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ISO 12217-1

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AMENDMENT 1
2009-06-15

Small craft — Stability and buoyancy assessment and categorization —

Part 1: Non-sailing boats of hull length greater than or equal to 6 m

AMENDMENT 1

Petits navires — Évaluation et catégorisation de la stabilité et de la flottabilité

Partie 1: Bateaux à propulsion non vélique d'une longueur de coque supérieure ou égale à 6 m

AMENDEMENT 1

Reference number
ISO 12217-1:2002/Amd.1:2009(E)

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Foreword

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Amendment 1 to ISO 12217-1:2002 was prepared by Technical Committee ISO/TC 188, *Small craft*.

Small craft — Stability and buoyancy assessment and categorization —

Part 1: Non-sailing boats of hull length greater than or equal to 6 m

AMENDMENT 1

Page 10, Table 2

Delete the row commencing “Downflooding angle”.

Page 10, 6.1.1.1

In the first line, delete “and 6.1.3”.

Page 12, 6.1.2.1 c)

In the third line, replace “the lowest point of that coaming” with “the lowest point of water ingress of that coaming (see Annex C)”.

Page 14, 6.1.3

Delete this subclause.

Page 14, 6.2

Replace 6.2 with the following:

6.2 Offset-load test

6.2.1 Objective

This test is to demonstrate sufficient stability for the boat against offset loading by the crew.

The test considers the hazards of downflooding, excessive heel angle and sudden loss of stability caused by the heeling moment exceeding the maximum righting moment. It also considers the possible variations in vertical positioning of the crew on boats with more than one deck or cockpit level.

6.2.2 Test

Conduct the offset-load test in accordance with Annex B using either the simplified method or the full method.

NOTE The simplified method incorporates greater safety margins and is most suitable for boats with generous static stability in relation to the crew limit, e.g. those with a crew limit of less than one per metre length.

The full method may be applied using either the physical test or the calculation method. The simplified method may only be applied by calculation.

6.2.3 Requirements

a) During the test, the heel angle ϕ_O shall be not greater than

$$\phi_{O(R)} = 11{,}5 + \frac{(24 - L_H)^3}{520}$$

(see Table 3)

Table 3 — Maximum permitted heel angle for offset-load test

L_H (m)	6,0	7,0	8,0	9,0	10,0	12,0	15,0	18,0	21,0	24,0
$\phi_{O(R)}$(°)	22,7	20,9	19,4	18,0	16,8	14,8	12,9	11,9	11,6	11,5

b) During the test, the freeboard margin to downflooding shall not be less than that given in Table 4.

Table 4 — Required minimum heeled freeboard margin during offset-load test

Dimensions in metres

Design category	A	B	C	D
Option 1 or 3 in Table 2	0,26 B_H	0,145 B_H	not applicable	not applicable
Option 2 in Table 2	not applicable	not applicable	0,046 B_H	0,010
Option 4 in Table 2	not applicable	not applicable	0,046 B_H	0,010
Option 5 or 6 in Table 2	not applicable	not applicable	0,110$\sqrt{L_H}$	0,070$\sqrt{L_H}$

Page 19, Annex A

In the sixth line, replace "$F_3 = 0{,}7 + k_{0,5}$" with "$F_3 = 0{,}7 + k^{0,5}$".

Page 20, Annex B

Replace Annex B with the following:

Annex B
(normative)

Method for offset-load test

B.1 Objective

The objective is to determine the safe crew limit when all persons on board are crowded to one side.

B.2 Means of determination

The test may be conducted in any of the following ways:

a) physical test (full method only);

b) calculation with supporting tests, but including separate additional margins to allow for errors, see D.2 (full or simplified methods);

c) calculation using supporting information from an inclining experiment (full or simplified methods).

Details of the application of these alternatives are given in B.3 to B.5.

