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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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Contents

Page

Foreword

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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).

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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 cancels 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);

— 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.

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)

3.2.3
opening appliance
appliance (3.2.1) that can be opened

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,

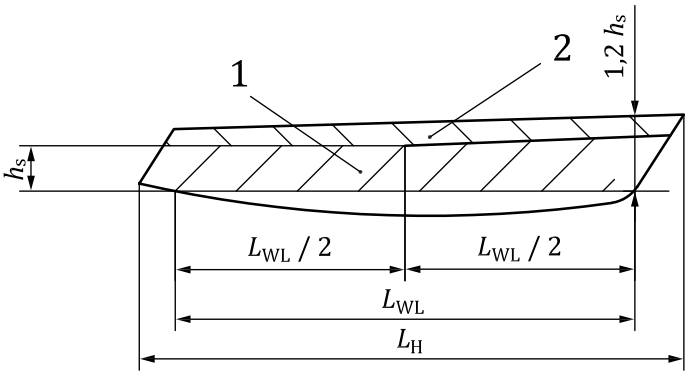
  — $h_S = L_H/17$ for motor boats, sailing catamarans and central hull of sailing trimarans

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 IIa* (3.5.3) or *area IIb* (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.

3.7 Types of glass

3.7.1
annealed glass
sheet glass
glass as delivered directly from the fabrication cycle without subsequent treatment

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
WL_{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

5.3.1 Restrictions of usage

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;

— on motor boats in design category A.

On other types of craft and design categories, simply supported plates may be used provided that all the following conditions are met:

— the glazing material is PMMA or PC (see Clause 5);

— the plate thickness is equal to 1,3 times the one required by Clause 7;

— the fixing devices of the plate (hinge bolts, fixing knob, etc.) are not spaced more than 250 mm.

The above restrictions of use need not be considered if the appliance is equipped with a deadlight meeting the requirements of 6.3.6.

6.1.1.2 Flexibly connected plates

Flexibly connected plates may only be used on motor boats of design categories C and D in areas III and IV (see Figure B.3.)

6.1.2 Semi-fixed plates

6.1.2.1 Plates made of material other than glass

Semi-fixed plates may be used in boats of all design categories and in all location areas with the restrictions of the special requirements given in 6.3.

This type of end connection can be achieved by one of the following means.

a) Connected with a counter frame: The edge fixity is achieved by pinching the plate at its periphery between the boat shell or a frame and a counter frame. The counter frame shall be mechanically fastened and/or glued to the structure of the boat.

b) Connected by gluing: The edge fixity is achieved by gluing the plate at its periphery to the boat shell, to the structure of the boat or to a frame. This gluing can either be in a rabbet or a face, edge gluing or any combination of these gluing methods.

c) Connected by direct fastening: The edge fixity is achieved by fastening the plate inside its periphery to the shell, the structure of the boat or to a frame by correctly spaced and sized mechanical fasteners. These fasteners may be bolts, rivets, self-tapping screws or any adequate mechanical fasteners.

NOTE Even with the best fastening system, full edge fixity of a non-stiffened plate at its periphery can never be achieved. Plates are therefore considered at best as semi-fixed.

6.1.2.2 Plates made of glass

There shall be no contact between metal and glass.

6.2 Fastening requirements

6.2.1 Fastening of plates and frames

Plates and frames can be fastened by mechanical means, glue or elastomer joints. All types of fastening shall ensure watertightness of the plate or frame, and resistance to loads due to normal operating pressure.

Every part of the mechanical elements connecting appliances to the rest of the craft shall be capable of withstanding, without breaking, twice the force induced by the pressure loads defined in Clause 7. This requirement shall be verified for inwards opening appliances, where hinges, locks, or any other

part of the link chain between the plate and the support shall be checked by calculation or testing in accordance with D.2.

6.2.2 Fastening of semi-fixed plates

Mechanical fasteners shall not induce parasitic stresses due to deflection or temperature changes, nor stress concentration or stress raising.

For example, bolts in sharp angle counterbores and countersunk screw heads in conical bores shall not be used.

Additional stresses brought by cold forming shall be considered when determining the plate scantlings in Clause 7.

6.2.3 Fastening of glued plates

Glued joints shall be resistant to (or protected against) sunlight (UV, heat, etc.) and all environmental effects or cleaning chemicals normally encountered in the manufacture and use of the craft.

