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

*Petits navires — Fenêtres, hublots, panneaux, tapes et portes —
Exigences de résistance et d'étanchéité*

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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*.

This second edition ~~is a technical revision of the first edition (ISO 12216:2002)~~ and replaces the first edition (ISO 12216:2002), which has been technically revised.

The main changes compared to the previous edition are as follows:

- new definitions ([Clause 3](#));
- change in watertightness requirements ([4.3.1](#));
- change of size allowance for glazing in the hull in area I ([6.3.1.1](#));
- change in the requirements for the use of glass in area IIa appliances ([6.3.2](#));
- new requirements for flush deck hatches ([6.3.3](#));
- new requirements for multihull break out panels ([6.3.8](#));
- new definition and requirements for prefabricated appliances ([6.3.9](#));
- new requirements for simply supported plates ([7.2.9](#) and [7.2.10](#));
- new direct calculation method for laminated glass plates ([7.3](#));
- new advanced calculation method for strength requirements on certain types of non glazed plates ([7.4](#));
- new requirements for pressure test ([D.2.1](#));
- new requirements for watertightness test ([D.2.2](#));
- new requirement for mechanical links test ([Clause D.3](#));

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- change to method of separation test ([D.4.3](#));
- new precalculated plate thickness tables ([Annex F](#)).

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

1 Scope

This document specifies technical requirements and test methods for windows, portlights, hatches, deadlights and doors on small craft with a length of hull, L_H , as defined in ISO 8666:2016, of up to 24 m. It takes into account the type of craft, its design category, and the location of the appliance.

The appliances considered in this document are only those that are critical for the craft's watertightness.

Openings and non-opening devices fitted below area I (see 3.5.2) are excluded from the scope of this document.

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 6603-1:2000, *Plastics — Determination of puncture impact behaviour of rigid plastics — Part 1: Non-instrumented impact testing*

ISO 11336-1:2012, *Large yachts — Strength, weathertightness and watertightness of glazed openings — Part 1: Design criteria, materials, framing and testing of independent glazed openings*

ISO 11812:2020, *Small craft — Watertight cockpits and quick-draining cockpits*

ISO 12217-1:2015, *Small craft — Stability and buoyancy assessment and categorization — Part 1: Non-sailing boats of hull length greater than or equal to 6 m*

ISO 12217-2:2015, *Small craft — Stability and buoyancy assessment and categorization — Part 2: Sailing boats of hull length greater than or equal to 6 m*

ISO 12217-3:2015, *Small craft — Stability and buoyancy assessment and categorization — Part 3: Boats of hull length less than 6 m*

EN 356:1999, *Glass in building — Security glazing — Testing and classification of resistance against manual attack*

EN 1063:1999, *Glass in building — Security glazing — Testing and classification of resistance against bullet attack*

3 Terms and definitions

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

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 General definitions of openings and their coverings

3.1.1

opening

cut-out in the shell of a craft such as in the hull or superstructures

Note 1 to entry: An opening is usually covered by a glazing or an appliance, that can be fixed or opening.

3.1.2

clear opening dimensions

dimensions of the area within a structure or frame, through which objects or people may pass when the incorporated plate is disregarded

3.2 Devices covering an opening

3.2.1

appliance

device made of a *plate* (3.3.1) and its associated framing, opening (hingeing) and fixture systems, when included, used to cover an opening in the hull, deck or superstructure of a boat; it can be fixed or openable (detachable, hinged, sliding, folding, etc.)

EXAMPLE *Windows* (3.4.1), *portlights* (3.4.2), *hatches* (3.4.3), *deadlights* (3.4.7), *doors* (3.4.6), *sliding appliances* (3.2.5), *escape hatches*.

3.2.2

fixed appliance

non opening *appliance* (3.2.1)

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3.2.3

opening appliance

appliance (3.2.1) that can be opened

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3.2.4

hinged appliance

opening appliance (3.2.3) that is connected to its framing by hinges

3.2.5

sliding appliance

opening appliance (3.2.3) which opens by sliding in line with its area, in any plane, where the plate either slides in a rabbet or a frame or is fixed in a sliding frame

3.2.6

composite appliance

system comprising *appliances* (3.2.1) [e.g. *portlights* (3.4.2)] situated within *plates* (3.3.1) that are themselves affixed to the vessel by direct bonding or mechanical fastening

3.3 Plate of an appliance

3.3.1

plate

sheet of material, transparent or not, that is attached to the boat structure either directly or indirectly, fixed or opening

3.3.2

stiffened plate

plate (3.3.1) with associated structural stiffeners

3.3.3

non-stiffened plate

plate (3.3.1) not equipped with associated structural stiffeners

3.3.4**unsupported dimensions of a plate**

clear dimensions between the inner edges of supports bearing the *plate* (3.3.1)

Note 1 to entry: These dimensions can be different from the *opening* (3.1.1) dimensions in the shell, because a plate can be fixed in either a fixed or opening framing.