B.3 Methods

B.3.1 General

B.3.1.1 This test is to demonstrate sufficient stability against offset loading by the crew, for unswamped boats. If it is more convenient, people may be used instead of test weights provided that the mass of each person used equals or exceeds that of the relevant test weight. Calculation of stability using a mass for the boat established by measurement may be used instead of a physical test. Testing shall be conducted in conditions of smooth water and light winds.

B.3.1.2 Each boat shall be tested according to either the simplified method in B.3.2 or the full method in B.3.3. The full method may be applied using either the physical test or calculation method. The simplified method may only be applied by calculation.

NOTE The simplified method incorporates greater safety margins and is most suitable for boats with generous static stability in relation to the crew limit, e.g. those with a crew limit of less than one per metre length.

B.3.1.3 All boats shall be tested at loaded displacement mass, m_{LDC}, except that boats having any tank (fuel, fresh and black water, live wells, oils, etc.) that has a maximum transverse dimension greater than $0{,}35B_H$ shall be tested with all tanks as close as practicable to 50 % full, but never less than 25 % or more than 75 % full. Where applicable, free-surface effect shall be represented either by a virtual increase in the VCG or by using a computer software that models the movement of fluid in tanks.

B.3.1.4 In general, boats shall be tested when heeled to both port and starboard. However, where it is clearly evident that one direction of heel is the most critical, only heel angles in this direction need be tested.

EXAMPLE Initial list and/or lower downflooding openings on one side and/or crew area are clearly asymmetrical.

B.3.1.5 During the tests, on boats with watertight or quick-draining cockpits, water may enter the cockpit through drains when the boat is heeled during the test, provided that this water drains overboard when all test weights on board are moved to the centreline. Where water enters the boat during the test, the heel angle and downflooding height measurements shall be recorded after the inflow of water has stopped.

B.3.1.6 During the tests, the freeboard margin (vertical height from the waterline) shall then be measured to the point at which water could first begin to enter the interior or bilge – see Annex C. When measuring the freeboard margin, downflooding openings through the topsides should also be considered. When making such measurements, one outboard engine well penetration fitted with a sealing boot may be regarded as watertight.

B.3.1.7 The “crew area” comprises the “working deck” as defined by the manufacturer in accordance with ISO 15085 plus the areas of all seats, bunks, sunbathing pads and internal decks. It shall always include all of the primary cockpit, and all areas designated to be used by the crew when the boat is stationary, but can exclude ledges less than 0,05 m in width.

NOTE See ISO 15085:2003, 3.6, Note 3 for treatment of sloping surfaces.

If the manufacturer chooses to assess the stability by excluding some areas from the “crew area” or limiting the number of people on any given level,

— such areas shall be listed in the Owner’s Manual, and

— such areas shall be physically marked at all clearly defined points of access with “no access” or “limited access” signs as illustrated in Figures B.1 and B.2, or

— a diagram shall be placed at each helm position identifying such areas and their access limitations – see Figure B.3, and in addition “no access” or “limited access” signs as illustrated in Figures B.1 and B.2 shall be placed at those points of access not visible from all alternative helm positions.

In open boats, the crew area comprises all the interior of the boat. In dayboats it may be restricted to the cockpit provided that doing so still permits anchoring or mooring to be undertaken.

In Figure B.2 the number and the location should be adjusted as appropriate to the required restriction, e.g. coachroof, foredeck, flybridge.

Figure B.1 — No access
(using ISO 7010 – P004 "No thoroughfare")

Figure B.2 — Limited access
(using ISO 7010 – W001 "General warning")