Glued joints shall fulfil the requirements of one of the following items:

a) the inside pressure test (D.4.2);

b) the separation test (D.4.3);

c) the manufacturer's gluing procedure and conditions are followed and the bond strength checked by calculation to meet test pressure in D.4.3.2.

The above requirements shall be verified after any change in material or gluing procedure.

Plates, with or without framing, are considered glued if they are fastened with mechanical devices, such as bolts, rivets or screws, spaced more than $20t$, where t is the nominal plate thickness defined in Clause 7.

6.2.4 Stiffeners and attachments

Particular attention shall be paid to different elongation of stiff materiel (e.g. glass) connected with less stiff material (e.g. GRP) frames/supports (see ISO 12215-5:2019).

6.3 Special requirements

6.3.1 Appliances fitted in area I

6.3.1.1 Requirements for all appliances

6.3.1.1.1 Maximum small side dimension for glazing in the hull.

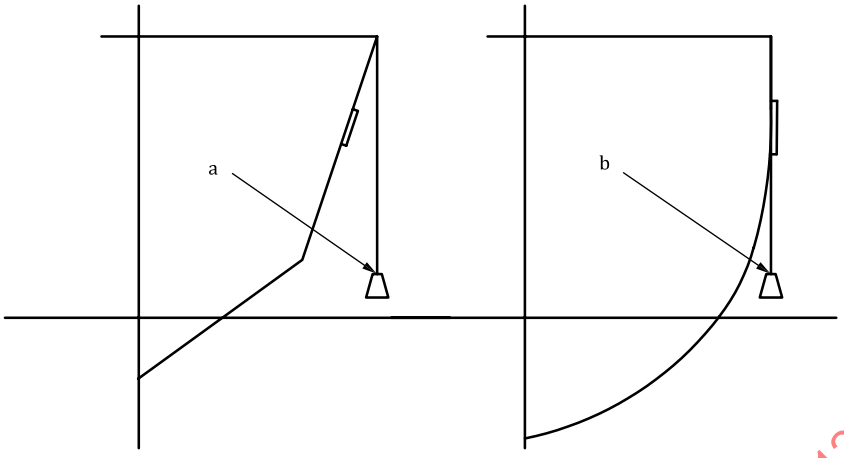
The maximum unsupported area of any one appliance situated wholly or partly within area I shall be not more than 0,852 m^2 (852 000 mm^2), and the maximum unsupported 'b' (short side) or equivalent 'b' dimension shall be not more than 300 mm unless laminated glass is used when the maximum unsupported b (short side) or equivalent b dimension shall be not more than 600 mm.

This requirement does not apply for inverted multihull escape hatches or craft transoms.

6.3.1.1.2 Protection

On boats of design categories A and B, no part of the plate or its framing or the appliance shall extend outside the local vertical tangent to the hull, deck, rubbing strake, fixed fender, or of a built-in fairing

which is an integral part of the hull. Figure 2 explains this requirement. This requirement does not apply to the inner hulls of multihulls.



a The local vertical tangent is outside the porthole: correct.

b The local vertical tangent is inside the portlight: the portlight shall either be placed in a recess or protected by a built-in fairing.

Figure 2 — Sketch explaining the requirement of 6.3.1.1.2

6.3.1.2 Use of glass

Glass shall not be used on sailing boats of all design categories and on motor boats of design categories A and B, unless the plate is made of high-impact-resistance glass, or if the appliance is equipped with a deadlight meeting the requirements of 6.3.6. High-impact-resistant glass types are listed in Annex E with corresponding requirements.

6.3.1.3 Opening appliances

6.3.1.3.1 Height above waterline

The lower edge of any opening shall be located according to ISO 12217-1:2015, ISO 12217-2:2015 or ISO 12217-3:2015, as applicable, at a height above reference waterline (see 3.9.5) of at least:

— 500 mm, for craft of design category A;

— 400 mm, for craft of design category B;

— 300 mm, for craft of design category C;

— 200 mm, for craft of design category D;

the craft being in m_{LDC} condition and upright.

6.3.1.3.2 Opening side

All opening appliances shall open inwards, with the exception of:

— transoms;

— multihull escape hatches, or opening windows in the inboard side of multihulls;

— designated escape hatches, when required by ISO 9094.

6.3.2 Appliances fitted in area IIa

6.3.2.1 Use of glass

On motor boats, the usage of monolithic and laminated glass is accepted without restriction.

