ISO 12217-2 SAILING BOATS OF LENGTH GREATER THAN OR EQUAL TO 6 m
CALCULATION WORKSHEET No. 1

Design: ……………………………………………………………………………………………

Design Category intended:	**Monohull / multihull:**			
Item	**Symbol**	**Unit**	**Value**	**Ref.**
Length of hull as in ISO 8666	L_H	m		3.4.1
Length waterline	L_{WL}	m		
Empty craft condition mass	m_{EC}	kg		3.5.1
standard equipment		kg		3.6.12
water ballast in tanks which are notified in the owner's manual to be filled whenever the boat is afloat		kg		3.5.2
Light craft condition mass = m_{EC} + standard equipment + ballast	m_{LC}	kg		3.5.2
Mass of:				
Desired Crew Limit	CL			3.6.3
Mass of:				
desired Crew Limit at 75 kg each		kg		3.5.4
provisions + personal effects		kg		3.5.4
drinking water		kg		3.5.4
fuel		kg		3.5.4
lubricating and hydraulic oils		kg		3.5.4
black water		kg		3.5.4
grey water		kg		3.5.4
any other fluids carried aboard (eg: in bait tanks)		kg		3.5.4
stores, spare gear and cargo (if any)		kg		3.5.4
optional equipment and fittings not included in basic outfit		kg		3.5.4
inflatable liferaft(s) in excess of essential safety equipment		kg		3.5.4
other small boats carried aboard		kg		3.5.4
margin for future additions		kg		3.5.4
Maximum load = sum of above masses	m_L	kg		3.5.4
Maximum load condition mass = $m_{LC} + m_L$	m_{LDC}	kg		3.5.4
mass to be removed for Loaded Arrival Condition		kg		3.5.6
Loaded arrival condition mass	m_{LA}	kg		3.5.6
Mass of:				
minimum number of crew according to 3.5.3		kg		3.5.3
non-consumable stores and equipment normally aboard		kg		3.5.3
inflatable liferaft		kg		3.5.3
Load to be included in Minimum Operating Condition	m'_L	kg		3.5.3
Light craft condition mass	m_{LC}	kg		3.5.2
Mass in the Minimum Operating Condition = $m_{LC} + m'_L$	m_{MO}	kg		3.5.3
Is boat sail or non-sail?				3.1.2
reference sail area according to ISO 8666	A_S	m^2		3.4.8
sail area / displacement ratio = $A_S / (m_{LDC})^{2/3}$		—		3.1.2
CLASSIFIED AS [non-sail if $A_S/(m_{LDC})^{2/3} < 0{,}07$]	SAIL/NON-SAIL ?			3.1.2
NB: : If SAIL, continue using these worksheets, if NON-SAIL, use ISO 12217-1				

ISO 12217-2 CALCULATION WORKSHEET No. 2 — TESTS TO BE APPLIED

Question			Answer	Ref.
Is boat fully enclosed? (see definition in ref.) YES/NO?				3.1.8
Is boat a catamaran or trimaran? YES/NO?				3.1.3 ; 3.1.4
If NO, choose from options 1 to 7. If YES, then:				
Length of hull	L_H	m		3.4.1
Beam between centres of buoyancy of sidehulls	B_{CB}	m		3.4.5
Is ratio $L_H / B_{CB} > 5$ YES / NO?				7.1
If YES, treat the boat as a monohull, and choose from options 1 to 7. If NO, use option 8				
Mass in the minimum operating condition	m_{MO}	kg		3.5.3
Mass in the loaded arrival condition	m_{LA}	kg		3.5.6

Choose any ONE of the following options, and use all the worksheets indicated for that option.

	All boats except catamarans and trimarans with $L_H / B_{CB} > 5$							Multih.
Option	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
categories possible	A + B	C + D	C + D	C + D	C + D	C + D	C + D	A – D
decking or covering	fully en-closed	fully en-closed	any amount	any amount	any amount	any amount	any amount	see note a
downflooding openings	3	3	3	3	3	3		3
downflooding angle	3	3						
downflooding height test – all boats	3	3	3		3			3
downflooding height test – full method	4	4	4		4			4
recess size	5[b]	5[c]			5[c]	5[c]		5[c]
minimum energy	6	6						
angle of vanishing stability	6	6						
stability index	7	7						
knockdown-recovery test			8	8				
wind stiffness test					9	9		
flotation requirement				10		10		10[d]
capsize recovery test							11	
bare poles speed								12
wind speed limits								13
stability requirements								14
habitable multihulls								14[d]
detection & removal of water	15	15	15	15	15	15	15	15
SUMMARY	16	16	16	16	16	16	16	16

a Fully enclosed if category A or B, otherwise any amount.

b Only applicable to boats using 6.5.2 or having $\phi_V < 90°$.

c Only applicable to boats of design categories A, B or C that are fully enclosed.

d Only applicable if boat is defined as habitable according to 3.1.9, and is deemed to be vulnerable to inversion when used in design category – see 7.11.2 & 7.11.3.

