Section 5

Safety Requirements

A. Technical Requirements for Ship Safety

1. General

1.1 The requirements defined hereinafter are to be checked by calculation and/or by trials with the prototype craft in the fully loaded ready for use condition. Trials are to be carried out under the supervision of a GL surveyor.

Details regarding the execution of the trials are laid down by GL Head Office.

1.2 Requirements/instructions in other Sections of these Rules based on the Operating Category are to be observed.

2. Maximum dead-weight

For all sorts and types of craft and in all Operating Categories, the maximum dead-weight "Z_{max}" derives from the displacement "D" at minimum freeboard subtracting the craft's lightweight "E":

$$Z_{max} = D - E$$

3. Number of persons

There is a recommendation in Annex H for the number of persons in relation to the space available on board.

4. Freeboard

The freeboard derives from the maximum draught for which the stability of the craft has been proven. A relevant recommendation is listed in Annex H.

5. Closure condition

5.1 All openings, cut-outs, passages, etc. in the shell must be designed to be closed by means of suitable devices, fittings, etc. that no water can enter the inside of the craft. This does not apply to cockpit drain pipes.

5.2 Doors, hatch and ventilation duct covers plus their hinges, lock tumblers and securing arrangements must be adequately dimensioned. Details are to be submitted for approval.

5.3 All doors and escape hatches [1] must be operable from both sides.

5.4 Regarding in- and outlet fittings on the shell for the cooling- and bilge water and sewage lines, see Section 3, E.3.

5.5 A closure plan report in accordance with GL Form F 434, showing all openings, cut-outs, passages, etc. in deck and shell is to be submitted in triplicate for approval before the start of construction.

6. Openings and closures in hull, deck, cockpit and superstructure

The following is required:

Component	Requirements	
	Operating Category I, II	Operating Category III, IV, V
Deck hatches	[1] [3]	[2] [3]
Cockpit hatches	[1]	[2] [3]
Sliding covers	[2] [3] [9]	[2] [3]
Cabin access	[2] [5]	[2] [4]
Ventilation ducts for accommodation	[2] [7]	[2] [3]
Ventilation ducts for Machinery space	[2] [3] [6] [7]	[2] [3] [6]
Air pipes	[2] [3] [6]	[2] [3] [6]
Centreboard case	[1]	[2] [8]
Hawsepipe	[2]	[2]

[1] Weathertight closure

"Weathertight" means that whatever condition of the sea arises, no water can penetrate into the craft. Weatherthightness is to be checked by spraying the closure from outside using a conventional water hose, from a distance of about 2,0 m (minimum jet pressure 1 bar).

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1 Regarding arrangement and size of escape hatches see B.5.3.

[2] Spraytight closure

"Spraytight" means that no major quantities of water can penetrate into the craft as a result of short-time immersion. Spraytightness is to be proven by shooting water from a bucket onto the closure from a distance of about 2 m.

[3] Craft unable to use sails or sail-like means for propulsion:

– all openings liable to become submerged over a heeling range from 0 to 50° shall, if the situation requires, be made weathertight to ensure a stability range up to 50°

– craft with a stability range of less than 50° are not excluded from this measure.

Craft able to use sails or sail-like means for propulsion:

– all openings liable to become submerged over a heeling range from 0 to 90° shall, if the situation requires, be made weathertight to ensure a stability range up to 90°

– craft with a stability range of less than 90° are not excluded from this measure.

"Sails or sail-like means"

Aerodynamic means of propulsion which as a rule cause significant heeling moments which must be taken into account for stability and its assessment.

[4] Height of coaming at least 50 mm.

Removable coamings of craft in Operating Category III must meet the requirements under [5].

[5] The heights of the coamings of the doors leading to the spaces below decks must not be less than the following values.

Position	**Motor craft** **Coaming height [mm]**	**Sailing craft and motorsailer** **Coaming height [mm]**
In side- and back walls, accessible from main deck	150	150
In back walls, accessible from cockpit	380 above cockpit floor	460 above cockpit floor
anywhere if this access leads directly into the spaces	460	460

Removable coamings in door openings are to be capable of being secured in place.

[6] May only be located above the main deck in a sheltered place, so that even in bad weather the engines can be kept going for as long as possible.

[7] Shall be capable of being closed weathertight (e.g. canvas cover) in the event of heavy weather.

[8] The safety gap from the flotation plane to the lowest point not watertight shall be at least 100 mm. Parts of the centreboard case above that level are to be made spraytight.