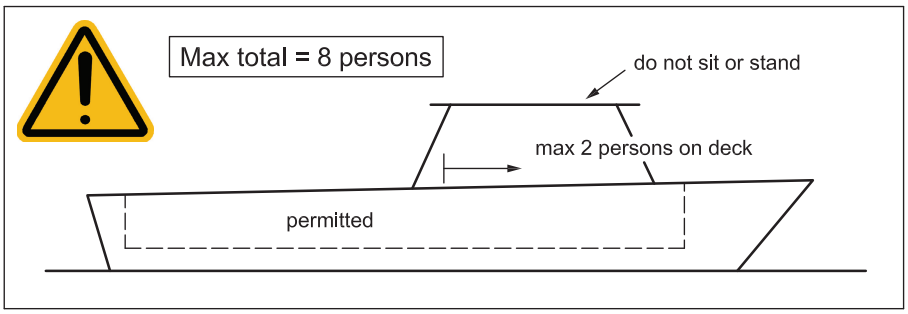


Figure B.3 — Example of crew area and access limitation label for control position
(using ISO 7010 – W001 "General warning")

B.3.1.8 When such labels are fitted, they shall be placed where they are clearly visible, and shall be made of rigid plate or flexible labels affixed to the craft in such a way that they can only be removed by the use of tools. The size of the symbols and text in Figures B.1, B.2 and B.3 shall comply with Table B.1. Text shall be in black on a white background, using a plain sans serif typeface such as Arial Narrow. The language used shall be acceptable or as required in the country of intended use.

Table B.1 — Size of safety signs and supplementary text

Expected viewing distance (m)	⩽ 0,6	> 0,6 ⩽ 1,2	> 1,2 ⩽ 1,8	> 1,8 ⩽ 2,4	> 2,4
Minimum height of sign in figures (mm)	20,0	20,0	30,0	40,0	50,0
Minimum height of capital letters (mm)	2,4	4,8	7,2	9,6	12,0
Minimum height of lower case letters (mm) [a]	1,7	3,4	5,1	6,9	8,6
[a] For example, height of the letter “e”.					

B.3.2 Simplified procedure for offset-load test

B.3.2.1 This method may only be applied by calculation.

B.3.2.2 Calculate the mass and centre-of-gravity of the boat for two conditions (LC1 and LC2) as follows:

— boat in loaded displacement condition except for the tanks, which are to be treated as described in B.3.1.3;

— VCG of the crew used shall represent the maximum number permitted (at 85 kg each) on the highest part of the crew area (as defined in B.3.1.7), e.g. flybridge or coachroof top, located with their VCG 0,1 m above seats, and the maximum number of crew permitted (at 85 kg each) on each successively lower part of the crew area (e.g. wheelhouse, main deck or cockpit), located with their VCG 0,1 m above the seats, until the total number of persons equals the intended crew limit. Where there are no seats, the VCG of crew shall be located 0,1 m above the surface on which they stand;

— (LC1) LCG of the crew at 75 % of the crew area length (as defined in B.3.1.7) forward of its aft limit, and CG on the centreline;

— (LC2) LCG of the crew at 25 % of the crew area length (as defined in B.3.1.7) forward of its aft limit, and CG on the centreline.

B.3.2.3 Calculate the curve of righting moments according to Annex D.

B.3.2.4 Apply a heeling moment equal to 961 CL ($B_C/2 - 0{,}2$) cos ϕ (N·m), where B_C is the maximum transverse distance between the outboard extremities of any parts of the crew area as defined in B.3.1.7, and

ϕ is the heel angle. Where the crew area includes side decks less than 0,4 m wide, the moment used shall be 480 CL B_C cos ϕ (N·m). Ledges less than 0,05 m wide may be excluded from the crew area.

B.3.2.5 The boat satisfies the test if:

— the minimum freeboard margin before downflooding (see Annex C) is not less than required in Table 4, whether obvious to the crew (e.g. over the gunwale) or not obvious (e.g. through openings in the topsides), and

— the heel angle (degrees) does not exceed $11{,}5 + \frac{(24 - L_H)^3}{520}$, see also Table 3, and

— the maximum righting moment occurring up to the downflooding angle is greater than the heeling moment at the resulting heel angle.

B.3.3 Full procedure for offset-load test

B.3.3.1 This method may be applied by either physical test or by calculation. Calculation should replicate the physical test method described below.