Option selected	

ISO 12217-2 CALCULATION WORKSHEET No. 3 DOWNFLOODING

Downflooding Openings:

Question		Answer	Ref.
Have all appropriate downflooding openings been identified?	YES/NO		6.2.1
Have potential downflooding openings within the boat been identified?	YES/NO		6.2.1.4
Do all closing appliances satisfy ISO 12216?	YES/NO		6.2.1.1
Hatches or opening type windows are not fitted below minimum height above waterline?	YES/NO		6.2.1.2
Seacocks comply with requirements?	YES/NO		6.2.1.3
Are all openings on Category A or B boats fitted with closing appliances? (Except openings for ventilation and engine combustion)	YES/NO		6.2.1.5
Categories possible: A or B if all are YES, C or D if first five are YES			6.2.1

Downflooding Angle:

Item	Symbol	Unit	Value	Ref.
Required value:				6.2.3
Cats. A + B = 40°, Cat. C = 35°, Cat. D = 30°	$\phi_{D(R)}$	degrees		Table 3
Actual Downflooding Angle: any opening at m_{MO}	ϕ_D	degrees		3.3.2
Actual Downflooding Angle: any opening at m_{LA}	ϕ_D	degrees		3.3.2
Method used to determine ϕ_D:				Annex B
Category possible on Downflooding Angle ϕ_D:				6.2.3
Actual Downflooding Angle: to non-quick-draining cockpit	ϕ_{DC}	degrees		3.3.2
Actual Downflooding Angle: to main hatchway	ϕ_{DH}	degrees		3.3.2

Downflooding Height:

Requirement			Basic requirement	Reduced value for small openings
applicable to			options 1 to 6 and 8	options 1 to 6 and 8, but only if figures are used
ref.			6.2.2.2 a)	6.2.2.2 b)
Obtained from Figure 2 or annex A?				= basic × 0,75
Maximum area of small openings ($50L_H^2$) (mm^2) =				
Required Downflooding Height $h_{D(R)}$	Fig. 2 / annex A	Category A		
	Fig. 2 / annex A	Category B		
	Fig. 2 / annex A	Category C		
	Fig. 2 / annex A	Category D		
Actual Downflooding Height h_D ref: 6.2.2.1				
Design Category possible				
Overall Design Category possible on Downflooding Height = lowest of above				

ISO 12217-2 CALCULATION WORKSHEET No. 4 DOWNFLOODING HEIGHT

Calculation using normative annex A assuming use of option …….

Item	Sym-bol	Unit	Opening 1	Opening 2	Opening 3	Opening 4
Position of openings:						
Least longitudinal distance from bow/stern	x	m				
Least transverse distance from gunwale	y	m				
F_1 = greater of $(1 - x/L_H)$ or $(1 - y/B_H)$	F_1	—				
Size of openings:						
Combined area of openings to top of any down-flooding opening	a	mm^2				
Longitudinal distance of opening from tip of bow	x'_D	m				
Limiting value of $a = (30L_H)^2$		mm^2				
If $a \geq (30L_H)^2$, $F_2 = 1{,}0$ If $a < (30L_H)^2$, $F_2 = 1 + \frac{x'_D}{L_H}\left(\frac{\sqrt{a}}{75L_H} - 0{,}4\right)$	F_2	—				
Size of recesses:						
Volume of recesses which are not quick-draining in accordance with ISO 11812	V_R	m^3				
Freeboard amidships (see 3.3.5)	F_M	m				
$k = V_R/(L_H B_H F_M)$	k	—				
If opening is not a recess, $F_3 = 1{,}0$ If recess is quick-draining, $F_3 = 0{,}7$ If recess is not quickdraining, $F_3 = (0{,}7 + k^{0,5})$	F_3	—				
Displacement:						
Loaded displacement volume (see 3.4.5)	V_D	m^3				
$B = B_H$ for monohulls, B_{WL} for multihulls	B	m				
$F_4 = [(10\ V_D)/(L_H \cdot B^2)]^{1/3}$	F_4	—				
Flotation:						
For boats using option 3 or 4, $F_5 = 0{,}8$ For all other boats, $F_5 = 1{,}0$	F_5	—				
Required calc. height: $= F_1 F_2 F_3 F_4 F_5\ L_H/15$	$h_{D(R)}$	m				
Required downflooding Height with Limits applied (see annex A, Table A.1) — Category A	$h_{D(R)}$	m				
Category B	$h_{D(R)}$	m				
Category C	$h_{D(R)}$	m				
Category D	$h_{D(R)}$	m				
Measured Downflooding Height:	h_D	m				
Design Category possible:						
lowest of above =						

ISO 12217-2 CALCULATION WORKSHEET No. 5a — RECESS SIZE

NB: This sheet is to be completed for the Loaded Arrival Condition.