Note 2 to entry: See Annexes B and C.

3.3.5**glazing**

plate (3.3.1) that is transparent or translucent

3.3.6**sandwich plate**

plate (3.3.1) having an inner core covered on each side by a working skin

3.4 Specific appliances**3.4.1****window**

glazed *appliance* (3.2.1)

3.4.2**portlight**

framed *window* (3.4.1), fixed or opening, located in the hull or transom below deck which, where openable, is hinged and opens inwards

3.4.3**hatch**

opening appliance (3.2.3), glazed or not glazed, used for access, lighting, inspection, ventilation or reach, located on any part of the shell

3.4.4**fire escape hatch****escape hatch**

hatch (3.4.3) intended or dedicated to provide an exit for people and designated means of escape

Note 1 to entry: See ISO 9094:2015 for definitions and requirements.

3.4.5**multihull escape hatch**

appliance (3.2.1) allowing a viable means of escape in the event of inversion for multihulls vulnerable to inversion

Note 1 to entry: See ISO 12217-1:2015, ISO 12217-2:2015 and ISO 12217-3:2015.

Note 2 to entry: As this appliance is not normally totally immersed in the upright and inverted position, it is usually fitted below deck level on the hull side, nacelle or crossarm bottom, or transom.

3.4.6**door**

opening appliance (3.2.3) up to 45° from the vertical intended to close a companionway *opening* (3.1.1)

EXAMPLE Door open at sea, door not open at sea, hinged door, sliding door.

3.4.7**deadlight**

secondary watertight *appliance* (3.2.1), permanently attached or separate and fitted to the inside of a *window* (3.4.1)

**3.4.8
washboard**

opening appliance (3.2.3) for companionway openings (3.1.1) made of one or more mobile board(s) that, when closed, are stacked one on top of each other

Note 1 to entry: This device is frequently found on sailing monohulls.

Note 2 to entry: Boards are added as the weather worsens to constitute a higher sill.

3.5 Areas definition

**3.5.1
appliance location area**

area of the watertight envelope of the craft where the appliance (3.2.1) is fitted

Note 1 to entry: See Annex A for sketches showing examples of appliance location areas.

**3.5.2
area I**

lower hull sides

part of the hull sides (and transom) situated above reference waterline (3.9.5), i.e. up the sheerline to its intersection with the weather deck (for decked craft), or the upper edge of the hull (for open craft or partially decked craft), but only to the following upper boundary:

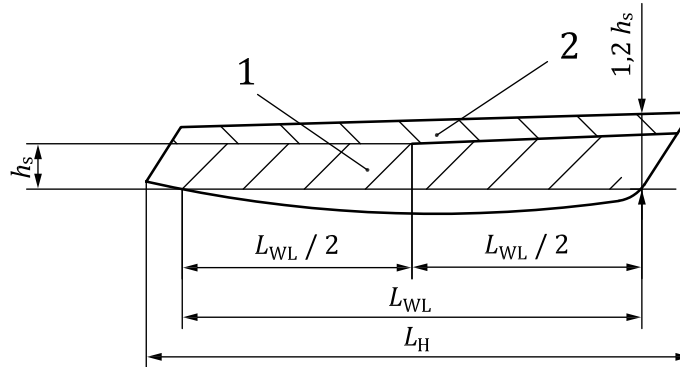
- a horizontal line located at the height h_S above waterline in the rear half of the waterline (see Figure 1);
- a sloped line having a height h_S at mid waterline, and a height $1,2h_S$ at the front end of the waterline, with
 - $h_S = L_H/12$ for sailing monohulls,
 - $h_S = L_H/17$ for motor boats, sailing catamarans and central hull of sailing trimarans

where h_S is limited as per Table 1

Table 1 — h_S limits of area 1

Design category	h_S higher limit	h_S lower limit
A	No limit	0,5 m
B	No limit	0,4 m
C	0,75 m	0,3 m
D	0,40 m	0,2 m

Note 1 to entry: The outer hulls of sailing trimarans are considered to be entirely in area I.

