INDIAN REGISTER OF SHIPPING

CLASSIFICATION NOTES

Stability Requirements for Inland Waterways Passenger Ships

November 2017

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Indian Register of Shipping

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STABILITY REQUIREMENTS FOR INLAND WATERWAYS PASSENGER SHIPS

Requirements of this document are applicable to Inland Waterways Passenger Ships contracted for construction on or after 1st November 2017

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Sections

1 General

1.1 The requirements of this Classification Note apply to passenger ships intended to operate in Inland Waterways, carrying more than 12 passengers and are supplementary to those given for the main character of class. These requirements are also applicable to passenger ships carrying cargo in addition to passengers. In such cases, relevant loading conditions in addition to those indicated in 3.2 will be considered.

1.2 Acceptance of compliance with similar stability, buoyancy and other safety criteria set by the Statutory Authority in lieu of the requirements laid down in this Classification Note, will be considered. The applicable statutory requirements of the local or National Administration are also to be complied with.

2 Documentation

2.1 The following details are to be submitted:

- Number of passengers to be carried;
- Intact stability calculations (including inclining experiment procedure, inclining experiment report, draught survey report) as per **3**;
- Subdivision and damaged stability calculations as per **4**;
- Arrangement of openings, if any, on watertight bulkheads;
- Weather tight Integrity Plan

2.2 For the purpose of this classification note the following definitions apply:

2.2.1 Bulkhead deck: The uppermost deck upto which the transverse bulkheads are watertight.

2.2.2 Margin line: Notional line drawn on the shell 100 [mm] below the top of the bulkhead deck at side. Where, in a part of the ship, the bulkhead deck is stepped below or not fitted, the margin line is to be drawn 100 [mm] below the level upto which both the transverse bulkheads and side shell are watertight.

2.2.3 Residual Freeboard: The vertical clearance available, in the event of the vessel heeling over, between the water level and the upper surface of the deck at the lowest point of the immersed side

2.2.4 Residual Safety Clearance: The vertical clearance available, in the event of the vessel heeling over, between the water level and the lowest point of the immersed side, beyond which the vessel is no longer regarded as watertight

3. Intact Stability

3.1 General

3.1.1 All calculations are to be carried out free to trim and sinkage. The lightship data taken into account for the stability calculation is to be determined by conducting an inclining test.

3.2 Loading Conditions

3.2.1 The intact stability is to be proven for the following standard loading conditions:

a) At the start of the voyage: (100% Passengers, 98% fuel and fresh water, 10% waste water)

b) During the voyage: (100% passengers, 50% fuel and fresh water, 50% waste water)

c) At the end of the voyage: (100% passengers,10% fuel and fresh water, 98% waste water)

d) Unladen vessel (no passengers, 10% fuel and fresh water, no waste water)

3.2.2 For all standard loading conditions, the ballast tanks are to be considered as either empty or full in accordance with normal operational conditions.

3.2.3 In addition, the requirements of 3.3.1 d) are to be proved for the following loading condition:

a) 100% Passengers, 50% fuel and fresh water, 50% waste water, all other liquid (including ballast) tanks are considered filled to 50%.

3.2.4 Stability calculations for additional loading conditions may need to be submitted, in case it is necessary to verify the safety of the vessel.

3.3 Criteria

3.3.1 The proof of adequate intact stability by means of a calculation is to be produced using the following definitions for the intact stability and for the standard loading conditions mentioned in 3.2:

a) the maximum righting lever h_{max} is to occur at a heeling angle of φ_{max} ≥(φ_{mom}+3°) and is not to be less than 0.2 [m]. However, in case φ_f<φ_{max} the righting lever at the downflooding angle φ_f is not to be less than 0.2 [m];

b) the downflooding angle φ_f is not to be less than (φ_{mom}+3°);

c) the area A under the curve of the righting levers is to, depending on the position of φ_f and φ_{max}, reach at least the following values:

Table 3.3.1 : Intact Stability Criteria

Case			Area
1	φ_{max} ≤ 15˚ or φ_f ≤ 15˚		0.05 [m.rad] up to the smaller of the angles φ_{max} or φ_f
2	15˚ < φ_{max} < 30˚	φ_{max} ≤ φ_f	0.035 + 0.001 (30 - φ_{max}) [m.rad] up to the angle φ_{max}
3	15˚ < φ_f < 30˚	φ_{max} > φ_f	0.035 + 0.001 (30 - φ_f) [m.rad] up to the angle φ_f
4	φ_{max} ≥ 30˚ and φ_f ≥ 30˚		0.035 [m.rad] up to the angle φ=30˚

Where,
h_{max} : is the maximum lever

φ: the heeling angle;

φ_f : the downflooding angle, that is the heeling angle, at which openings in the hull, in the superstructure or deck houses which cannot be closed so as to be watertight, submerge;

φ_{mom} : the maximum heeling angle according to e);

φ_{max} : the heeling angle at which the maximum righting lever occurs;

A: the area under the curve of the righting levers;

d) the initial metacentric height, GMo, corrected by the free surface effect in liquid tanks, is not to be less than 0.15 [m];

e) in each of the following two cases the heeling angle φ_{mom} is not to exceed 12°:

   i. in application of the heeling moment due to persons and wind according to sections 3.4 and 3.5;

   ii. in application of the heeling moment due to persons and turning according to sections 3.4 and 3.6;

f) for a heeling moment resulting from moments due to persons, wind and turning according to 3.4, 3.5 and 3.6, the residual freeboard is to be not less than 0.2 [m];

g) for vessels with windows or other openings in the hull located below the bulkhead decks and not closed watertight, the residual safety clearance is to be at least 0.1 [m] on the application of the three heeling moments resulting from f) above.

3.4 Heeling moment due to accumulation of persons

3.4.1 The heeling moment M_p [kN-m], caused by accumulation of persons on one side of the ship, is the sum of individual heeling moments on various decks occupied by passengers, and, is to be calculated according to the following formula:

$$M_p = g\ P\ y = g \sum P_i\ y_i\ \ [kNm]$$

P = total mass of persons on board in [t], calculated by adding up the maximum permitted number of passengers and the maximum number of shipboard personnel and crew under normal operating conditions, assuming an average mass per person of 0.075 [t]

y = lateral distance of center of gravity of total mass of persons P from centre line in [m]

g = acceleration of gravity (g = 9.81 [m/s^2])

P_i = mass of persons accumulated on area A_i ;

$$P_i = n_i \; 0.075 \; A_i \;\; [t]$$

where,

A_i = area occupied by the persons in [m^2]

n_i = number of persons per square meter:

n_i = 3.75 for free deck areas; for deck areas with fixed seating furniture such as benched, n_i is to be calculated by assuming as area of 0.5 [m] in width and 0.75 [m] in seat depth per person.

y_i = lateral distance of geometrical centre of area A_i from centre line in [m]

3.4.2 The calculation is to be carried out for accumulation of persons both to starboard and to port.

3.4.3 The distribution of persons is to correspond to the most unfavourable one from the point of view of stability. Cabins are to be assumed unoccupied for the calculation of the persons' moment.

3.4.4 For the calculation of the loading cases, the centre of gravity of a person is to be taken as 1 [m] above the lowest point of the deck at 0.5 LWL, ignoring any deck curvature and assuming a mass of 0.075 [t] per person.

3.4.5 A detailed calculation/ plan of deck areas which are occupied by persons may be dispensed with if the value of y is considered as 0.45 of the breadth.

3.5 Heeling moment due to Wind

3.5.1 The heeling moment due to wind pressure M_w is to be calculated as follows:

$$M_w = p_w \, A_w \left(L_w + \frac{T}{2}\right) \;\; [kNm]$$

where:

p_w = 0.25 [kN/m²].However, the value for p_w may be taken as per actual prevailing wind conditions in the relevant service area of the vessel and not less than 0.1 [kN/m^2]. Any operating restrictions are to be indicated in the Stability Booklet and Class Certificate.

A_w = lateral plane of the vessel above the plane of draught according to the considered loading condition in [m²];

Lw = distance of the centre of gravity of the lateral plane A_w from the plane of draught according to the considered loading condition in [m].

3.5.2 In calculating the lateral plane, account is to be taken of the intended enclosure of the deck by awnings and similar mobile installations.