Item	Symbol	Unit	Value		Ref.
			Recess 1	Recess 2	
Angle of vanishing stability > 90° ?		YES/NO			6.3.1a)
Depth recess < 3% max breadth of the recess over >35% of periphery?		YES/NO			6.3.1b)
Bulwark height < B_H /8 and has ≥ 5% drainage area in the lowest 25%?		YES/NO			6.3.1c)
Drainage area per side (m²) divided by recess volume (m³)					6.3.1d)
Height position of drainage area (lowest 25% / lowest 50% / full depth)					6.3.1d)
Drainage area meets requirements 1) and 2)?		YES/NO			6.3.1d)
Recess exempt from size limit?		YES/NO			6.3.1
SIMPLIFIED METHOD: Use 1), 2) or 3) below.			**Zone 1**	**Zone 2**	
Requirement: from results below, design category possible =					6.3.2.1
Average freeboard to loaded waterline at aft end of recess	F_A	m			6.3.2.1
Average freeboard to loaded waterline at sides of recess	F_S	m			6.3.2.1
Average freeboard to loaded waterline at forward end of recess	F_F	m			6.3.2.1
Average freeboard to recess periphery $= (F_A + 2F_S + F_F) / 4$	F_R	m			6.3.2.1
Category A permitted percentage loss in metacentric height $(GM_T) = 250\ F_R / L_H$					6.3.2.1
Category B permitted percentage loss in metacentric height $(GM_T) = 550\ F_R / L_H$					6.3.2.1
Category C permitted percentage loss in metacentric height $(GM_T) = 1\ 200\ F_R / L_H$					6.3.2.1

Continued on worksheet 5b

ISO 12217-2 CALCULATION WORKSHEET No. 5b — RECESS SIZE

NB: This sheet is to be completed for the Loaded Arrival Condition.

Item	Symbol	Unit	Value		Ref.
SIMPLIFIED METHOD: Use 1), 2) or 3) below.			Zone 1	Zone 2	
1) Loss of GM_T used? YES / NO					6.3.2.2
second moment of area of free-surface of recess	SMA_{RECESS}	m^4			6.3.2.2
metacentric height of boat at m_{LA}	GM_T	m			6.3.2.2
Calculated percentage loss in metacentric height $(GM_T) = \frac{102\ 500 \times SMA_{RECESS}}{m_{LA} \times GM_T}$					6.3.2.2
2) Second moment of areas used? YES / NO					6.3.2.3
second moment of area of free-surface of recess	SMA_{RECESS}	m^4			6.3.2.3
second moment of area of waterplane of boat at m_{LA}	SMA_{WP}	m^4			6.3.2.3
Calculated percentage loss in metacentric height $(GM_T) = \left(\frac{220 \times SMA_{RECESS}}{SMA_{WP}}\right)$					6.3.2.3
3) Recess dimensions used? YES / NO					6.3.2.4
maximum length of recess at the retention level (see 3.5.11)	l	m			6.3.2.4
maximum breadth of recess at the retention level (see 3.5.11)	b	m			6.3.2.4
Calculated percentage loss in metacentric height $(GM_T) = 240\left(\frac{l \times b^3}{L_H \times B_H{}^3}\right)^{0,7}$					6.3.2.4
DIRECT CALCULATION METHOD used? YES / NO					6.3.3
percentage full of water = 60 – 240 F / L_H					6.3.3a)
actual residual righting moment up to ϕ_D, ϕ_V or 90° whichever is least		N·m			6.3.3b)
required residual righting moment up to ϕ_D, ϕ_V or 90° whichever is least		N·m			6.3.3b)
design category possible					
Design category achieved					

ISO 12217-2 CALCULATION WORKSHEET No. 6 **MINIMUM RIGHTING ENERGY & ANGLE OF VANISHING STABILITY**

Minimum righting energy:

Item	Symbol	Unit	m_{MO}	Ref.
Mass in minimum operating condition	m_{MO}	kg		3.5.3
Area under GZ curve up to ϕ_V m_{MO}	A_{GZ}	m·deg		6.4
Righting energy up to $\phi_V = m_{MO} \cdot A_{GZ}$	E_{GZ}	kg·m·deg		6.4
Requirement: For Category A: $E_{GZ} \geq 172\,000$; for Category B: $E_{GZ} \geq 57\,000$.				Table 4
Category possible on minimum energy:				