B.3.3.2 Prepare a set of test weights totalling 85 kg for each person up to the desired crew limit. Then test the boat according to B.3.3.3. Where the crew limit is expected to exceed seven persons, up to 25 % of the crew limit may be added at each of the first two stages in B.3.3.3 a) and c). Increments for the following stages shall not exceed one person.

NOTE 1 The use of water containers instead of metallic test weights will give a less advantageous result. The use of persons might give a less advantageous result but be more convenient to test.

NOTE 2 85 kg includes a margin of 13 % to allow for the probability that a group of persons can weigh on average more than 75 kg each.

B.3.3.3 The following procedure shall be followed.

a) With the boat at loaded displacement mass except that the tanks are to be filled as in B.3.1.3, place the first set of test weights to one side of the crew area, but not less than 200 mm from the outboard edge of the crew area, in the position that results in the maximum heel angle, investigating positioning test weights on various deck levels within the crew area and at various longitudinal locations to ensure that the worst case is found. Measure the heel angle and freeboard margin (see Annex C). Where the crew area includes side decks less than 0,4 m wide, test weights shall be placed at mid-width of such decks.

b) If necessary, repeat in the opposite direction of heel. Where both directions are tested, the most adverse of the two measurements made of each parameter shall be recorded.

c) Place the next set of test weights to one side of the crew area, in the position that results in the maximum heel angle, investigating positioning test weights on various deck levels within the crew area and at various longitudinal locations to ensure that the worst case is found. The centre of gravity of the sets of test weights shall be positioned as far to one side as practicable, provided that adjacent sets of test weights are not placed with their centres of gravity less than 500 mm apart in any direction, or less than 200 mm from the outboard edge of the crew area. Where the crew area includes side decks less than 0,4 m wide, test weights shall be placed at mid-width of such decks.

d) Measure the heel angle and least freeboard margin. If necessary, repeat in the opposite direction of heel. Where both directions are tested, the most adverse of the two measurements made shall be recorded.

e) Repeat c) and d) for further increments of not more than one set of test weights at a time, whilst observing the manufacturer's definition of crew area according to B.3.1.7. Stop the test when the first of the following events happens:

1) the minimum freeboard margin before downflooding is reached (see Annex C) according to Table 4, whether obvious to the crew (e.g. over the gunwale) or not obvious to the crew (e.g. through downflooding openings in the topsides);

2) the heel angle (degrees) is about to exceed $11{,}5 + \frac{(24 - L_H)^3}{520}$ (see also Table 3);

3) the total mass of test weights on board reaches 98 kg per person for the desired crew limit;

NOTE 98 kg per person is used here to ensure that a safety margin is achieved against sudden loss of stability.

4) the heel angle suddenly increases a large amount for a small increase in heeling moment. This is when the boat is close to a complete loss of residual stability and consequent capsize.

CAUTION — Take great care when doing this test because some boats can capsize suddenly. Increase heeling moments carefully, especially when approaching the expected crew limit. As this point is approached, use smaller increments of test weights. In smaller boats it is helpful to attach a capsize-preventer rope (e.g. from the depressed gunwale to a strong point ashore) provided that this is kept slack enough not to interfere with the test. For larger boats, to give warning of loss of stability, use a continuously plotted graph of heel angle against heeling moment (mass of test weights multiplied by the distance off the centreline measured parallel to the design waterline).

CAUTION — Because of the risk of capsize, persons should not be used instead of sets of test weights in any locations from which escape would become hazardous.

f) Of the measurements made according to a), b), d) or e), the maximum heel angle recorded shall be less than that required in e) above, and the minimum measured freeboard margin recorded shall exceed the requirement for the appropriate option as given in Table 4.

g) If the test is limited by downflooding that is obvious to the crew (eg: over the gunwale), the crew limit corresponds to the maximum mass of test weights divided by 85 kg, and rounded downward to the nearest whole number.

h) If the test is limited by maximum heel angle, loss of stability or downflooding that is not obvious to the crew (e.g. through openings in the topsides), the crew limit corresponds to the maximum mass of test weights divided by 98 kg and rounded downward to the nearest whole number.