[9] May only be located on a superstructure or deckhouse.

Hatches with sliding covers in the forward part of the craft shall have a coaming height of 150 mm above the superstructure

7. Windows, skylights and port lights

7.1 In any case windows opening into enclosed spaces shall be watertight and adequately dimensioned for the intended Operating Category.

Machinery space windows must be fixed ones.

7.2 Windows in the hull which can be opened must be kept closed when at sea. Where the craft is used for commercial purposes or for public use, this must be suitably ensured.

The bottom edge of windows in the hull shall be at least 500 mm above the flotation plane.

Windows in the hull are not permitted in machinery spaces.

7.3 Deadlights are to be carried on board for all windows in the hull, windows in walls facing forward and those whose surface area exceeds 0,20 m^2. If there are windows of the same size on the port and the starboard side, deadlights are only needed for one side.

Deadlights may be dispensed with if:

– glass thickness is twice that required under 7.7, or

– the craft is due to operate in category IV and the windows are above the weather deck, or

– the craft is due to operate in category V.

7.4 Window panes shall preferably be made of toughened or tempered safety glass ("ESG"), but laminated glass ("MSG"), acrylic and polycarbonate sheet material or equivalent material may also be used.

Machinery space window panes in deckhouses must be of toughened/tempered safety glass; if not, an external deadlight shall be provided.

In Operating Categories I and II, plastic panes shall be UV-stabilised.

7.5 Hull windows with silicate glass ("ESG", "MSG") panes shall have metal frames which can be tightly bolted to the shell. The bearing width of the glass against the frame must be at least 6,0 mm.

Panes of acrylic or polycarbonate sheet material are to be fixed by frames. They may also be bolted directly to the shell or external wall, provided the bolting is capable of resisting the stresses arising and guarantees lasting water-tightness. The bearing width of the glass is to be 3 % of whichever is the shortest side of the pane, but at least 20 mm.

Designs offering equivalent safety are permitted. The strength is to be proven by tests and/or calculation.

7.6 Rubber clamping sections may be used only in Operating Categories IV and V, provided the shorter side of the window is no longer than 300 mm and the corner radius is at least 50 mm.

7.7 The window glass thicknesses are to be determined as follows:

$$t = n \sqrt{\frac{F \cdot F_b}{y}} \quad [mm]$$

F = surface area of pane in [m^2]

F_b = freeboard in accordance with Annex H in [m]

y = height of window centre above flotation plane in [m]

n = factor in accordance with Table below

t_{min} = minimum thickness, see Table below

7.8 Only acrylic or polycarbonate sheet material may be used for skylights and hatches. The thickness of the panes in these must be 25 % greater than that of the shell windows or forward facing windows in accordance with 7.7, but at least 7,0 mm.

7.9 Port holes are treated like windows.

8. Cockpit

8.1 Cockpit floor plus longitudinal and transverse walls count as primary structural members, the scantling of which shall be in accordance with Section 1. Cockpits shall be watertight to the inside of the craft.

8.2 Regarding closures and coaming heights of hatches and doors of adjoining storage and living spaces, see 5. and 6.

8.3 The cockpit floor must be sufficiently high above the flotation plane to drain water that has entered immediately through drain pipes or clearing ports under all foreseeable states of heel and trim of the craft.

8.4 Each cockpit shall be provided with at least one drain pipe each side. The total cross section of the pipes on both sides shall be determined as follows:

$$f = 15 \cdot V \quad [cm^2]$$

V = cockpit volume in [m^3] measured to top edge of cockpit coaming at its lowest point.

The total cross section of all drain pipes may not be less than:

f_{min} = 25,0 cm^2 in Operating Category I

f_{min} = 12,5 cm^2 in Operating Categories II and III

f_{min} = 10,0 cm^2 in Operating Categories IV and V

The cross section values determined are also required in the area of any strainers that may be present.

Window type and position	**Pane material**	**n**		**t_{min} [mm]**
		Operating Category I, II, III	**Operating Category IV, V**	
Hull- and forward facing windows of cabins and superstructure	"ESG"	12,0	11,0	6
	Polycarbonate	15,6	14,0	5
	Acrylic "MSG"	18,0	16,0	5
Windows in rear walls or recessed sidewalls of cabin and superstructure	"ESG"	9,6	8,6	4
	Polycarbonate	12,5	11,0	5
	Acrylic "MSG"	14,4	13,0	5

8.5 Cockpits extending all the way across the craft must have clearing ports or drain pipe cross sections in accordance with 9.2.

