a reliable draught indicating system by which the bow and stern draughts can be determined.

7.4 On completion of loading of the ship and prior to its departure, the master shall determine the ship’s trim and stability and also ascertain and record that the ship is in compliance with stability criteria in the relevant regulations. The determination of the ship’s stability shall always be made by calculation. The Administration may accept the use of an electronic loading and stability computer or equivalent means for this purpose.

8.1 No relaxation from the requirements for damage stability may be considered by the Administration unless it is shown that the intact metacentric height in any service condition necessary to meet these requirements is excessive for the service intended.

8.2 Relaxations from the requirements for damage stability shall be permitted only in exceptional cases and subject to the condition that the Administration is to be satisfied that the proportions, arrangements and other characteristics of the ship are the most favourable to stability after damage which can practically and reasonably be adopted in the particular circumstances.
Regulation 8-1

*Stability of ro–ro passenger ships in damaged condition*

Ro–ro passenger ships constructed before 1 July 1997 shall comply with regulation 8, as amended by resolution MSC.12(56), not later than the date of the first periodical survey after the date of compliance prescribed below, according to the value of $A/A_{\text{max}}$ as defined in the annex of the Calculation Procedure to assess the survivability characteristics of existing ro–ro passenger ships when using a simplified method based upon resolution A.265(VIII), developed by the Maritime Safety Committee at its fifty-ninth session in June 1991 (MSC/Circ.574).†

<table>
<thead>
<tr>
<th>Value of $A/A_{\text{max}}$</th>
<th>Date of compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 85%</td>
<td>1 October 1998</td>
</tr>
<tr>
<td>85% or more but less than 90%</td>
<td>1 October 2000</td>
</tr>
<tr>
<td>90% or more but less than 95%</td>
<td>1 October 2002</td>
</tr>
<tr>
<td>95% or more but less than 97.5%</td>
<td>1 October 2004</td>
</tr>
<tr>
<td>97.5% or more</td>
<td>1 October 2005</td>
</tr>
</tbody>
</table>

Regulation 8-2

*Special requirements for ro–ro passenger ships carrying 400 persons or more*

Notwithstanding the provisions of regulations 8 and 8-1:

.1 Ro–ro passenger ships certified to carry 400 persons or more constructed on or after 1 July 1997 shall comply with the provisions of paragraph 2.3 of regulation 8, assuming the damage applied anywhere within the ship’s length $L$; and

.2 Ro–ro passenger ships certified to carry 400 persons or more constructed before 1 July 1997 shall comply with the requirements of subparagraph .1 not later than the date of the first periodical survey after the date of compliance prescribed in subparagraph .2.1, .2.2 or .2.3 which occurs the latest:

<table>
<thead>
<tr>
<th>Value of $A/A_{\text{max}}$</th>
<th>Date of compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 85%</td>
<td>1 October 1998</td>
</tr>
<tr>
<td>85% or more but less than 90%</td>
<td>1 October 2000</td>
</tr>
<tr>
<td>90% or more but less than 95%</td>
<td>1 October 2002</td>
</tr>
<tr>
<td>95% or more but less than 97.5%</td>
<td>1 October 2004</td>
</tr>
<tr>
<td>97.5% or more</td>
<td>1 October 2010</td>
</tr>
</tbody>
</table>

For the application of specific stability requirements to ro–ro passenger ships, refer to resolution 14 of the 1995 SOLAS Conference and resolution MSC.141(76), Revised model test method under resolution 14 of the 1995 SOLAS Conference.

† Refer to MSC/Circ.649, Interpretations of provisions of resolution MSC.26(60) and MSC/Circ.574.
.2.2 Number of persons permitted to be carried
1,500 or more  1 October 2002
1,000 or more but less than 1,500  1 October 2006
600 or more but less than 1,000  1 October 2008
400 or more but less than 600  1 October 2010

.2.3 Age of the ship equal to or greater than 20 years,
where the age of the ship means the time counted from the
date on which the keel was laid or the date on which it was at a
similar stage of construction or from the date on which the
ship was converted to a ro–ro passenger ship.