NOTE 98 kg per person is used here to ensure that a safety margin is achieved against sudden loss of stability.

i) After completion of testing according to a) to h), the sets of test weights are to be moved to the positions [using the criteria of c) above] that result in the least freeboard margin. If the measured freeboard does not satisfy Table 4, sets of test weights shall be removed until this is achieved, whilst maintaining the most adverse positioning of the remainder.

j) The final crew limit shall be that which complies with both the procedure described in a) to h), and that given in i) above.

B.3.4 Additions of top-weight

Because additions of weight high above the waterline can dramatically affect the heel angle during this test, it is important that the test and/or calculations be undertaken for any boat that deviates substantially from the standard outfit. In particular, masts, radar antennae, lifting equipment and flybridges can significantly affect stability. The effects of such equipment variations from a boat on which a test has been performed can be determined by calculation using the mass and co-ordinates of the equipment variations.

A significant deviation from the standard outfit shall be assumed to have occurred if

$$\Sigma(m,h) > 0{,}02 B_{\mathrm{H}} m_{\mathrm{LDC}}$$

where

$\Sigma(m,h)$ is the sum for all variations from the standard outfit of the product of the mass of the component and its height above the waterline.

B.4 Assessment by physical test

Test weights or persons may be used to represent the mass of the crew. Where persons are used, the moment applied shall be calculated using their actual masses. If standing, they should stand with feet together and maintain their balance without using handholds unless this is essential for their safety.

When applying the heeling moments according to B.3.3.3, the vertical position of the crew may either be represented by persons or by test weights placed on top of seats, or on the deck where the people are assumed to be standing.

When recording the heel angle of the boat, people engaged in measuring this shall return to the same position on board each time that measurements are recorded. Heeled freeboard margin shall be measured by a person not on board the boat being tested.

CAUTION — Take great care during the test to avoid capsize or sinking. Refer to the cautions given in B.3.3.3 e).

B.5 Assessment by calculation

B.5.1 For the simplified method, follow the requirements of B.3.2.

B.5.2 For the full method of B.3.3, the procedure is set out below.

a) Calculate a series of loading conditions each representing the possible placement of each set of test weights, including the free-surface correction to the VCG, but ignoring the effect of the crew on the transverse centre of gravity. The VCG of each person shall be taken as 0,1 m above each seat or 0,1 m above the deck for standing persons.

b) Calculate curves of righting moments for the boat in each of the conditions prepared according to a), for a range of relevant heel angles using the methods of Annex D. Therefore, a separate righting moment curve will be required for each successive stage of B.3.3.

c) Calculate the heeling moment appropriate to each loading condition derived in a) using:

— heeling moment (N·m) at heel angle $\phi = 834 \cos \phi \, \Sigma(y_n)$ for freeboard margin against downflooding that is obvious to the crew (e.g. over the gunwale);

— heeling moment (N·m) at heel angle $\phi = 961 \cos \phi \, \Sigma(y_n)$ for heel angle, loss of stability and freeboard margin against downflooding that is not obvious to the crew (e.g. through downflooding openings in the topsides);

where

$\Sigma(y_n)$ is the sum of the distances off the centreline of the boat of each person being represented, measured at right angles to the centreline plane.

d) Compare the freeboard margin, heel angle and maximum righting moment with the requirements of B.3.3.3 e) and determine the crew limit according to B.3.3.3 j).