8.6 Cockpit drain pipes shall be equal in strength to the surrounding hull.

Cockpit drain pipes may only be replaced by hoses with special permission.

Valves in cockpit drain pipes must be kept permanently open.

8.7 Short hose sleeves are permissible under the following conditions:

– the distance between sleeve and waterline shall be at least 100 mm.

– The sleeve shall still be above the waterline with the craft heeled 15°.

– The hose used shall be in accordance with DIN 20022.

– Two corrosion resistant clips are to be fitted at each end of the sleeve.

9. Deck drainage

9.1 An adequate number of outlets or scuppers shall be fitted to allow water to drain from the weather deck(s).

9.2 If a bulwark is envisaged, this must have sufficient clearing ports of adequate size. The clear opening A of all the ports on one side of the craft is to be determined in accordance with the following formula:

$$A = 0{,}01 \cdot \ell \cdot h + 0{,}035\,\ell \cdot h^2 \quad \left[m^2\right]$$

ℓ = length of bulwark in [m] of one ship's side

h = height of bulwark in [m]

9.3 The clear opening of the clearing ports in a superstructure bulwark shall not be less than 50 % of the opening determined in accordance with 9.2.

9.4 The bottom edges of the clearing ports and bulwark cut-outs are to be as close to the deck as possible. If the clear height of a port or cut-out is more than 230 mm, a rail is recommended as protection against falling overboard.

9.5 Deck drain pipes shall match the surrounding hull in strength.

Deck drain pipes may only be replaced by hoses with special permission.

Valves are not permitted in deck drain pipes.

9.6 Short hose sleeves are permitted. The conditions in accordance with 8.7. are to be observed.

10. Guardrails, guardrail stanchions, bow and stern pulpits

10.1 Specification

Depending on Operating Category and craft size, each craft shall be fitted with guardrails meeting the following specification:

Operating Category	Guardrail height [mm]	Specification and remarks
I II, III, IV	600	for craft whose **L** ≥ 8,0 m [1] [2] [3] [4] [5]
I II, III, IV	450	for craft whose **L** < 8,0 m [1] [2] [4]
V	450	for decked craft with cabins & superstructures with **L** ≥ 6,0 m [2] [4] [6]

[1] Guardrails plus bow and stern pulpits provide the required degree of safety only if the adjoining surfaces are also safe to walk on in all foreseeable situations.

On each side of the craft there shall be a passageway of sufficient width and with a non skid surface, plus a toerail at least 20 mm high along the deck edge.

[2] Guardrail stanchions must not be more than 2,15 m apart.

[3] The distance between rails, and from rails to deck, must not exceed 300 mm.

On each side of the craft, the rails in way of the cockpit shall have slipping arrangements, adequately sized and simple to operate.

If a stern pulpit is not needed, the rails in a sailing craft shall run from the bow pulpit to the cockpit after edge and around the back of the cockpit.

[4] Bow pulpit required

[5] Stern pulpit required

[6] Guardrails are not needed if other safety arrangements appropriate to the craft type are provided. These include handrails and handholds on the cabins.

10.2 Required component dimensions

Guardrails shall consist of multi strand steel wire. The minimum thickness of the top rail shall be at least 4 mm. The thickness of the lower rails may be reduced by 40 % but must not be less than 3 mm dia.

Guardrail stanchions and pulpits shall have the following minimum section modulus at the foot:

$$W = c \cdot \frac{h}{R_{eH}} \left[cm^3\right]$$

c = $300\ a + 100$

c_{min} = 400

a = stanchion spacing in [m]

h = stanchion height in [m]

R_{eH} = yield stress of material in [N/mm²]

Stanchion feet and pulpits must be bolted through or welded down.

'Plug-in' stanchions and pulpits shall have the feet secured.

11. Flotability, reserve buoyancy

11.1 Open and partially decked craft shall be capable of remaining afloat with max. deadweight when swamped, and have enough reserve buoyancy to serve as flotation aid for the occupants. A reserve buoyancy in the swamped condition of at least 15 kg per person is to be provided.

11.2 The buoyant chambers necessary to provide the reserve buoyancy shall be permanently installed and should be foam filled. If not foam filled, they shall comprise of at least two separate cells and shall demonstrate watertightness.