Angle of vanishing stability:

Item	Symbol	Unit	m_{MO}	m_{LA}	Ref.
Required value of angle of vanishing stability:					6.5
Category A = (130 – m/500) but ≥ 100° Category B = (130 – m/200) but ≥ 95° Category C = 90° Category D = 75°	$\phi_{V(R)}$	degree			Table 5
Actual angle of vanishing stability:	ϕ_V	degree			3.4.10
Category possible on angle of vanishing stability:					6.5.1

Alternative for Design Category B only:

Item	Symbol	Unit	m_{MO}	m_{LA}	Ref.
Mass of boat in each condition	m_{MO} or m_{LA}	kg			3.5.3 or 3.5.6
Required value of $\phi_V = (130 - 0{,}005m)$ but always ≥ 75°		degree			6.5.2a)
Actual angle of vanishing stability:	ϕ_V	degree			3.4.11
Required value of ϕ_V	$\phi_{V(R)}$	degree			6.5.2a)
Is required value of ϕ_V attained?		YES / NO			6.5.2a)
Volume of buoyancy calculated according to annex D	V_B	m^3			annex D
Mass of boat in maximum load condition	m_{LDC}	kg			3.5.5
Is $V_B > (m_{LDC}/850)$?		YES / NO			6.5.2b)
Are accesses to non-habitable compartments fitted with hatches or doors watertight to degree 2 and marked “Keep shut when under way”?		YES / NO			6.5.2c)
Do flotation elements (where fitted) comply with annex E		YES / NO			6.5.2d)
Is stability information required by 6.5.2e) supplied?		YES / NO			6.5.2e)
Are safety signs according to Figure 3 displayed?		YES / NO			6.5.2f)
Can boat be assigned Design Category B? If all answers are YES		YES / NO			6.5.2

ISO 12217-2 CALCULATION WORKSHEET No. 7 — STABILITY INDEX

Stability Index (STIX): complete both columns

Factor	Item	Symbol	Unit	m_{MO}	m_{LA}	Ref.
FDS (6.6.2)	Positive area under GZ curve to ϕ_V	A_{GZ}	m deg.			6.6.2
	Length of hull	L_H	m			3.4.1
	Factor as calculated = $A_{GZ}/(15{,}81\ L_H^{0,5})$	FDS	—			6.6.2
	FDS when limited to the range 0,5 to 1,5	FDS	—			6.6.2
FIR (6.6.3)	Angle of vanishing stability	ϕ_V	degree			3.4.10
	If m < 40,000, FIR = $\phi_V/(125 - m/1\,600)$ If $m \geq$ 40,000, FIR = $\phi_V/100$	FIR	—			6.6.3
	FIR when limited to the range 0,4 to 1,5	FIR	—			6.6.3
FKR (6.6.4)	Righting lever at 90° heel	GZ_{90}	m			6.6.4
	Reference sail area (see ISO 8666)	A_S	m^2			3.4.8
	Height of centre of area of A_S above waterline	h_{CE}	m			6.6.4
	Calculate $F_R = (GZ_{90}\ m)/(2\ A_S\ h_{CE})$	F_R	—			6.6.4
	If $F_R \geq 1{,}5$, FKR = $(0{,}875 + 0{,}0833\ F_R)$ If $F_R < 1{,}5$, FKR = $(0{,}5 + 0{,}333\ F_R)$ If ϕ_V < 90°, FKR = 0,5	FKR	—			6.6.4
	FKR when limited to the range 0,5 to 1,5	FKR	—			6.6.4
FDL (6.6.5)	Length waterline	L_{WL}	m			3.4.2
	Length base size $L_{BS} = (2\ L_{WL} + L_H)/3$	L_{BS}	m			6.6.5
	Calculate $F_L = (L_{BS}/11)^{0,2}$	F_L	—			6.6.5
	Calculate FDL = $\left\{0{,}6 + \left[\frac{15 m_{MO} F_L}{L_{BS}^3 (333 - 8 L_{BS})}\right]\right\}^{0,5}$	FDL	—			6.6.5
	FDL when limited to the range 0,75 to 1,25	FDL	—			6.6.5
FBD (6.6.6)	Beam of hull	B_H	m			3.4.3
	Beam waterline	B_{WL}	m			3.4.4
	Calculate $F_B = 3{,}3\ B_H / (0{,}03\ m)^{1/3}$	F_B	—			6.6.6
	If $F_B > 2{,}20$ FBD = $[13{,}31\ B_{WL}/(B_H\ F_B^3)]^{0,5}$ If $F_B < 1{,}45$ FBD = $[B_{WL} F_B^2/(1{,}682\ B_H)]^{0,5}$ Otherwise FBD = $1{,}118\ (B_{WL}/B_H)^{0,5}$,	FBD	—			6.6.6
	FBD when limited to the range 0,75 to 1,25	FBD	—			6.6.6
FWM (6.6.7)	Downflooding angle = lesser of ϕ_{DC} and ϕ_{DH}	ϕ_D	degree			3.3.2
	If $\phi_D \geq 90°$ (see worksheet 3) then FWM = 1,0 If ϕ_D is less than 90° then:					
	Righting lever at downflooding angle	GZ_D	m			6.6.7
	Lever from centre of sail area to underwater profile	$h_{CE} + h_{LP}$	m			6.6.7
	Calc. wind speed at which serious flooding occurs = $\{13\ m_{MO}\ GZ_D/[A_S\ (h_{CE}+h_{LP})\ \lvert\cos \phi_D\rvert^{1,3}]\}^{0,5}$	v_{AW}	m/s			6.6.7
	If ϕ_{DW} < 90°, FWM = $v_{AW}/17$; if $\phi_{DW} \geq 90°$, FWM = 1,0	FWM	—			6.6.7
	FWM when limited to the range 0,5 to 1,0	FWM	—			6.6.7

