INTERNATIONAL STANDARD

ISO 12217-3

Fourth edition
2022-12

Small craft — Stability and buoyancy assessment and categorization —

Part 3: Boats of hull length less than 6 m

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

Partie 3: Bateaux d'une longueur de coque inférieure à 6 m

Reference number
ISO 12217-3:2022(E)

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Published in Switzerland

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Contents

Page

Foreword ..... **v**
Introduction ..... **vi**
1 Scope **1**
2 Normative references **2**
3 Terms and definitions **2**
3.1 Primary 2
3.2 Downflooding 4
3.3 Condition and mass 5
3.4 Other definitions 7
4 Symbols **9**
5 Procedure **10**
5.1 Maximum load 10
5.2 Sailing or non-sailing 10
5.3 Tests to be applied 11
5.3.1 General 11
5.4 Alternatives 11
5.5 Variation in input parameters 11
6 Tests to be applied to non-sailing boats **12**
6.1 General 12
6.2 Habitable non-sailing multihull boats 13
6.3 Downflooding 13
6.3.1 Requirements for downflooding openings 13
6.3.2 Downflooding height with maximum load 15
6.3.3 Downflooding height — outboard boats when starting 17
6.4 Recess size 18
6.4.1 Application 18
6.4.2 Simplified methods 18
6.4.3 Direct calculation method 20
6.5 Offset-load test 20
6.5.1 General 20
6.5.2 Simplified procedure for offset-load test 23
6.5.3 Full procedure for offset load-test 24
6.5.4 Procedure for gunwale load test 26
6.6 Heel due to wind action 27
6.6.1 General 27
6.6.2 Calculation 27
6.6.3 Requirement 28
6.7 Level flotation test 28
6.8 Basic flotation test 28
6.9 Capsize-recovery test 29
6.10 Detection and removal of water 30
7 Tests to be applied to sailing boats **30**
7.1 General 30
7.2 Downflooding 31
7.3 Recess size 31
7.4 Flotation tests 31
7.4.1 Level flotation test 31
7.4.2 Basic flotation test 32
7.5 Capsize-recovery test 32
7.6 Knockdown recovery test 33
7.7 Wind stiffness test 34
7.7.1 General 34

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7.7.2 Practical test 34
7.7.3 Compliance by calculation 36
7.7.4 Requirements 36
7.8 Inverted buoyancy 37
8 Safety signs 38
9 Application 38
9.1 Deciding the design category 38
9.2 Meaning of the design categories 38
Annex A (normative) **Full method for required downflooding height 40**
Annex B (normative) **Methods for calculating downflooding angle 43**
Annex C (normative) **Method for flotation tests 45**
Annex D (normative) **Flotation material and elements 50**
Annex E (normative) **Calculation method for basic flotation requirement 52**
Annex F (normative) **Information for the craft's owner's manual 54**
Annex G (informative) **Summary of requirements 58**
Annex H (informative) **Worksheets 60**
Annex I (informative) **Illustration of recess retention level 77**
Bibliography 78

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 188, *Small craft*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 464, *Small Craft*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fourth edition cancels and replaces the third edition (ISO 12217-3:2015), of which it constitutes a minor revision. The main changes are as follows:

— the Normative references have been updated;

— the "allowance for the maximum mass of optional equipment and fittings not included in the manufacturer's basic outfit" has been moved from 3.3.3 (maximum load) to 3.3.4 (maximum load condition);

— in Clause F.1, the first paragraph has been slightly reworded as a Note, so as to clearly make an informative reference to ISO 10240, which has been moved from Clause 2 to the Bibliography;

— in Annex H, the calculation worksheet No. 1 has been corrected to reflect the changes in 3.3.3 and 3.3.4;

— minor editorial changes throughout the document.

A list of all parts in the ISO 12217 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document enables the determination of the limiting environmental conditions to be determined for which an individual boat has been designed.