12. Required and permissible engine power

12.1 The safe handling of pleasure craft presupposes a certain minimum power of the propulsion engines. For craft with inboard engines and fixed pitch propellers, the following minimum powers are recommended:

Type of craft	Minimum power in kW per 1,0 m³ of displacement
Sailing craft with $V \leq 2{,}25\ m^3$	$2{,}20 + (2{,}25 - V)\ 1{,}65$
Sailing craft with $V > 2{,}25\ m^3$	2,2
Motorsailers with $V \geq 2{,}25\ m^3$	3,0
Motor yachts	4,50
V = in accordance with Section 1, A.1.	

12.2 A maximum permissible engine power may be stated for motor yachts and motor boats if this is necessary for the safety of the craft.

B. Fire Protection

1. General

1.1 To prevent a fire from starting as well as from spreading, preventive measures shall be taken in the area of possible sources of fire.

Possible sources of fire are

– machinery

– electrical installations and appliances

– heating and cooking appliances

1.2 Installation of the machinery and the electrical gear in accordance with Sections 3 and 4 of these Rules already provides a certain basic level of required fire protection measures.

1.3 Compliance with the GL Rules which follow, preventive maintenance of the appliances and installations by the owner and the operator of the craft, plus the latter's prudent behaviour and regular checks will contribute to reduce the risk of a fire to a minimum.

2. Paintwork, insulation, etc.

2.1 Paintwork/topcoats in machinery spaces must be hard-to-ignite, e.g. in accordance with DIN 4102.

2.2 Material used for the insulation of machinery spaces shall be at least hard-to-ignite. The surface of the insulation towards the machinery space shall be oil repellent.

2.3 In motor yachts whose propulsion power > 400 kW, incombustible material - e.g. in accordance with DIN 4102 (A) - is to be used for insulating the surfaces of the principal partitions, which should in its effect correspond to a B-15 insulation in accordance with Reg. 3, Chapter II-2, **SOLAS 74**.

Principal partitions shall be gastight in addition.

Note

A principal partition is the partition (bulkhead or deck) between machinery space on one hand and the steering position or cabin above or adjoining on the other.

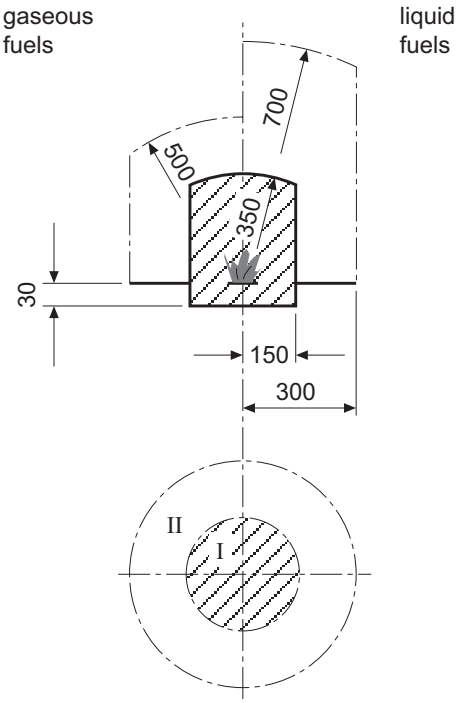
3. Ventilation systems

3.1 In craft whose propulsive power > 400 kW, all machinery space ventilation inlets and outlets shall be able to be closed from the outside.

3.2 If machinery space fans are power driven, it must be possible to switch them off from outside the space.

4. Open flame cooking appliances

4.1 Materials and surfaces of components in the vicinity of an open flame cooking appliance must meet the requirements of the illustration below.



Dimensions in [mm]

I. Incombustible material

II. Approved surface material with low flame-spread

4.2 Drip trays shall be arranged underneath open flame cooking appliances using liquid fuel.

4.3 Self extinguishing materials are to be used for net curtains and other curtains.

4.4 Cooking and heating appliances shall be mounted so as to be safe under the loads arising from sea motion. They may be gimballed or semi-gimbal mounted.

4.5 Cooking and heating appliances in which gas for domestic purposes is used (e.g. propane, butane), liquefied under pressure, shall comply with the regulations in Section 3, F. of these Rules.

5. Escape routes and emergency exits

5.1 Cabins or deckhouses of craft whose **L** ≥ 7,5 m shall have at least two escape routes, if this is practicable.

5.2 For craft whose length **L** is less than 7,50 m, emergency exits are recommended.

5.3 Emergency exits shall lead to the open deck and shall meet the following requirements:

– minimum size 400 × 400 mm clear width

– closures on hatches or on the skylights or side windows unable as emergency exits must be operable from both sides.