ISO 12217-2 CALCULATION WORKSHEET No. 7 (continued) STABILITY INDEX

complete both columns

Factor	Item	Symbol	Unit	m_{MO}	m_{LA}	Ref.
FDF (6.6.8)	Downflooding angle to non-quick-draining cockpit	ϕ_{DC}	degree			3.3.2
	Downflooding angle to main access hatch	ϕ_{DH}	degree			3.3.2
	Total area of openings for finding ϕ_{DA} = $(1,2 L_H B_H F_M)$		cm^2			6.6.8
	Downflooding angle at which above area is immersed	ϕ_{DA}	degree			6.6.8
	Angle of vanishing stability	ϕ_V	degree			3.4.11
	Least of the above four angles	ϕ_{DF}	degree			6.6.8
	Then FDF = $\phi_{DF}/90$					6.6.8
	FDF when limited to the range 0,5 to 1,25	FDF_1	—			6.6.8
	Does boat float acc. to 7.6 and also when flooded have GZ_{90} > 0, YES/NO?					6.6.8
	If YES, calculate final FDF = $1,2 \cdot FDF_1$, otherwise FDF = FDF_1					6.6.8

NB: Final value to be used for each factor is the figure in the shaded box.

Calculation of STIX, and assignment of Design Category:

Item	Symbol	Unit	m_{MO}	m_{LDC}	Ref.
Length base size L_{BS} (from Worksheet 5) = $(2 L_{WL}+L_H)/3$	L_{BS}	m			6.6.9
Product of all 7 factors = FDS · FIR · FKR · FDL · FBD · FWM · FDF	F	—			6.6.9
STIX = $[(7 + 2,25 L_{BS}) \cdot F^{0,5}]$	STIX	—			6.6.9
Design Category possible on STIX: A when STIX > 32, B when STIX > 23, C when STIX > 14, D when STIX > 5					Table 6

ISO 12217-2 CALCULATION WORKSHEET No. 8 KNOCKDOWN-RECOVERY TEST

Design Categories C and D only

Item	Symbol	Cat. C	Cat. D	Ref.
Experimental method: Crew Limit	CL			3.6.3
Is boat prepared and persons positioned as in 6.7.2,	YES/NO?			6.7.2,
Is water or other weight used instead of persons, if so which?				6.7.2
Masthead taken to		waterline	horizontal	6.7.3, 6.7.4
Masthead held in position for		60 s	10 s	6.7.3, 6.7.4
Boat recovers when released,	YES/NO?			6.7.3, 6.7.4
Boat floats so it can be pumped or bailed out,	YES/NO?			6.7.3, 6.7.4
If boat achieves YES to each of above, Design Category is OK				
Alternative theoretical method: Is GZ positive at heel angle defined above?	YES/NO?			6.7.5
Design Category given:				

ISO 12217-2 CALCULATION WORKSHEET No. 9 — WIND STIFFNESS TEST

Design Categories C and D only

Experimental method:

Item	Symbol	Unit	Un-reefed	Reefed	Ref.
Boat prepared and weight positioned as in 6.8.2,	YES / NO?				6.8.2.1
Final tension in pull-down line	T	kg			6.8.2.3
Perpendicular lever between pull-down and mooring lines	h	m			6.8.2.3 Figure 5
Final angle of heel observed	ϕ_T	degree			6.8.2.3
Beam of hull	B_H	m			3.4.3
Actual profile projected area of sails, including overlaps	A'_S	m^2			3.4.9
Upright lever from centre of sail area to underwater profile	$h'_{CE} + h_{LP}$	m			6.8.2.4 Figure 6
Calculated wind speed = $\sqrt{\dfrac{13hT + 390B_H}{A'_S\left(h'_{CE} + h_{LP}\right)\left(\cos\phi_T\right)^{1,3}}}$	v_W	m/s			6.8.2.4
Is reefed sail plan used? YES/NO?					6.8.4.2
Design Category given according to Table 7.					Table 7

NB: Safety signs in accordance with Figure 7 must be affixed to the boat.