It enables the boat to be assigned to a design category appropriate to its design and maximum load. The design categories used align with those in the Recreational Craft Directive of the European Union, EU Directive 2013/53/EU.

Annex H provides worksheets to assist in the systematic assessment of a boat according to this document.

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Small craft — Stability and buoyancy assessment and categorization —

Part 3:
Boats of hull length less than 6 m

CAUTION — Compliance with this document does not guarantee total safety or total freedom of risk from capsize or sinking.

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of the document. Users should therefore consider printing this document using a colour printer.

1 Scope

This document specifies methods for evaluating the stability and buoyancy of intact (i.e. undamaged) boats. The flotation characteristics of craft susceptible to swamping are also encompassed.

The evaluation of stability and buoyancy properties using this document will enable the boat to be assigned to a design category (C or D) appropriate to its design and maximum load.

This document is applicable to boats of hull length less than 6 m, whether propelled by human or mechanical power, except habitable sailing multihulls. Boats of hull length less than 6 m which are fitted with a full deck and quick-draining cockpit(s) complying with ISO 11812 can alternatively be assessed using ISO 12217-1 or ISO 12217-2 (for non-sailing and sailing boats, respectively), in which case higher design categories can be assigned.

In relation to habitable multihulls, this document includes assessment of susceptibility to inversion, definition of viable means of escape and requirements for inverted flotation.

This document excludes:

— inflatable and rigid-inflatable boats covered by the ISO 6185 series, except for references made in the ISO 6185 series to specific clauses of the ISO 12217 series;

— personal watercraft covered by ISO 13590 and other similar powered craft;

— aquatic toys;

— canoes and kayaks;

— gondolas and pedalos;

— sailing surfboards;

— surfboards, including powered surfboards;

— hydrofoils, foil stabilized boats and hovercraft when not operating in the displacement mode; and

— submersibles.

NOTE Displacement mode means that the boat is only supported by hydrostatic forces.

It does not include or evaluate the effects on stability of towing, fishing, dredging or lifting operations, which need to be separately considered if appropriate.

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2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2896:2001, *Rigid cellular plastics — Determination of water absorption*

ISO 3864-1:2011, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

ISO 8666:2020, *Small craft — Principal data*

ISO 9093, *Small craft — Seacocks and through-hull fittings*

ISO 11812, *Small craft — Watertight or quick-draining recesses and cockpits*

ISO 12216, *Small craft — Windows, portlights, hatches, deadlights and doors — Strength and watertightness requirements*

ISO 12217-1:2022, *Small craft — Stability and buoyancy assessment and categorization — Part 1: Non-sailing boats of hull length greater than or equal to 6 m*

ISO 12217-2:2022, *Small craft — Stability and buoyancy assessment and categorization — Part 2: Sailing boats of hull length greater than or equal to 6 m*

ISO 14946:2021, *Small craft — Maximum load capacity*

ISO 15083, *Small craft — Bilge-pumping systems*

ISO 15085, *Small craft — Man-overboard prevention and recovery*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

NOTE The meanings of certain symbols used in the definitions are given in Clause 4.

3.1 Primary

3.1.1
design category
description of the sea and wind conditions for which a boat is assessed to be suitable

Note 1 to entry: See also 9.2.

3.1.2
recess
volume open to the air that might retain water within the range of loading conditions and corresponding trims

EXAMPLE Cockpits, wells, open volumes or areas bounded by bulwarks or coamings.

Note 1 to entry: Cabins, shelters or lockers provided with closures according to the requirements of ISO 12216 are not recesses.

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Note 2 to entry: Cockpits that are open aft to the sea are considered to be recesses. Flush decks without bulwarks or coamings are not recesses.

3.1.3
quick-draining recess
recess fulfilling all the requirements of ISO 11812 for "quick-draining cockpits and recesses"

Note 1 to entry: ISO 11812 contains requirements with which most sailing dinghies cannot comply.

Note 2 to entry: According to its characteristics, a cockpit may be considered to be quick-draining for one design category, but not for a higher category.