C. Stability

1. Stability

1.1 Adequate stability of the craft shall be proven. Insofar as rig, craft type and propulsive installation do not demonstrate any unusual characteristics, the criteria listed below are used for determining stability. Legal national regulations beyond these may also have to be complied with. Craft whose scantling length **L** ≥ 10,00 m shall have their proof of stability based on an inclining experiment; the test is to be supervised by a GL surveyor.

Note

Smaller boats in particular may have their stability endangered under unfavourable circumstances in spite of remaining within the stated limiting values for stability. Good seamanship is therefore an essential prerequisite for a stability secure craft.

1.2 Criteria to be used

1.2.1 Craft with a scantling length L < 10,00 m also open craft

1.2.1.1 Motor craft

An angle of heel of 12° shall not be exceeded with the craft under the combined influence of the centrifugal moment from a turning circle manoeuvre and a personnel moment, in accordance with the following formula:

$$M = 0{,}25\,\mathbf{D}\cdot\frac{v^2}{\mathbf{L}}\cdot\left(0{,}7\,\mathbf{H}-0{,}5\,\mathbf{T}\right)+n\left(0{,}2\cdot\mathbf{B}+0{,}10\right)\quad[\mathrm{kN}\cdot\mathrm{m}]$$

v = speed in [m/s]

n = number of persons on board

D, L, H and **T** in accordance with Section 1, A.1.5.

1.2.1.2 Sailing craft (including motorsailers) without ballast keel

An angle of heel of 30° shall not be exceeded when the craft is exposed to a heeling moment due to lateral wind pressure in accordance with the following formulae:

$$M = 0{,}07\cdot S\cdot z - 0{,}35\cdot n'\cdot\mathbf{B}\quad[\mathrm{kN}\cdot\mathrm{m}]$$

$$S = 0{,}5\left(I\cdot J + P\cdot E\right)\quad[\mathrm{m}^2]$$

S = sail area [m²]

I = height of foresail triangle [m]

J = base of foresail triangle [m]

P = length of mainsail luff [m]

E = length of main boom [m]

z = distance between centre of lateral resistance and centre of effort of sails [m], see Fig. 5.1

n' = $2 \cdot n_{Luv} - n$

n_{Luv} = maximum number of persons for whom there is space on the windward side, but not more than n

n = number of persons on board

In the case of other types of rigs or sail plans the sail area is to be calculated as appropriate.

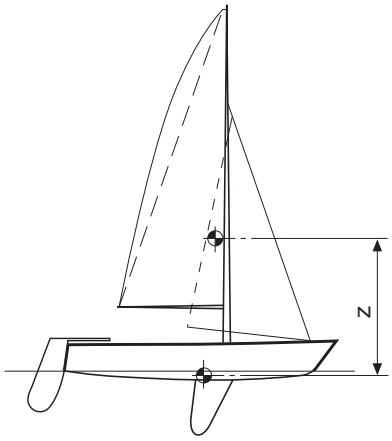


Fig. 5.1

If water can penetrate into the craft through unprotected openings at an angle of heel < 30°, the permissible angle shall be reduced appropriately.

If there are devices - e.g. a trapeze - permitting a reduction in the resultant heeling moment beyond what is already allowed for in the second part of the formula, this may be taken into consideration.

1.2.1.3 Sailing craft (including motorsailers) with a ballast keel

An angle of heel of 30° shall not be exceeded when the craft is exposed to a heeling moment due to lateral wind pressure in accordance with the following formula:

$$M = 0{,}07\cdot S\cdot z\quad[\mathrm{kN}\cdot\mathrm{m}]$$

For S, z see Fig. 5.2 and 1.2.1.2.

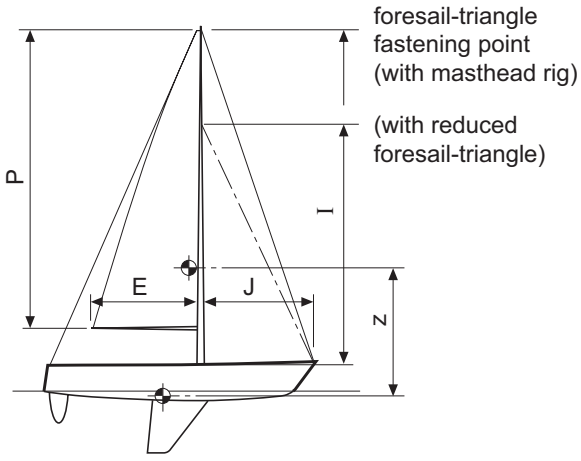


Fig. 5.2

The righting moment of the craft in the ready for use condition without personnel at 90° of inclination shall not be less than:

$$M_{90°} = 1{,}0\cdot D\quad[\mathrm{kN}\cdot\mathrm{m}]$$

D = displacement in [t]

1.2.1.4 For craft with a scantling length **L** < 10,00 m, the proof of adequate stability may be provided by calculation or by experiment.