Regulation 8-3
Special requirements for passenger ships, other than ro–ro
passenger ships, carrying 400 persons or more

Notwithstanding the provisions of regulation 8, passenger ships, other than
ro–ro passenger ships, certified to carry 400 persons or more constructed on
or after 1 July 2002 shall comply with the provisions of paragraphs 2.3 and
2.4 of regulation 8, assuming the damage applied anywhere within the
ship’s length L.

Regulation 9
Ballasting of passenger ships

1 Water ballast should not in general be carried in tanks intended for oil
fuel. In ships in which it is not practicable to avoid putting water in oil fuel
tanks, oily-water separating equipment to the satisfaction of the Admin-
istration shall be fitted, or other alternative means, such as discharge to shore
facilities, acceptable to the Administration shall be provided for disposing of
the oily-water ballast.

2 The provisions of this regulation are without prejudice to the
provisions of the International Convention for the Prevention of Pollution
from Ships in force.

Regulation 10
Peak and machinery space bulkheads, shaft tunnels, etc.,
in passenger ships*

1 A forepeak or collision bulkhead shall be fitted which shall be
watertight up to the bulkhead deck. This bulkhead shall be located at a

* Refer to MSC/Circ.855, Interpretation of the position of the forward perpendicular for the
purpose of SOLAS regulation II-1/10.
8. What is the consequence if a compartment does not contain the above mentioned construction element?
no B/5 bulkhead $\Rightarrow$ whole compartment damaged i.e. flooded

9. What is the maximum length of a Main-Fire-Zone and by what constructional elements are MFZ separated?

normal max. length 40 m but in special cases max. 48 m, in order to place the main fire bulkhead on top of the watertight bulkheads. The main fire bulkheads separate the space above the freeboard deck similarly to the watertight bulkheads below.
27 *Helicopter facility* is a helideck including any refuelling and hangar facilities.

28 *Lightweight* is the displacement of a ship in tonnes without cargo, fuel, lubricating oil, ballast water, fresh water and feedwater in tanks, consumable stores, and passengers and crew and their effects.

29 *Low flame-spread* means that the surface thus described will adequately restrict the spread of flame, this being determined in accordance with the Fire Test Procedures Code.

30 *Machinery spaces* are machinery spaces of category A and other spaces containing propulsion machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces.

31 *Machinery spaces of category A* are those spaces and trunks to such spaces which contain either:

   .1 internal combustion machinery used for main propulsion;

   .2 internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or

   .3 any oil-fired boiler or oil fuel unit, or any oil-fired equipment other than boilers, such as inert gas generators, incinerators, etc.

32 *Main vertical zones* are those sections into which the hull, superstructure and deckhouses are divided by "A" class divisions, the mean length and width of which on any deck does not in general exceed 40 m.

33 *Non-combustible material* is a material which neither burns nor gives off flammable vapours in sufficient quantity for self-ignition when heated to approximately 750°C, this being determined in accordance with the Fire Test Procedures Code.

34 *Oil fuel unit* is the equipment used for the preparation of oil fuel for delivery to an oil-fired boiler, or equipment used for the preparation for delivery of heated oil to an internal combustion engine, and includes any oil pressure pumps, filters and heaters dealing with oil at a pressure of more than 0.18 N/mm².
Regulation 9 - Containment of fire

1 Purpose

The purpose of this regulation is to contain a fire in the space of origin. For this purpose, the following functional requirements shall be met:

1. The ship shall be subdivided by thermal and structural boundaries;
2. Thermal insulation of boundaries shall have due regard to the fire risk of the space and adjacent spaces; and
3. The fire integrity of the divisions shall be maintained at openings and penetrations.

2 Thermal and structural boundaries

2.1 Thermal and structural subdivision

Ships of all types shall be subdivided into spaces by thermal and structural divisions having regard to the fire risks of the spaces.

2.2 Passenger ships

2.2.1 Main vertical zones and horizontal zones

2.2.1.1 In ships carrying more than 36 passengers, the hull, superstructure and deckhouses shall be subdivided into main vertical zones by "A-60" class divisions. Steps and recesses shall be kept to a minimum, but where they are necessary they shall also be "A-60" class divisions. Where a category (5), (9) or (10) space defined in paragraph 2.2.3.2.2 is on one side or where fuel oil tanks are on both sides of the division the standard may be reduced to "A-0".