3.1.4
watertight recess
recess fulfilling all the requirements of ISO 11812 for "watertight cockpits and recesses"

Note 1 to entry: This term only implies requirements in respect of watertightness and sill heights, but not those for drainage.

3.1.5
fully enclosed boat
boat in which the horizontal projection of the sheerline area comprises any combination of:

— watertight deck and superstructure, and/or

— quick-draining recesses complying with ISO 11812, and/or

— watertight recesses complying with ISO 11812 with a combined volume of less than $(L_H\ B_H\ F_M)/40$, and

all closing appliances having their degree of watertightness in accordance with ISO 12216

Note 1 to entry: The size of recesses permitted for some boats of design category C is restricted by the requirements of 6.4.

3.1.6
partially protected boat
boat which does not fulfil the definition of a fully-enclosed boat and in which the plan projected area of decking, cabins, shelters, outboard engine wells or other rigid covers which are watertight from above according to ISO 12216 and which immediately shed water directly overboard (i.e. not via drains) and

— comprises at least one-third of the plan projected area of the sheerline, and

— includes all the area within $L_H/3$ from the bow, and

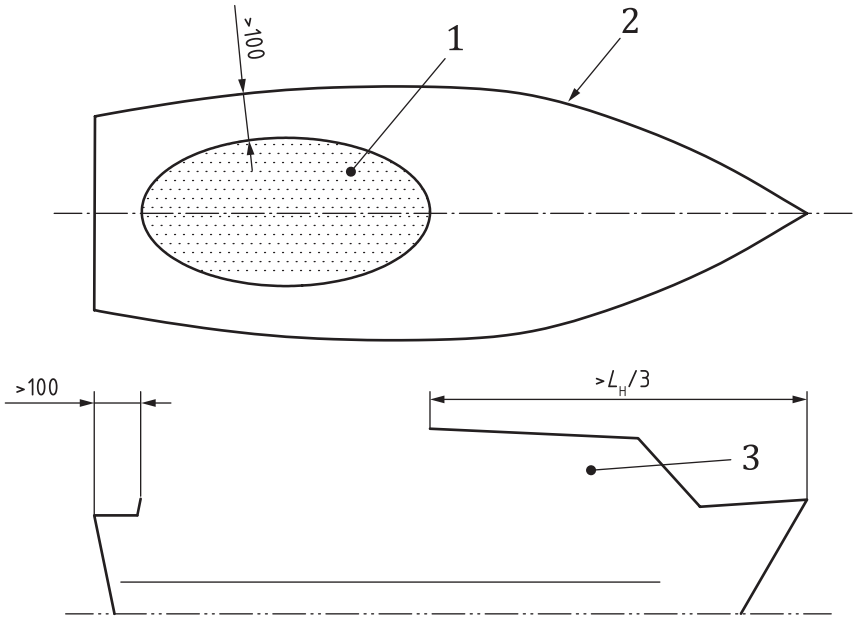
— includes at least 100 mm inboard from the sheerline,

except that the area of any watertight recesses with a total volume of less than $(L_H\ B_H\ F_M)/40$ may shed water via drains

Note 1 to entry: This is illustrated in Figure 1.

Note 2 to entry: Outboard engine wells are considered to provide a covering suitable for this purpose.

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Key

1 recess area open from above (less than two-thirds of the total sheerline area)

2 sheerline

3 open shelter or enclosed cabin

Figure 1 — Partially protected boat

3.1.7
habitable boat
boat having a fully enclosed cabin with rigid roof fitted with one or more bunks, benches, pipecots, hammocks or similar locations that can be used for sleeping when the boat is under way

Note 1 to entry: A boat is considered to be "habitable" if a fabric closure is used instead of a rigid door, or the cabin has fabric sides.

Note 2 to entry: The following are not considered to render a boat "habitable":

— a cockpit tent, or

— an open-sided cuddy intended to provide limited protection from spray, provided it is not fitted with fabric closures all round.