Alternative theoretical method:

Item	Symbol	Unit	Un-reefed	Reefed	Ref.
Righting moment curve increased by one crew to windward	YES/NO?				6.8.3.2
Option (from Worksheet 2) being used					Table 2
Design Category intended					
Relevant calculation wind speed taken from Table 6	v_W	m/s			Table 6
Actual profile projected area of sails, including overlaps	A'_S	m^2			3.4.9
Upright lever from centre of sail area to underwater profile	$h'_{CE} + h_{LP}$	m			6.8.2.4 Figure 6
Calculate: 0,75 $v_W{}^2\ A'_S\ (h'_{CE} + h_{LP})$	M_{W0}	N·m			6.8.3.3
From righting moment curve and wind heeling curve [= $M_{W0}\ (\cos\phi)^{1,3}$] resulting angle of heel =	ϕ	degree			6.8.3.4
Is $\phi < \phi_D$ (see Worksheet 3) and < 45°?	YES/NO?				6.8.3.4
Is reefed sail plan used?	YES/NO?				6.8.4.2
If YES, Design Category given:					

NB: Safety signs in accordance with Figure 7 must be affixed to the boat.

ISO 12217-2 CALCULATION WORKSHEET No. 10 FLOTATION REQUIREMENT

Annex D

Objective: to show that the buoyancy available from the hull structure, fittings and flotation elements equals or exceeds that required to support the loaded boat.

Item	Mass kg	Density kg/m^3	Volume m^3 = mass/density	Ref.
Hull structure: GRP laminate		1 500		Table D.1
Foam core materials		50		Table D.1
Balsa core materials		150		Table D.1
Plywood		600		Table D.1
Other timber (type =)				Table D.1
Permanent ballast (type =)				Table D.1
Fastenings and other metalwork (type=)				Table D.1
Windows (glass / plastic)				Table D.1
Engines and other fittings and equipment: Diesel engine(s)		5 000		Table D.1
Petrol engine(s)		4 000		Table D.1
Outboard engine(s)		3 000		Table D.1
Sail-drive or stern-drive strut(s)		3 000		Table D.1
Mast(s) and spar(s) (material = alloy / spruce)				Table D.1
Stowed sails and ropes		1 200		Table D.1
Food and other stores		2 000		Table D.1
Miscellaneous equipment		2 000		Table D.1
Non-integral fuel tank(s) (material =)				Table D.1
Non-integral water tank(s) (material =)				Table D.1
Gross volumes of fixed tanks and air containers:				D.2.2
Fuel tank(s)				D.2.2
Water tank(s)				D.2.2
Other tank(s)				D.2.2
Air tanks or containers meeting the requirements of annex E				D.2.2
Total volume of hull, fittings and equipment, V_B = sum of all above volumes				D.2.2
Mass in maximum load condition	m_{LDC}	kg		3.5.5
		calculate ratio m_{LDC}/V_B =		D.2.3
For options 4 and 6, $m_{LDC}/V_B < 850$		YES/NO?		D.2.3

ISO 12217-2 CALCULATION WORKSHEET No. 11 CAPSIZE-RECOVERY TEST

Design Categories C and D only

Objective: to demonstrate that a boat can be returned to the upright after a capsize by the actions of the crew using their body action and/or righting devices purposely designed and permanently fitted to the boat, that it will subsequently float, and to verify that the recommended minimum crew mass is sufficient for the recovery method used.

Item	Unit	Value	Ref.
Minimum number of crew required	—		6.10.7
Minimum mass of crew required	kg		6.10.7
Is boat prepared as in 6.10.2 to 6.10.5	YES/NO?		6.10.2 to 6.10.5
Does boat float for > 5 min when fully capsized	YES/NO?		6.10.6
Time required to right the boat (least time of 1 to 3 attempts)	minutes		6.10.8
Is this time less than 5 min	YES/NO?		6.10.8
With one 75 kg person aboard, boat floats so it can be pumped or bailed out,	YES/NO?		6.10.10
With full Crew Limit aboard, without bailing, boat floats approx. level with at least 2/3 periphery showing, for more than 5 min	YES/NO?		6.10.11