3.6 Heeling moment due to turning

3.6.1 The moment due to centrifugal force M_{dr}, caused by the turning of the vessel, is to be calculated as follows:

$$M_{dr} = c_{dr}\ C_B\ v^2\ \frac{D}{L_{WL}}\left(KG - \frac{T}{2}\right)\ [kNm]$$

where

C_{dr} = a coefficient of 0.045;

C_B = block coefficient (if not known, taken as 1.0);

v = maximum speed of the vessel in [m/s];

KG = distance between the centre of gravity and the keel line in [m].

D = Mass Displacement in tonnes

3.6.2 For passenger vessels with rudder-propeller, water-jet, cycloidal-propeller and bow-thruster propulsion systems, M_{dr} is to be derived from full-scale or model tests or else from corresponding calculations.

4 Subdivision and Damage Stability

4.1 It is to be proved by calculation that the damage stability of the vessel is appropriate. The calculation of the final stage of flooding should be based on the method of “lost buoyancy” and the interim states of flooding should be calculated on the basis of the method of “added mass”. All calculations are to be carried out free to trim and sinkage.

4.2 Buoyancy of the vessel in the event of flooding is to be proven for the standard loading conditions specified in 3.2. Accordingly, mathematical proof of sufficient stability is to be determined for the three intermediate stages of flooding (25, 50 and 75 % of flood build-up) and for the final stage of flooding.

4.3 Passenger vessels are to comply with the one-compartment status and the two-compartment status. The following assumptions concerning the extent of damage are to be taken into account in the event of flooding:

Table 4.3 : Damage Stability Criteria		
	1-Compartment Status	2-Compartment Status[2]
Dimension of the side damage		
Longitudinal l [m]	0.10 L_{WL} , however not less than 4 [m]	0.05 L_{WL} , however not less than 2.25 [m]
Transverse b [m]	B/5	0.59
Vertical h [m]	From vessel bottom to top without delimitation	
Dimension of the bottom damage		
Longitudinal l [m]	0.10 L_{WL} , however not less than 4 [m]	0.05 L_{WL} , however not less than 2.25 [m]
Transverse b [m]	B/5	
Vertical h [m]	0.59; pipework are to be deemed intact[1]	

1) Where a pipework system has no open outlet in a compartment, the pipework shall be regarded as intact in the event of this compartment being damaged, if it runs within the safe area and is more than 0.50 [m] off the bottom of the vessel.

2) Passenger vessels with a length L of not more than 45 [m] and authorized to carry up to a maximum of 250 passengers do not need to have 2 compartment status.

4.3.1 For 1-compartment status the bulkheads can be assumed to be intact if the distance between two adjacent bulkheads is greater than the damage length. Longitudinal bulkheads at a distance of less than B/3 to the hull, measured perpendicular to the centre line from the shell plating at the maximum draft are not to be taken into account for calculation purposes. A bulkhead recess in a transverse bulkhead that is longer than 2.5 [m], is considered a longitudinal bulkhead.

4.3.2 For 2-compartment status each bulkhead within the extent of damage will be assumed to be damaged. This means that the position of the bulkheads is to be selected in such a way as to ensure that the passenger vessel remains buoyant after flooding of two or more adjacent compartments in the longitudinal direction.

4.3.3 The lowest point of every non-watertight opening (e.g. doors, windows, access hatchways) is to lie at least 0.1 [m] above the damaged waterline. The bulkhead deck is not to be immersed in the final stage of flooding.

4.3.4 Permeability is assumed to be 95 %. If it is proven by a calculation that the average permeability of any compartment is less than 95 %, the calculated value can be used instead. The values to be adopted are not to be less than those indicated in Table 4.3.4:

Table 4.3.4: Permeability Values	
Lounges	95%
Engine and boiler room	85%
Luggage and store room	75%
Double bottoms, fuel bunkers, ballast and other tanks, depending on whether, according to their intended purpose, they are to be assumed to be full or empty for the vessel floating at the plane of maximum draught	0% or 95%

4.3.5 If damage of a smaller dimension than specified above produces more detrimental effects with respect to heeling or loss of metacentric height, such damage is to be taken into account for calculation purposes.