Note 3 to entry: Locations used for sleeping have minimum dimensions of 1,5 m diagonal length, 0,4 m width at the widest point, and with a minimum headroom of 0,4 m over the length. The cabin sole and compartments designated by the builder to be used exclusively for storage and referenced in the owner's manual are not included.

3.2 Downflooding

3.2.1
downflooding opening
any opening in the hull or deck (including the edge of a recess) that might admit water into the interior or bilge of a boat, or a recess, apart from those excluded in 6.3.1.5

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3.2.2
downflooding height
h_D
smallest height above the waterline to any downflooding opening (apart from those excluded in 6.3.1.5) when the boat is upright in calm water in the maximum load condition, measured to the critical downflooding point which might be within pipes or ducts inside the hull

Note 1 to entry: Downflooding height is expressed in metres.

3.2.3
downflooding angle
ϕ_D
angle of heel at which the downflooding openings (apart from those excluded in 6.3.1.5) become immersed, when the boat is in calm water and in the appropriate loading condition at design trim

Note 1 to entry: Downflooding angle may be determined using either of the methods in Annex B.

Note 2 to entry: Where openings are not symmetrical about the centreline of the boat, the case resulting in the smallest angle is used.

Note 3 to entry: Downflooding angle is expressed in degrees.

3.3 Condition and mass

3.3.1
empty craft condition
empty boat including fittings and equipment as listed below but excluding all optional equipment and fittings not included in the manufacturer's basic outfit:

a) structure: comprising all the structural parts, including any fixed ballast keel and/or drop keel/centreboard/daggerboard(s) and rudder(s);

b) ballast: any fixed ballast installed;

c) internal structure and accommodation: bulkheads and partitions, insulation, lining, built-in furniture, flotation material, windows, hatches and doors, permanently installed mattresses and upholstery materials;

d) permanently installed engine(s) and fuel system: comprising inboard engine(s), including all supplies and controls as needed for their operation, permanently installed fuel systems, including tanks;

e) fluids in permanently installed systems: residual working fluids as needed for their operation (see examples below), but excluding contents of fluid ballast systems and tanks, and main storage tanks which are included in maximum load;

   EXAMPLE Fluids in hot or cold water, fuel, lubricating or hydraulic oil systems.

f) internal equipment: including:

   — all items of equipment permanently attached to the craft, e.g. tanks, toilet system(s), water transfer equipment;

   — bilge pumping system(s), cooking and heating devices, cooling equipment, ventilation system(s);

   — electrical installation and equipment, including permanently installed batteries mounted in the position intended by the builder;

   — fixed navigational and electronic equipment;

   — fixed firefighting equipment, where fitted;

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g) external equipment: including:

— all permanently attached standard or specified deck fittings, e.g. guardrails, pulpits and pushpits, bowsprits and their attachments, bathing platforms, boarding ladders, steering equipment, winches, sprayhood(s);

— awning(s), cockpit tables, gratings, signal mast(s), where fitted;

— mast(s), boom(s), standing and running rigging, in the stowed position ready for use; all standing and running rigging in place;

Note 1 to entry: The mass in the empty craft condition is denoted by m_{EC} and is expressed in kilograms.

3.3.2
light craft condition
empty craft condition plus *standard equipment* (3.4.10) plus removable ballast (whether solid or liquid) when supplied and/or intended by the manufacturer to be carried when the boat is afloat, with elements positioned as follows:

a) where provision is made for propulsion by outboard engine(s) of more than 3 kW, the heaviest engine(s) recommended for the boat by the manufacturer, mounted in the working position(s);

b) where batteries are fitted, they are mounted in the position intended by the builder, and if there is no specific stowage provided for batteries, the mass of one battery for each engine over 7 kW is allowed for, and located within 1,0 m of the engine location;

c) all upwind sails supplied or recommended by the builder as standard, onboard and rigged ready for use, but not hoisted, e.g. mainsail on boom, roller furling sails furled, hanked foresails on stay stowed on foredeck

Note 1 to entry: For the minimum mass of outboard engines and batteries, refer to Tables C.1 and C.2.