1.2.2 Craft with scantling length L ≥ 10,00 m, decked craft

1.2.2.1 Motor craft

– GM ≥ 0,35 m

– righting lever at 30° inclination ≥ 0,20 m

– stability range ≥ 60° (not for multi hull craft)

– area under lever arm curve up to 30° inclination ≥ 0,055 m · rad

– turning circle angle of heel ≤ 12°, to be determined by turning trials

During the trials the speed is to be increased in steps until either the turning circle angle of heel reaches 12° or the maximum speed is attained.

The proof of adequate stability shall be provided for the craft in the fully loaded ready for use condition with

– full crew

– full set of stores and

– residual stores

1.2.2.2 Sailing craft (including motorsailers)

– GM ≥ 0,60 m

– stability range ≥ 60° for craft without ballast keel

– stability range ≥ 90° for craft with ballast keel

– righting lever at the maximum of the lever arm curve ≥ 0,30 m

– static angle of heel under sail ≤ 20°, but not more than deck edge to water

– areas B + C ≥ 1,4 · (A + B), see Fig. 5.3

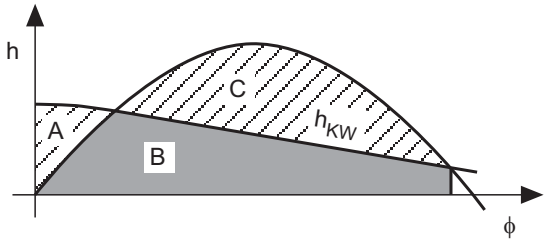


Fig. 5.3 Lever arm curve

h_{KW} = curve of heeling levers due to lateral wind pressure

If any of these criteria are not complied with, this may be accepted by GL if proof of equivalent safety is provided.

For multi hull sailing craft, stability ranges < 60° are permitted.

The proof of adequate stability shall be provided for the craft at least under the following conditions:

– all sails set

– half the sail area

– storm sails

– sails struck

the wind speed or strength in each case being determined at which the limit of stability set by the criteria is reached. With the sails struck, a lateral wind pressure equivalent to Beaufort 12 (32,7 to 36,9 m/s) must be tolerable.

1.2.2.3 In exceptional cases, GL may dispense with proof of stability in accordance with 1.2.2 for craft with a scantling length **L** of

$$10,00 \text{ m} \leq \mathbf{L} < 15,00 \text{ m}$$

The proof is then to be provided in accordance with 1.2.1.

Other methods of determining the stability are acceptable provided they permit assessment of the stability with certainty.

Table 5.1 Stability

Range of service	Type of vessel	Type of propulsion	Requirements	
V	open and partial decked vessel	without propulsion	A.11.1 and A.11.2	C.1.2.1.1 only the second addend of the formula and a maximum inclination of 10° shall not be exceeded.
		motor vessel	A.11.1 and A.11.2	C.1.2.1.1
		sailing vessel (including motor sailing vessel)	A.11.1 and A.11.2	C.1.2.1.1 and C.1.2.1.2
IV	decked vessel	motor vessel	C.1.2.1.1	
		sailing vessel	C.1.2.1.3	
III II I	decked vessel	motor vessel	C.1.2.2.1 alternatively C.1.2.2.3	
		sailing vessel (including motor sailing vessel)	C.1.2.2.2 alternatively C.1.2.2.3	

A.11.1 and A.11.2: "Flotability, Reverse Buoyancy → cap sized"

C.1.2.1.1: Second summand: $M = n\,(0{,}2 \times B + 0{,}1)$ with $\varphi < 10°$

C.1.2.1.1: $M = 0{,}25\,D\,\frac{v^2}{L}\,(0{,}7\,H - 0{,}5\,T) + n\,(0{,}2 \cdot B + 0{,}1)$ with $\varphi > 12°$