2.2.1.2 In ships carrying not more than 36 passengers, the hull, superstructure and deckhouses in way of accommodation and service spaces shall be subdivided into main vertical zones by "A" class divisions. These divisions shall have insulation values in accordance with tables in paragraph 2.2.4.

2.2.1.2 As far as practicable, the bulkheads forming the boundaries of the main vertical zones above the bulkhead...
deck shall be in line with watertight subdivision bulkheads situated immediately below the bulkhead deck. The length and width of main vertical zones may be extended to a maximum of 48 m in order to bring the ends of main vertical zones to coincide with watertight subdivision bulkheads or in order to accommodate a large public space extending for the whole length of the main vertical zone provided that the total area of the main vertical zone is not greater than 1,600 m² on any deck. The length or width of a main vertical zone is the maximum distance between the furthermost points of the bulkheads bounding it.

2.2.1.3 Such bulkheads shall extend from deck to deck and to the shell or other boundaries.

2.2.1.4 Where a main vertical zone is subdivided by horizontal "A" class divisions into horizontal zones for the purpose of providing an appropriate barrier between a zone with sprinklers and a zone without sprinklers, the divisions shall extend between adjacent main vertical zone bulkheads and to the shell or exterior boundaries of the ship and shall be insulated in accordance with the fire insulation and integrity values given in table 9.4.

2.2.1.5.1 On ships designed for special purposes, such as automobile or railroad car ferries, where the provision of main vertical zone bulkheads would defeat the purpose for which the ship is intended, equivalent means for controlling and limiting a fire shall be substituted and specifically approved by the Administration. Service spaces and ship stores shall not be located on ro-ro decks unless protected in accordance with the applicable regulations.

2.2.1.5.2 However, in a ship with special category spaces, such spaces shall comply with the applicable provisions of regulation 20 and, where such compliance would be inconsistent with other requirements for passenger ships specified in this chapter, the requirements of regulation 20 shall prevail.

2.2.2 Bulkheads within a main vertical zone

2.2.2.1 For ships carrying more than 36 passengers, bulkheads which are not required to be "A" class divisions shall be at least "B" class or "C" class divisions as prescribed in the tables in paragraph 2.2.3.

2.2.2.2 For ships carrying not more than 36 passengers, bulkheads within accommodation and service spaces which are not required to be "A" class divisions shall be at least "B" class or "C" class divisions as prescribed in the tables in paragraph 2.2.4. In addition, corridor bulkheads, where not required to be "A" class, shall be "B" class divisions which
10. Which rule do all passenger ships built after 01.07.2010 have to fulfill, that have a length as defined in SOLAS Rule II-1/2.5 of 120 m or more or three or more vertical main fire zones?

Safe Return to Port
Chapter II-2, Part G - Special Requirements

Enters into Force

1st July 2010

Amendment Details

The following new regulations 21, 22 and 23 are added after the existing regulation 20:

Amendment Consolidated

Note: Amendments are highlighted.

Regulation 21 – Casualty threshold, safe return to port and safe areas

1 Application

Passenger ships constructed on or after 1 July 2010 having length, as defined in regulation II-1/2.5, of 120 m or more or having three or more main vertical zones shall comply with the provisions of this regulation.

2 Purpose

The purpose of this regulation is to establish design criteria for a ship's safe return to port under its own propulsion after a casualty that does not exceed the casualty threshold stipulated in paragraph 3 and also provides functional requirements and performance standards for safe areas.

3 Casualty threshold

The casualty threshold, in the context of a fire, includes:

- 1 loss of space of origin up to the nearest "A" class boundaries, which may be a part of the space of origin, if the space of origin is protected by a fixed fire extinguishing system; or

- 2 loss of the space of origin and adjacent spaces up to the nearest "A" class boundaries, which are not part of the space of origin.