INFORMATION FOR OWNER'S MANUAL:

Likelihood of capsize occurring in normal use:

Righting technique which is most successful:

Minimum number of crew required:	**Minimum mass of crew required:** kg
Design category recommended by the builder:	

ISO 12217-2 CALCULATION WORKSHEET No. 12 BARE POLES FACTOR

Boat is a catamaran/trimaran: …………………Intended Design Category: ……………. Refer to 7.7

Item	Transverse			Longitudinal		
Limiting moment	**LM_T (kN.m) =**			**LM_L (kN.m) =**		
Hull	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Mast No. 1	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Boom No. 1	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Mast No. 2	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Boom No. 2	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Antennae with area greater than 0,01m^2	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Standing rigging	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Total hull & rig moments of area $\Sigma(A_H . h_H)$ =				**Total hull/rig mmt of area =**		
Sail stowed on boom No. 1	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Roller furled sail No. 1 (excluding in-mast furling)	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Roller furled sail No. 2 (excluding in-mast furling)	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Total bare poles moment of area $\Sigma(A_{BP} . h_{BP})$ =				**Total bare poles mmt area =**		
Wing mast	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	$\Sigma(A_{WM}.h_{WM})$ =		moment (m^3)	$\Sigma(A_{WM}.h_{WM})$ =	
Bare Poles speed, $v_{BP} = 1,85\sqrt{\dfrac{LM_T}{0,8\Sigma(A_{BP}.h_{BP})+\Sigma(A_{WM}.h_{WM})}}$				$1,85\sqrt{\dfrac{LM_L}{0,8\Sigma(A_{BP}.h_{BP})+\Sigma(A_{WM}.h_{WM})}}$		
Lesser value of v_{BP} in roll and pitch =						

ISO 12217-2 CALCULATION WORKSHEET No. 13 WIND SPEED LIMITS

This work sheet is to be used as many times as necessary to cover the range of probable sail combinations.

Boat is a catamaran/trimaran: …………………Intended Design Category: ……………. Refer to 7.5

Item	Transverse			Longitudinal		
Limiting moment		**LM_T (kN.m) =**			**LM_L (kN.m) =**	
	Total hull & rig moments of area $\Sigma(A_H . h_H)$ =			**Total hull/rig mmt of area =**		
Sail No. 1 ………………………… ………	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Sail No. 2 ………………………… ………	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Sail No. 3 ………………………… ………	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Sail No. 4 ………………………… ………	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Sail stowed on boom ………………………… ……..	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Sail stowed on boom ………………………… ……..	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Roller furled sail ………………………… ……..	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
Roller furled sail ………………………… ……..	area (m^2) =			area (m^2) =		
	lever (m) =			lever (m) =		
	moment (m^3)	area x lever =		moment (m^3)	area x lever =	
	Total sail moments of area $\Sigma(A_S . h_S)$ =			**Total sail moment of area =**		
	Wind speed limit, v_W = 1,85 $\sqrt{\frac{LM_T}{0{,}8\Sigma(A_H . h_H) + \Sigma(A_S . h_S)}}$ =			1,85 $\sqrt{\frac{LM_L}{0{,}8\Sigma(A_H . h_H) + \Sigma(A_S . h_S)}}$ =		
	Lesser value of v_W in roll and pitch =					

<u>NB: Where a boat is fitted with a wing mast, it shall be treated as a sail.</u>

ISO 12217-2 CALCULATION WORKSHEET No. 14 STABILITY REQUIREMENTS

Boat is a catamaran/trimaran: ………………… **Intended Design Category: …………….**

Item	Symbol	Unit	Value			Ref.
			Cat A	Cat B	Cat C	
Bare Poles Factor						
Bare Poles wind speed (see worksheet 12)	v_{BP}	knots				7.7
Bare Poles Factor = $\left(\frac{v_{BP}}{70}\right)^{0,4}$ where $v_{BP} < 70$ = 1,0 where $v_{BP} \geq 70$	BPF	-				7.7b)
Rolling in breaking waves						
Required maximum transverse righting lever	GZ	m				Table 8
Actual maximum transverse righting lever		m				
Design category possible for rolling in breaking waves		YES / NO				7.8
Ratio (actual) / (required)						7.11.2-.3
Does ratio exceed that for "not vulnerable to inversion"? (1,35 for catamarans, 1,80 for trimarans)		YES / NO				7.11.2-.3
Pitchpoling						
Required minimum longitudinal righting moment area		kN·m·rad				Table 9
Actual minimum longitudinal righting moment area		kN·m·rad				
Design category possible on pitchpoling		YES / NO				7.9
Ratio (actual) / (required)						7.11.2-.3
Does ratio exceed that for "not vulnerable to inversion"? (1,35 for catamarans, 1,80 for trimarans)		YES / NO				7.11.2-.3
Diagonal stability						
Required transverse righting moment for 1° heel		N·m		1 500	n/a	7.10
Bow down actual transverse righting moment for 1° heel		N·m			n/a	7.10
Stern down actual transverse righting moment for 1° heel		N·m			n/a	7.10
Design category possible on diagonal stability?		YES / NO			n/a	7.10
Design cat. possible: rolling, pitchpoling & diag stability		YES / NO				