Page 24, Annex C

Replace Annex C with the following:

Annex C
(normative)

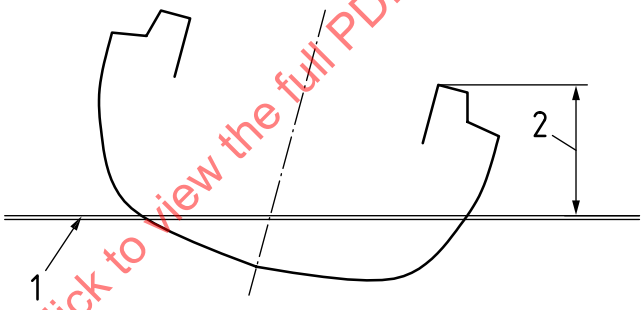
Method for measuring freeboard margin

C.1 Definition

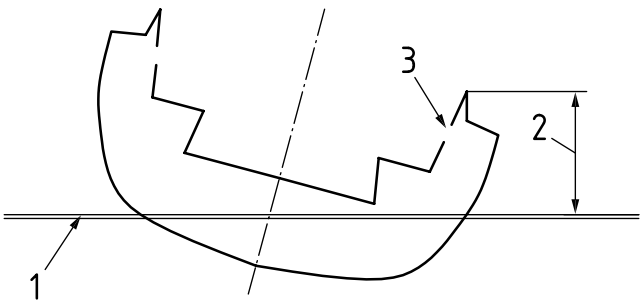
The freeboard margin to be measured during the offset-load test is the least height when the boat is heeled from the waterline to the point at which water can first enter the interior, bilge or non-quick-draining part of the boat, taking account of any tubes or ducts inside the hull.

Where openings are protected by a higher coaming or sill, this height should be measured to the lowest point of water ingress of that coaming or sill when the boat is heeled during the test.

C.2 Examples

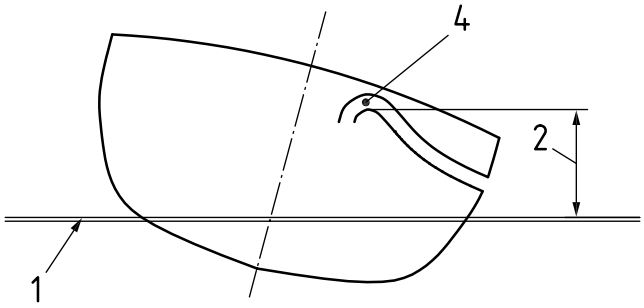


a) Boat with a wide coaming



b) Boat with a “protected” opening

Figure C.1 — Freeboard margin



c) Boat with a piped or ducted opening

Key

1 waterline
2 freeboard margin
3 downflooding opening protected by coaming
4 downflooding point in ducted opening

Figure C.1 (*continued*)

Page 34, G.2

Add the following after list item b):

c) **IMPORTANT: Failure to observe these limitations can result in the boat capsizing.**
(Where certain parts of the boat have had crew access restricted by the offset-load test, the following text shall be included, as appropriate)

For stability reasons, the following parts of the boat should only be accessed by people in exceptional circumstances: *(insert list of relevant locations)*. Such locations are indicated by the following safety sign:

(using ISO 7010 – P004 “No thoroughfare”)

For stability reasons, the following parts of the boat should only be accessed by more than the indicated number of persons in exceptional circumstances: *(insert list of relevant locations, e.g. deck, coachroof, flybridge, and limit on each location)*. Such locations are indicated by the following safety sign and/or a sign at each control position:

(using ISO 7010 – W001 “General warning”)

Page 35, Annex H

Replace Annex H with the following:

Annex H
(informative)

Summary of requirements

The design category given in respect of stability and buoyancy is that for which the boat satisfies ALL the requirements according to 5.3, as summarized in Table H.1.