4.4 For all intermediate stages of flooding referred to in 4.2, the following criteria are to be met:

4.4.1 The heeling angle φ at the equilibrium position of the intermediate stage in question is to not exceed 15°.

4.4.2 Beyond the heel in the equilibrium position of the intermediate stage in question, the positive part of the righting lever curve is to display a righting lever value of GZ ≥0.02 [m] before the first unprotected opening becomes immersed or a heeling angle φ of 25° is reached.

4.4.3 Non-watertight openings are not to be immersed before the heel in the equilibrium position of the intermediate stage in question has been reached.

4.4.4 The calculation of the free surface effect in all intermediate stages of flooding is to be based on the gross surface area of the damaged compartments.

4.5 During the final stage of flooding, the following criteria are to be met taking into account the heeling moment in accordance with 3.4:

4.5.1 The heeling angle φ_E is to not exceed 10°.

4.5.2 Beyond the equilibrium position the positive part of the righting lever curve is to display a righting lever value of GZ_R ≥0.02 [m] with an area A ≥0.0025 [$m \cdot rad$]. These minimum values for stability are to be met until the immersion of the first unprotected opening or in any case before reaching a heeling angle of 25°.

4.5.3 Non-watertight openings are not to be immersed before the equilibrium position has been reached. If such openings are immersed before this point, the rooms affording access are deemed to be flooded for damage stability calculation purposes.

4.5.4 The shut-off devices which are to be able to be closed watertight are to be marked accordingly.

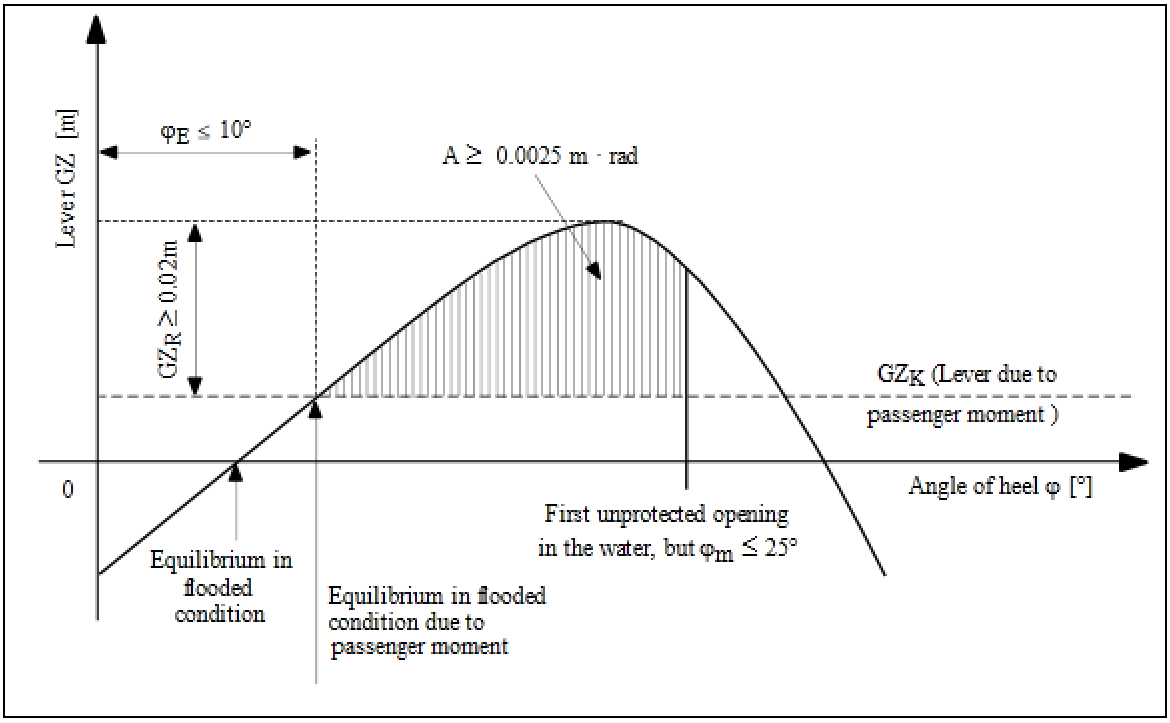

Figure 4.5: Damage Stability

4.6 The shut-off devices which are able to be closed watertight are to be marked accordingly.

4.7 Cross flooding arrangements

4.7.1 If cross-flood openings to reduce asymmetrical flooding are provided, they are meet the following conditions:

a) for the calculation of cross-flooding, IMO Resolution MSC.245(83) is to be applied;

b) they are to be self-activating;

c) they are not to be equipped with shut-off devices;

d) the total time allowed for compensation is not to exceed 15 minutes.