Habitable boats

Habitable boats		**Answer**	**Ref.**
Is boat habitable?	YES / NO		3.1.9
Is boat vulnerable to inversion when used in design category?	YES / NO		7.11.2-.3
Clause(s) of standard that apply ref vulnerability to inversion			7.11.2-.3
If both the above responses are YES, then:			
Does boat comply with inverted buoyancy requirements? (see worksheet 10)	YES / NO		7.12
Does boat comply with viable means of escape requirements?	YES / NO		7.13

ISO 12217-2 CALCULATION WORKSHEET No.15 DETECTION + REMOVAL OF WATER

Item	Unit	Re-sponse	Ref.
The internal arrangement facilitates the drainage of water to bilge suction point(s), to a location from which it may be bailed rapidly, or directly overboard?	YES/NO		6.11.1
Is boat provided with means of removing water from the bilges in accordance with ISO 15083?	YES/NO		6.11.2
Table 2 option used for assessment:			6.11.3
Can water in boat be detected from helm position?	YES/NO		6.11.3
Method(s) used:			
direct visual inspection			6.11.3
transparent inspection panels			6.11.3
bilge alarms			6.11.3
indication of the operation of automatic bilge pumps			6.11.3
other means (specify):			6.11.3

ISO 12217-2 CALCULATION WORKSHEET No. 16 SUMMARY

Sheet	Item	Symbol	Unit	Value
	Length of hull: (as in ISO 8666)	L_H	m	
1	**Length waterline**	L_{WL}	m	
	Mass:			
	Empty craft condition mass	m_{EC}	kg	
	Light craft condition mass	m_{LC}	kg	
	Maximum load	m_L	kg	
	Maximum load condition mass = m_{LC} + m_L	m_{LDC}	kg	
	Loaded arrival condition mass	m_{LA}	kg	
	Minimum operating mass	m_{MO}	kg	
1	**Is boat sail or non-sail?**	SAIL / NON-SAIL		
2	**Option selected:**			

Sheet	Item	Unit	Re-quired	Actual	Pass/Fail
3	**Downflooding openings**: are all requirements met?				
	Downflooding angle: to any opening, ϕ_{DA}	degree	>		
	to non-quick-draining cockpit, ϕ_{DC}	degree			
	to main access hatchway, ϕ_{DH}	degree			
3 and 4	**Downflooding height**: Worksheet employed for basic height				
	basic requirement	m	≥		
	reduced height for small openings (sheet 3 only)	m	≥		
5 and 6	**Stability index**: *(options 1 + 2 only)* STIX =	—	>		
6	**Angle of vanishing stability**: *(options 1 + 2 only)* ϕ_V =	degree	>		
7	**Knockdown-recovery test**: *(options 3 + 4 only)* PASS/FAIL?				
	method used = experimental or theoretical?				
	Design Category =				
8	**Wind stiffness test**: *(options 5 + 6 only)* v_W =	m/s	>		
	Design Category =				
	was reefed sail area used? (i.e.: are warning labels required?) YES / NO				
9	**Flotation requirement**: ratio m_{LDC}/V_B = *(options 4, 6 + 8 only)*	kg/m^3	<		
10	**Capsize recovery test**: *(option 7 only)* are all requirements met? YES / NO				
	Design Category recommended by the builder				
11 + 12	**Stability information**: *(option 8 only)* info. supplied like Table F.1 YES/NO				

ISO 12217-2 CALCULATION WORKSHEET No. 16 SUMMARY (continued)

Sheet	Item		Unit	Re-quired	Ac-tual	Pass/Fail
13	**Rolling in breaking waves** maximum transverse righting lever		m	≥		
	Pitchpoling longitudinal righting moment area		kN·m·rad	≥		
	Diagonal stability: transverse righting moment for 1° heel	bow down	N·m	≥		
		stern down	N·m	≥		
13	**Habitable boats**					
	Is boat habitable?					
	Is boat vulnerable to inversion when used in design category?					
	If both the above responses are YES, then:					
	Does boat comply with inverted buoyancy requirements?					
	Does boat comply with viable means of escape requirements?					
NB: Boat must pass all requirements applicable to option to be given intended Design Category.						
Design category given:		**Assessed by:**				