Table H.1 — Summary of requirements

	Option number	1		2		3	4		5		6	
	Design category	**A**	**B**	**C**	**D**	**B**	**C**	**D**	**C**	**D**	**C**	**D**
Degree of decking or covering	any amount					yes	yes	yes			yes	yes
	partially decked								yes	yes		
	fully decked	yes	yes	yes	yes							
Downflooding openings comply (6.1.1)		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Required down-flooding height (using figures)	$h_{D(R)}$ >	0,5	0,4	0,353	0,3	0,4	0,3	0,25	0,5	0,4	0,6	0,4
	$h_{D(R)}$ to be >	$L_H/17$	$L_H/17$	$L_H/17$	$L_H/20$	$L_H/17$	$L_H/20$	$L_H/24$	$L_H/12$	—	$L_H/10$	—
	$h_{D(R)}$ need not be >	1,41	1,41	0,75	0,4	1,41	0,75	0,4	0,75	—	0,75	—
Down-flooding height (by Annex A)	$h_{D(R)}$ to be >	0,5	0,4	0,3	0,2	0,4	0,3	0,2	0,3	0,2	0,5	0,4
	$h_{D(R)}$ need not be >	1,41	1,41	0,75	0,4	1,41	0,75	0,4	0,75	0,4	0,75	—
Offset load (6.2)	$\phi_O < \phi_{O(R)}$ =	$11,5 + (24 - L_H)^3/520$										
	residual freeboard to be >	0,26 B_H	0,145 B_H	0,046B_H	0,010	0,145 B_H	0,046 B_H	0,010	0,11$\sqrt{L_H}$	0,07$\sqrt{L_H}$	0,11$\sqrt{L_H}$	0,07$\sqrt{L_H}$
Rolling in waves (6.3.2)	when v_W (m/s) =	28	21			21						
	$A_2 \geqslant A_1$ when ϕ_R =	$25 + 20/V_D$	$20 + 20/V_D$			$20 + 20/V_D$						
Resistance to waves (6.3.3)	If $\phi_{GZmax} \geqslant 30°$, RM_{30} to be $\geqslant$	25 kN·m	7 kN·m			7 kN·m						
	If $\phi_{GZmax} \geqslant 30°$, GZ_{30} to be $\geqslant$	0,20 m	0,20 m			0,20 m						
	If $\phi_{GZmax} < 30°$, RM_{max} to be $\geqslant$	$750/\phi_{GZmax}$ kN·m	$210/\phi_{GZmax}$ kN·m			$210/\phi_{GZmax}$ kN·m						
	If $\phi_{GZmax} < 30°$, GZ_{max} to be $\geqslant$	$6/\phi_{GZmax}$ m	$6/\phi_{GZmax}$ m			$6/\phi_{GZmax}$ m						
Heel due to wind (6.4) only if $A_{LV} > L_H B_H$	when v_W (m/s) =			17	13		17	13	17	13	17	13
	wind heel angle ϕ_W <			$\phi_{O(R)}/2$	$\phi_{O(R)}/2$		$\phi_{O(R)}/2$	$\phi_{O(R)}/2$	$\phi_{O(R)}/2$	$\phi_{O(R)}/2$	$\phi_{O(R)}/2$	$\phi_{O(R)}/2$
Level flotation test (6.5)	none required	yes	yes	yes	yes				yes	yes	yes	yes
	required					yes	yes	yes				

ISO 12217-1 CALCULATION WORKSHEET - No. 3a **OFFSET-LOAD TEST**

Mass of people used for test **Design:** .....

Name	Ident.	Mass (kg)
	A	
	B	
	C	
	D	
	E	
	F	
	G	
	H	

Name	Ident.	Mass (kg)
	I	
	J	
	K	
	L	
	M	
	N	
	O	
	P	

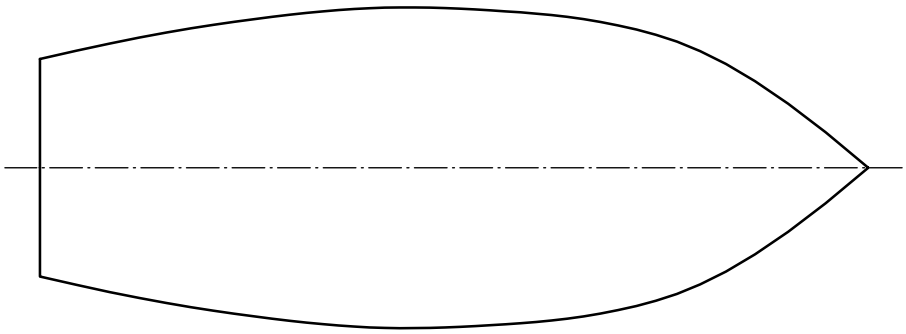
Crew area

Areas included and access limitations (if any):