Note 2 to entry: The mass in the light craft condition is denoted by m_{LC} and is expressed in kilograms.

3.3.3
maximum load
greatest load which the boat is designed to carry in addition to the light craft condition, comprising:

— the crew limit at 75 kg each (adult) or 37,5 kg (child);

— the personal effects of the crew;

— stores and cargo (if any), dry provisions, consumable liquids;

— contents of all permanently installed storage tanks filled to 95 % of their maximum capacity, including fuel, drinking water, black water, grey water, lubricating and hydraulic oil, bait tanks and/or live wells plus ballast water at 100 % capacity;

— consumable liquids in portable tanks (drinking water, fuel) filled to 95 % of the maximum capacity;

— dinghy or other small craft intended to be carried aboard, and any outboard motor associated with them;

— liferaft(s) if carried in excess of the minimum required in essential safety equipment;

— non-edible stores and equipment normally carried on the boat and not included in the manufacturer's list of standard equipment, e.g. loose internal equipment and tools, spare parts, additional anchors or sails, dinghy and outboard if carried aboard

Note 1 to entry: Liferafts are not included in essential safety equipment for Categories C and D.

Note 2 to entry: As a guide, not less than 20 kg/person should be allowed for personal effects on habitable boats.

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Note 3 to entry: As a guide, the mass of yachting liferafts varies from approximately 12 + 2CL (kg) to double this, according to specification.

Note 4 to entry: The mass of maximum load is denoted by m_{ML} and is expressed in kilograms.

3.3.4
maximum load condition
boat in the light craft condition with the maximum load added and an allowance for the maximum mass of optional equipment and fittings not included in the manufacturer's basic outfit so as to produce the design trim

Note 1 to entry: The mass in the maximum load condition is denoted by m_{LDC} and is expressed in kilograms.

3.3.5
loaded arrival condition
boat in the maximum load condition minus 85 % of the maximum capacity of fixed or portable storage tanks for fuel, oils and drinking water, and minus 90 % of edible stores, but including the worst combination of optional fittings or equipment with respect to stability

Note 1 to entry: In this condition, tanks have 10 % of their maximum capacity remaining.

Note 2 to entry: The mass in the loaded arrival condition is denoted by m_{LA} and is expressed in kilograms.

3.4 Other definitions

3.4.1
crew
collective description of all persons on board a boat

3.4.2
crew limit
CL
maximum number of persons (with a mass of 75 kg each) used when assessing the design category

Note 1 to entry: A half number denotes a child weighing less than 37,5 kg.

3.4.3
design trim
longitudinal attitude of a boat when upright, with crew, fluids, stores and equipment in the positions designated by the designer or builder

Note 1 to entry: Crew are assumed to be in positions designated by the builder. In the absence of builder's instructions, crew and gear are assumed to be positioned in a manner most likely to provide a favourable test result, provided that such positions are consistent with the proper operation of the boat, and that crew are assumed to be either standing at designated positions fitted with handholds, or seated.

3.4.4
essential safety equipment
loose equipment considered essential to the safe operation of the boat, which may include distress flares and rockets, lifebuoy with light and battery, first aid box, wire cutters for standing rigging, lifejackets, safety harnesses and lines, portable firefighting equipment, flashlight, binoculars, radio (e.g. VHF), ball and cone visual signals, charts and navigational publications in the corresponding design category

Note 1 to entry: Quantities carried may vary according to the size of boat, design category and crew limit.

Note 2 to entry: As a guide, the mass allowed for essential safety equipment but excluding any liferaft(s) should not be less than $3L_H$ (kg).

Note 3 to entry: Liferafts are not considered to be essential safety equipment in design categories C and D.