4 Safe return to port*

When fire damage does not exceed the casualty threshold indicated in paragraph 3, the ship shall be capable of returning to port while providing a safe area as defined in regulation 3. To be deemed capable of returning to port, the following systems shall remain operational in the remaining part of the ship not affected by fire:

.1 propulsion;
.2 steering systems and steering-control systems;
.3 navigational systems;
.4 systems for fill, transfer and service of fuel oil;
.5 internal communication between the bridge, engineering spaces, safety centre, fire-fighting and damage control teams, and as required for passenger and crew notification and mustering;
.6 external communication;
.7 fire main system;
.8 fixed fire-extinguishing systems;
.9 fire and smoke detection system;
.10 bilge and ballast system;
.11 power-operated watertight and semi-watertight doors;
.12 systems intended to support "safe areas" as indicated in paragraph 5.1.2;
.13 flooding detection systems; and
.14 other systems determined by the Administration to be vital to damage control efforts.

5 Safe area(s)

5.1 Functional requirements:

.1 the safe area(s) shall generally be internal space(s); however, the use of an external space as a safe area may be allowed by the Administration taking into account any restriction due to the area of operation and relevant expected environmental conditions.
conditions;

.2 the safe area(s) shall provide all occupants with the following basic services* to ensure that the health of passengers and crew is maintained:

.1 sanitation;

.2 water;

.3 food;

.4 alternate space for medical care;

.5 shelter from the weather;

.6 means of preventing heat stress and hypothermia;

.7 light; and

.8 ventilation;

.3 ventilation design shall reduce the risk that smoke and hot gases could affect the use of the safe area (s); and

.4 means of access to life-saving appliances shall be provided from each area identified or used as a safe area, taking into account that a main vertical zone may not be available for internal transit.

5.2 Alternate space for medical care

Alternate space for medical care shall conform to a standard acceptable to the Administration.**

* Refer to the Performance standards for the systems and services to remain operational on passenger ships for safe return to port and orderly evacuation and abandonment after a casualty (MSC.1/Circ.1214).

** Refer to the Guidance on the establishment of medical and sanitation related programmes for passenger.

Regulation 22 - Design criteria for systems to remain operational after a fire casualty
1 Application

Passenger ships constructed on or after 1 July 2010 having length, as defined in regulation II-1/2.2, of 120 m or more or having three or more main vertical zones shall comply with the provisions of this regulation.

2 Purpose

The purpose of this regulation is to provide design criteria for systems required to remain operational for supporting the orderly evacuation and abandonment of a ship, if the casualty threshold, as defined in regulation 21.3, is exceeded.

3 Systems*

3.1 In case any one main vertical zone is unserviceable due to fire, the following systems shall be so arranged and segregated as to remain operational:

1. fire main;
2. internal communications (in support of fire-fighting as required for passenger and crew notification and evacuation);
3. means of external communications;
4. bilge systems for removal of fire-fighting water;
5. lighting along escape routes, at assembly stations and at embarkation stations of life-saving appliances; and
6. guidance systems for evacuation shall be available.

3.2 The above systems shall be capable of operation for at least 3 h based on the assumption of no damage outside the unserviceable main vertical zone. These systems are not required to remain operational within the unserviceable main vertical zones.

3.3 Cabling and piping within a trunk constructed to an "A-60" standard shall be deemed to remain intact and serviceable while passing through the unserviceable main vertical zone for the purposes of paragraph 3.1. An equivalent degree of protection for cabling and piping may be approved by the Administration.

* Refer to the Performance standards for the systems and
services to remain operational on passenger ships for safe return to port and orderly evacuation and abandonment after a casualty (MSC.1/Circ.1214).

**Regulation 23 - Safety centre on passenger ships**

**1 Application**

Passenger ships constructed on or after 1 July 2010 shall have on board a safety centre complying with the requirements of this regulation.

**2 Purpose**

The purpose of this regulation is to provide a space to assist with the management of emergency situations.

**3 Location and arrangement**

The safety centre shall either be a part of the navigation bridge or be located in a separate space adjacent to and having direct access to the navigation bridge, so that the management of emergencies can be performed without distracting watch officers from their navigational duties.

**4 Layout and ergonomic design**

The layout and ergonomic design of the safety centre shall take into account the guidelines developed by the Organization*, as appropriate.

**5 Communications**

Means of communication between the safety centre, the central control station, the navigation bridge, the engine control room, the storage room(s) for fire extinguishing system(s) and fire equipment lockers shall be provided.