**Key**

- 1 area I
2 area II b

Figure 1 — Limits of areas I and II b**3.5.3****area II a**

area, other than *area I* (3.5.2), where persons are liable to walk or step, such as decks, superstructures, cockpit soles, at an inclination of less than 25° to the horizontal in a longitudinal direction, and at an inclination of less than 50° to the horizontal in the transversal direction respectively for sailing monohulls, or 25° for multihulls.

3.5.4**area II b**

upper hull side

areas from the hull sides (and transom) not belonging to *area I* (3.5.2)

Note 1 to entry: The following areas may be included if they correspond to the definition:

- rear faces of transverse girders of multihulls when located above the waterline.

Note 2 to entry: Areas on which people may stand or step, even inadvertently, are part of *area II a* (3.5.3).

EXAMPLE 1 Top of sailboat coachroof on which one may stand or attend to sails.

Note 3 to entry: Superstructure areas on which people cannot normally stand or step, are not part of *area II a*, but *area III* (3.5.5).

EXAMPLE 2 Top of motorboat wheelhouse is an area on which people cannot normally stand or step.

3.5.5**area III**

deck and superstructures exposed areas

areas, other than *area I* (3.5.2), *area II a* (3.5.3) or *area II b* (3.5.4), exposed to the direct impact of sea or slamming waves coming from front and side

3.5.6**area IV**

deck and superstructure protected areas

parts of *area III* (3.5.5) protected from the direct impact of sea or slamming waves coming from front and side, and not located within $L_H/3$ from the bow

EXAMPLE Cockpits, rear and side faces of superstructures.

Note 1 to entry: Areas other than the ones given in the example can be included in *area IV*. The protection against impact from the sea is the responsibility of the manufacturer.

3.6 Plate end-connections

See [Annex B](#) for sketches showing examples of types of plate end-connection.

3.6.1

semi-fixed plate

SF plate

plate ([3.3.1](#)) fixed to restrict deflection and to prevent lateral movement at its boundaries

EXAMPLE Unframed or framed plate, if bolted and/or glued.

3.6.2

simply supported plate

SS plate

plate ([3.3.1](#)) that can deflect at its boundaries and/or perform a lateral movement

EXAMPLE Unframed plate, whether hinged or sliding, e.g. frameless sliding windows and *hatches* ([3.4.3](#)), including companionway sliding hatches, companionway ladderboards, frameless hinged windows.

3.6.3

flexibly connected plate

simply supported plate ([3.6.2](#)) where the connection is achieved by an elastic support around the perimeter of the plate

Note 1 to entry: A car windscreen joint, shown in [Figure B.3](#), is a flexibly connected plate where there is no overlap between the plate and its support, hence the plate can be pushed in the boat by the outside pressure.

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3.7 Types of glass

3.7.1

annealed glass

sheet glass

glass as delivered directly from the fabrication cycle without subsequent treatment

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3.7.2

thermally tempered glass

TG glass

glass where better mechanical properties are obtained by thermal treatment

3.7.3

chemically reinforced glass

glass where better mechanical properties are obtained by chemical treatment

3.7.4

monolithic glass

glass consisting of one ply

3.7.5

laminated glass

multi-layer sheet having glass as outer plies, where the inside plies are made of plastic inter-layers, plastic sheets, glass, or other glazing material

3.8 Watertightness

3.8.1

watertightness

<appliance> capacity of an appliance or a fitting to prevent ingress of water inside the boat

3.8.2**degree of watertightness**

capacity of an appliance or fitting to resist ingress of water, according to the conditions of exposure to water

Note 1 to entry: See [Table 2](#).

Table 2 — Definitions of the degrees of watertightness

Degree of watertightness	Definition
1 (waterproof)	Constructed to withstand continuous immersion
2 (watertight)	Constructed to prevent ingress of water when tested according to D.2
3 (weathertight)	Constructed to minimize seepage when tested according to D.2.2.1
4 (spraytight)	Protection against water drops falling at an angle of up to 15° from the vertical according to D.2.2.2

3.9 Other general definitions**3.9.1****craft****small craft**

recreational boat, and other watercraft using similar equipment, of up to 24 m length of hull (L_H)

Note 1 to entry: The length of hull is defined in ISO 8666:2016.