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3.4.5
flotation element
element which provides “buoyancy” to the boat and thus influences the flotation characteristics

3.4.5.1
air tank
tank made of hull construction material, and integral with hull or deck structure

3.4.5.2
air container
container made of stiff material, and not integral with the hull or deck structure

3.4.5.3
low density material
material with a specific gravity of less than 1,0 primarily incorporated into the boat to enhance the buoyancy when swamped

3.4.5.4
rib collar
heavy duty tubular collar fitted around the periphery of the boat and always intended to be inflated whenever the boat is being used

3.4.5.5
inflated bag
bag made of flexible material, not integral with hull or deck, accessible for visual inspection and intended always to be inflated when the boat is being used

Note 1 to entry: Bags intended to be inflated automatically when immersed (e.g. at the masthead as a means to prevent inversion) are not regarded as flotation elements.

3.4.6
length of hull
L_H
length of the hull measured according to ISO 8666

Note 1 to entry: Length of hull is expressed in metres.

3.4.7
loaded waterline
waterline of the boat when upright in the maximum load condition

3.4.8
reference sail area
A_S
actual profile area of sails set abaft a mast, plus the maximum profile area of all masts, plus reference triangle area(s) forward of each mast as defined in ISO 8666

Note 1 to entry: Sail area is expressed in square metres.

3.4.9
recess retention level
level of water in recesses, when the boat is at design trim, at which 20 % of the uppermost periphery of the surrounding coaming (measured in horizontal plane parallel to waterline at design trim) would be covered by water, assuming that all gates, doors or drainage openings are considered to be sealed

Note 1 to entry: This definition is illustrated in Annex I.

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3.4.10
standard equipment
devices including outboard motors (excluding those for tenders), loose furniture and furnishings such as tables, chairs, non-permanently installed mattresses, curtains, etc., portable bilge pumping equipment, anchors, chain, warps, sails, loose external equipment such as fenders, boathook and boarding ladder, oars (if appropriate), and essential safety equipment

Note 1 to entry: Where outboard engine(s) are fitted, the heaviest engine(s) recommended for the boat by the manufacturer is(are) included, the mass allowed for outboard engines and their batteries (if not permanently installed) not being less than that given in columns 1 and 3 of Tables C.1 and C.2.

Note 2 to entry: As a guide, the mass allowed for anchors, anchor chain, warps and fenders should not be less than about $0{,}25L_H^{2,2}$ (kg). In some cases, up to double this mass may be appropriate.

3.4.11
watertightness degree
degree of watertightness as specified in ISO 11812 and ISO 12216

Note 1 to entry: The degree of watertightness is summarized as follows:

— Degree 1: Degree of tightness providing protection against effects of continuous immersion in water.
— Degree 2: Degree of tightness providing protection against effects of temporary immersion in water.
— Degree 3: Degree of tightness providing protection against splashing water.
— Degree 4: Degree of tightness providing protection against water drops falling at an angle of up to 15° from the vertical.

3.4.12
windage area
A_{LV}
projected profile area of hull, superstructures, deckhouses, outboard motors and spars above the waterline at the appropriate loading condition, the boat being upright

Note 1 to entry: Canopies and screens that can be erected when under way in bad weather are included, e.g. cockpit dodgers, pram hoods.

Note 2 to entry: Windage area is expressed in square metres.

3.4.13
angle of vanishing stability
ϕ_V
angle of heel nearest the upright (other than upright) in the appropriate loading condition at which the transverse stability righting moment is zero; determined assuming that there is no offset load, and that all potential downflooding openings are assumed to be watertight

Note 1 to entry: Where a boat has recesses which are not quick-draining, ϕ_V is to be taken as the downflooding angle to these recesses, unless the loss of buoyancy due to such recesses is fully accounted for in determining ϕ_V.

Note 2 to entry: Angle of vanishing stability is expressed in degrees.

3.4.14
under way
not at anchor, or made fast to the shore, or aground

4 Symbols

For the purposes of this document, the symbols in Table 1 apply.

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