**6 Control and monitoring of safety systems**

Notwithstanding the requirements set out elsewhere in the Convention, the full functionality (operation, control, monitoring or any combination thereof, as required) of the safety systems listed below shall be available from the safety centre:

1. all powered ventilation systems;
2. fire doors;
.3 general emergency alarm system;
.4 public address system;
.5 electrically powered evacuation guidance systems;
.6 watertight and semi-watertight doors;
.7 indicators for shell doors, loading doors and other closing appliances;
.8 water leakage of inner/outer bow doors, stern doors and any other shell door;
.9 television surveillance system;
.10 fire detection and alarm system;
.11 fixed fire-fighting local application system(s);
.12 sprinkler and equivalent systems;
.13 water-based systems for machinery spaces;
.14 alarm to summon the crew;
.15 atrium smoke extraction system;
.16 flooding detection systems; and
.17 fire pumps and emergency fire pumps.

* Refer to guidelines to be developed by the Organization.
11. What is the margin line and for what kind of ships is it relevant?

The margin line is an imaginary horizontal line 76mm below the freeboard deck. The margin line is only relevant for passenger ships built in accordance with SOLAS 90. These ships' margin line must not be submerged in the damage case. By introduction of the SOLAS 2009 the margin line criterion was abolished.
Regulation 3
Definitions relating to parts C, D and E

For the purpose of parts C, D and E, unless expressly provided otherwise:

1. **Steering gear control system** is the equipment by which orders are transmitted from the navigation bridge to the steering gear power units.

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* This relates to the chapter II-2 in force before 1 July 2002. The equivalent term in the amended chapter II-2 is “ro–ro spaces”.
Part B
Subdivision and stability

(Part B applies to passenger ships and to cargo ships, as indicated in the regulations)

Regulation 4
Floodable length in passenger ships

1. The floodable length at any point of the length of a ship shall be determined by a method of calculation which takes into consideration the form, draught and other characteristics of the ship in question.

2. In a ship with a continuous bulkhead deck, the floodable length at a given point is the maximum portion of the length of the ship, having its centre at the point in question, which can be flooded under the definite assumptions set forth in regulation 5 without the ship being submerged beyond the margin line.

3.1. In the case of a ship not having a continuous bulkhead deck, the floodable length at any point may be determined to an assumed continuous margin line which at no point is less than 76 mm below the top of the deck (at side) to which the bulkheads concerned and the shell are carried watertight.

3.2. Where a portion of an assumed margin line is appreciably below the deck to which bulkheads are carried, the Administration may permit a limited relaxation in the watertightness of those portions of the bulkheads which are above the margin line and immediately under the higher deck.

Regulation 5
Permeability in passenger ships

1. The definite assumptions referred to in regulation 4 relate to the permeability of the spaces below the margin line.

2. In determining the floodable length, a uniform average permeability

* Instead of the requirements in this part, the Regulations on subdivision and stability of passenger ships as an equivalent to part B of chapter II of the International Convention for the Safety of Life at Sea, 1960, adopted by the Organization by resolution A.265(VIII), may be used, if applied in their entirety.
12. Please explain a typical propulsion concept for a passenger ship.

Large passenger vessel: Diesel-electric. 4 x four stroke medium speed diesel engines. Flexible generator power for demands by the hotel and propulsion – sea-voyage at night, and hotel during the day. 2 x FPP. Twin screw for enhanced manoeuvrability. FPP to avoid pressure side cavitation in off-design operation due to high demands in comfort and vibration.

13. Please mark the following in the general arrangement plan of the cruise vessel: bulkhead deck, all main fire zones as well as the watertight transverse bulkheads.

14. Please explain a typical propulsion concept for a ro-ro passenger ship.

Conventional Diesel-mechanic: 2 x CPP + Gear + four stroke medium speed diesels + PTO/PTI and additional generator sets. Twin screw for enhanced manoeuvrability. RoPax usually does not have separated times of hotel and propulsion mode. Diesel-mechanic offers better efficiency than diesel-electric propulsion. Four stroke engines require CPP.

15. Which intact stability criterions do passenger ships have to fulfill?

IS Code 2008. Additionally to valid criteria for cargo ships the maximum heel is restricted to 10 degrees for inclining moments in turning circles and passenger accumulation on one side of the ship.