3.9.2**design category**

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

Note 1 to entry: See also ISO 12217-1:2015.

3.9.3**sailing boat**

craft ([3.9.1](#)) for which the primary means of propulsion is by wind power

Note 1 to entry: See also ISO 8666:2016.

3.9.4**motor boat**

non-sailing *craft* ([3.9.1](#)) upon which the main propulsion system is a propulsion engine

3.9.5**reference waterline**

$W_{L_{REF}}$

level of the water on the hull in the fully loaded, ready-for-use condition

Note 1 to entry: The fully loaded, ready-for-use condition is defined in ISO 8666:2016.

3.9.6**prefabricated appliance**

component that is commercially available and has been type tested to conform to certain requirements and has been marked as such

4 General requirements

4.1 Requirements of other International Standards

Other International Standards can have requirements regarding these appliances, which are outside the scope of this document and therefore not addressed here.

These include but are not limited to:

- ISO 9094: 2015;
- ISO 12217-1:2015, ISO 12217-2:2015 and ISO 12217-3:2015;
- ISO 15085: 2003 Amd2:2018.

4.2 Strength of appliances

The strength of all parts of the appliance, i.e. plates, framing, tracks and attaching (e.g. fastenings and glue) shall meet the requirements of [Clause 7](#).

4.3 Watertightness of appliances

To avoid flooding, all appliances shall be designed and fixed to prevent substantial ingress of water in the interior of the boat when closed.

4.3.1 Minimum degree of watertightness

The required minimum degree of watertightness of an appliance, as fitted on the craft, is a function of the boat's design category, and shall meet the requirements given in [Table 3](#).

The required degree of watertightness of appliances shall be tested by the appliance manufacturer before installation on the craft using the test method specified in [D.2](#). The minimum degrees of watertightness given in [Table 3](#) shall be met.

Table 3 — Minimum degree of watertightness

Watercraft type	Appliance and/or location area	Design category		
		A/B	C	D
Any	Area I: lower hull side	2	2	2
Sailing monohull	Area II (a+b)	2	2	3
Non-sailing + sailing multihull		2	3	4
Any	Sliding companionway hatch in areas IIa	3	3	4
Any	Area III: deck and superstructure, exposed areas	3	3	4
Sailing monohull	Area IV: deck and superstructure, protected areas	3	3	4
Non-sailing + sailing multihull		3	4	4

4.3.2 Additional requirements for appliances related to watertightness

4.3.2.1 Sliding appliances

Sliding appliances shall not be used in area I.

4.3.2.2 Deck hatches of trimaran outrigger hulls

Hatches fitted on the decks of trimaran outrigger hulls shall not be sliding appliances.

4.3.2.3 Non-permanently attached hatches

These appliances shall not be fitted in area I.

5 Plate materials

5.1 General

Appliance plates shall be made of

- a transparent glazing material, such as polymethylmethacrylate (PMMA), polycarbonate (PC), tempered glass, chemically reinforced glass or laminated glass, or
- a non-transparent plate material, such as plywood (PW), glass-fibre reinforced thermosetting plastic (GRP), aluminium alloy, steel, etc.; or
- any other material of strength and stiffness or greater equivalent to those cited above.

5.2 Acrylic sheet materials

Polymethylmethacrylate (PMMA) made with a technique other than the casting procedure shall have mechanical properties and resistance to ageing at least equal to those of cast PMMA.

5.3 Glass

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5.3.1 Restrictions of usage

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The use of glass is restricted as per [5.3.1.1](#) and [5.3.1.2](#) for use of simply supported plates, [6.3.1](#) for use in area I and [6.3.2](#) for use in area IIa.

5.3.1.1 Monolithic glass

Monolithic glass shall only be made of thermally tempered glass, use of monolithic chemically reinforced glass is not allowed.

5.3.1.2 Laminated glass

The glass plies used in laminated glass may be made of tempered glass (thermally or chemically reinforced).

6 Specific requirements of appliances

6.1 Plate end connection and location

6.1.1 Simply supported plates

6.1.1.1 Plates in area I

Simply supported plates shall not be used in area I:

- on sailing monohulls in design categories A and B, and sailing multihulls in design category A;