4.8 Passenger vessels authorized to carry up to a maximum of 50 passengers and with a length LWL of not more than 25 [m] are to prove adequate stability after damage according to 4.1 to 4.7 or, as an alternative, prove that they comply with the following criteria after symmetrical flooding:

a) the immersion of the vessel is not to exceed the margin line and

b) the residual metacentric height GM_R is not to be less than 0.10 [m].

The necessary residual buoyancy is to be assured through the appropriate choice of material used for the construction of the hull or by means of highly cellular foam floats, solidly attached to the hull. In the case of vessels with a length of more than 15 [m], residual buoyancy can be ensured by a combination of floats and subdivision complying with the 1-compartment status.

5 Watertight integrity

5.1 Apart from the watertight bulkheads as required by IRS *Rules and Regulations for the Construction and Classification of Inland Waterways Ships*, Pt.3, Ch.9, additional watertight bulkheads are to be fitted to meet the requirements for subdivision and damage stability given in **4**. They are all to extend at least upto the bulkhead deck.

5.2 Passenger spaces are to be separated from machinery spaces, boiler room and cargo holds by watertight bulkheads.

5.3 Openings or watertight doors below the bulkhead deck are not allowed in the collision bulkhead, nor in a bulkhead separating passenger spaces from machinery spaces.

5.4 Where openings are required in other watertight bulkheads their number is to be limited to the minimum required for the normal operation of the ship and all such openings are to be provided with watertight doors.

5.5 Watertight doors in bulkheads which normally remain open are to be fitted with local controls on either side of the bulkhead and remote control in an accessible place above the bulkhead deck. The following requirements are also to be complied with:

a) The remote control is to be fitted with an indicator showing whether the door is open or closed.

b) In addition, indicators are to be fitted in the wheelhouse, showing whether these doors are open or closed.

c) An automatic audible alarm is to be fitted at the door, sounding during the closing of the door.

d) The operation of watertight doors and automatic alarms is to be possible independent from the ship's normal electrical system.

e) The closing time of the doors is to be not less than 30 seconds and not more than 60 seconds.

5.6 Watertight doors, which are not remotely operated are permitted, only in those spaces which are not accessible to passengers. Such doors are to be kept closed and may only be opened for passage and are to be closed again immediately.

5.7 All watertight doors with their local and remote controls as well as alarm arrangements are to be located inboard of the assumed transverse extent of damage.

5.8 Piping systems and ventilation ducts with open ends are to be so arranged that flooding of the compartment under consideration will not result in the flooding of any other space or tank.

5.9 Where several compartments are in open connection through pipe lines or ventilation ducts, the pipes and ducts are to be led through the watertight bulkheads, above the water line in the most unfavourable conditions of flooding. Where this is not possible, valves which are remotely controlled from above the bulkhead deck are to be fitted at the watertight bulkheads.

5.10 When a pipe system has no open end in a compartment, this pipe line will be considered undamaged in the case of flooding of that compartment provided it is situated inboard of the assumed transverse extent of damage and 0.5 [m] above the ships bottom.

5.11 Cables which are to pass through watertight bulkheads are to be so arranged that the watertight integrity of the bulkheads is not impaired.

5.12 All watertight portlights to be fitted below the damaged waterline are to be of the non-opening type and of adequate strength and fitted with deadlights. No window is to be fitted below the damaged waterline.

6 Minimum freeboard

6.1Freeboard requirements will be governed by the relevant statutory regulations.

6.2 Where in a part of the vessel, the bulkhead deck has not been fitted, or where it has been fitted at a low level so as to form a deep well above it, the freeboard measured from the waterline to the level upto which the side shell is watertight, is not to be less than:

500 [mm] – Zone 3
1000 [mm] – Zone 2
1700 [mm] – Zone 1.

End of Classification Note