Area	P/S?[1)]	Incl?	Persons limit
main cockpit		✓	
aft cockpit			
forward cockpit			
saloon			
cabins			
side decks			
fore deck			

Area	P/S?[1)]	Incl?	Persons limit
cuddy top			
coachroof top			
wheelhouse top			
fly bridge			
swim platform			

Sketch: Indicate possible seating locations along the length of the side to be tested using numbers, so that these may later be used to record the positions that people actually occupy. Locations should not be closer than 0,5 m between centres, and not less than 0,2 m from outboard edge unless on side-decks less than 0,4 m wide.



1) Note whether it is asymmetric by adding P (port) or S (starboard) to denote the larger side.

ISO 12217-1 CALCULATION WORKSHEET - No. 3b **OFFSET-LOAD TEST**

Stability test — Full procedure **Design:** .....

Boat being tested for:	**stability**	**downflooding**	(use for either, please circle which)

L_H (m)	**Min. permitted freeboard margin (see Table 4)**	**Max. permitted heel angle (°)** $= 11{,}5 + \frac{(24 - L_H)^3}{520}$	**Intended crew limit (CL)**	**Intended design category**	**Mass test weights per person** (kg) **(Cat D only)**	**Max. mass of test weights** (kg) (= 98 × CL)

Does boat have a list?	YES/NO	**If "YES", to which side?**	P/S
Is crew area asymmetric?	YES/NO	**If "YES", to which side?**	P/S
Is downflooding asymmetric?	YES/NO	**If "YES", to which side?**	P/S
Boat tested:	**to P** **to S**	**in both directions**	(please circle)

Test data:

Mass ident.	**Location**		**Mass** (kg)	**Total mass** (kg)	**Lever** (m)	**Moment** (kg·m)	**Heel angle** (°) P/S	**Min. freeb'd** (m)	
	area	**fore & aft**						**F**	**A**

Max. mass of people allowed per above	kg	hence CL =		at	kg/person

Design category given:

ISO 12217-1 CALCULATION WORKSHEET - No. 4 **DOWNFLOODING**

Downflooding openings:

Question	Answer	Ref.
Have all appropriate downflooding openings been identified? YES/NO		6.1.1.1
Do all closing appliances satisfy ISO 12216? YES/NO		6.1.1.2
Opening type appliances are not fitted below 0,2 m above waterline unless they comply with ISO 9093 or ISO 9094? YES/NO		6.1.1.3
Are all openings fitted with closing appliances (except openings for ventilation and engine combustion)? YES/NO		6.1.1.5
Categories possible: A or B if all are YES, C or D if first three are YES		6.1.1

Downflooding height:

Requirement			Basic requirement	Reduced value for small openings	Reduced value at outboard	Increased value at bow
Applicable to			all options	all options but only if figures are used	options 3, 4	options 3, 4, 6
Ref.			6.1.2.2 a)	6.1.2.2 d)	6.1.2.2 c)	6.1.2.2 b)
Obtained from Figs. 2+3 or Annex A?				= basic × 0,75	= basic × 0,80	= basic × 1,15
Maximum area of small openings ($50L_H^2$) (mm^2) =					////////////////////	////////////////////
Required down-flooding height $h_{D(R)}$ (m)	Fig. 2/Ann. A	Category A				
	Fig. 2/Ann. A	Category B				
	Fig. 2/Ann. A	Category C				
	Fig. 3/Ann. A	Category D				
Actual downflooding height h_D						
Design category possible						
Design category possible on downflooding height = lowest of above						