On sailing boats, neither monolithic nor laminated glass shall be used forward of the mast or foremast, unless the plate is made of high-impact-resistance glass, or if the appliance is equipped with a deadlight meeting the requirements of 6.3.6. High-impact-resistance glass types are listed in Annex E.

This restriction need not be considered if the plate is protected against shocks by an adequate device.

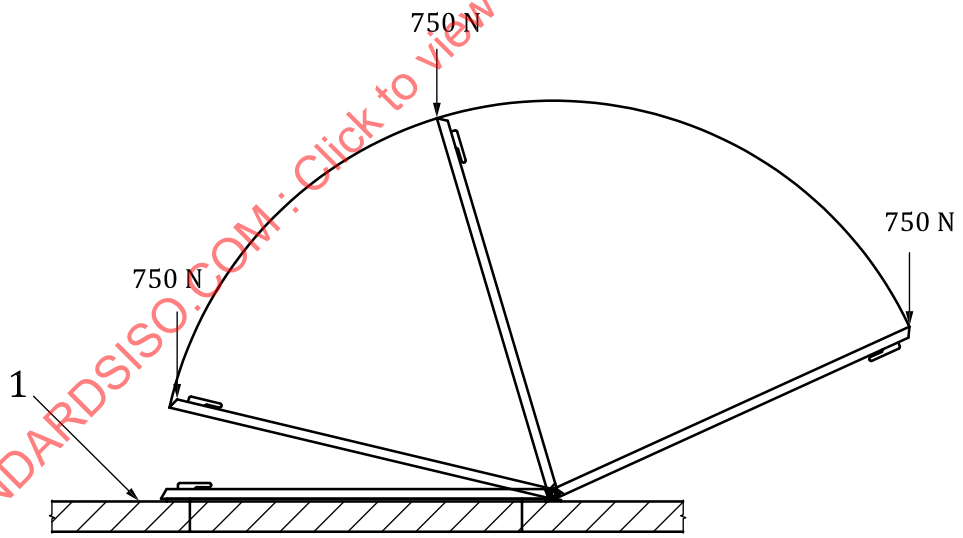
EXAMPLE Outside grid network, protection bars.

6.3.2.2 Tests on hinged deck hatches

6.3.2.2.1 Unintentional stepping test

The test is performed on a hinged deck hatch fixed to a rigid flat support of dimensions twice those of the hatch, as shown in Figure 3.

The hatch is open in any position, up to its maximum operating position, and shall be able to withstand a concentrated force of 750 N applied anywhere on the outside edge of the hatch, without permanent deformation or damage to the hatch, its framing or hinge. The hatch will normally close under the applied force, and the system that is used to maintain the hatch open may be damaged. The hatch is considered to fulfil the requirements of this test if the integrity of the hatch, and its closing and watertightness capabilities, are maintained.



Key

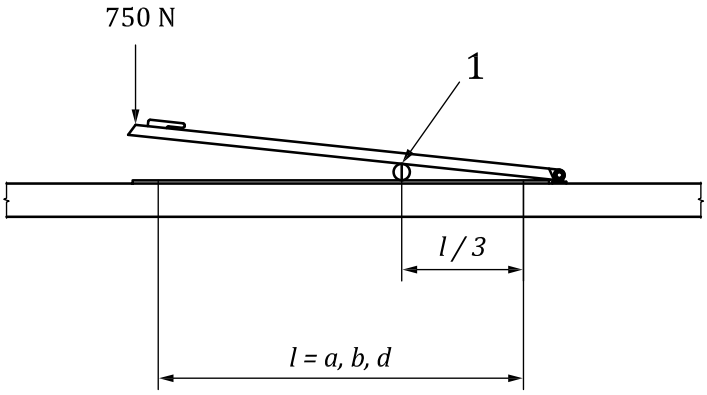
1 flat plate (see 6.3.2.2.1)

Figure 3 — Unintentional stepping test

6.3.2.2.2 Rope jamming test

The test is performed on the same test device and loading as in 6.3.2.2.1, but with a 14 mm, three-strand polypropylene rope simultaneously jamming both sides, as shown in Figure 4.

The test is considered as passed if there is no permanent deformation or damage to the hatch, its framing or hinges.



Key

1 three-strands polypropylene rope of diameter 14 mm

Figure 4 — Rope jamming test

6.3.2.2.3 Hatch and hinge strength test

The test is performed on the same test device as in 6.3.2.2.1, with the hatch open at 90°, as shown in Figure 5.

Apply a twisting torque made by two parallel and opposite forces of 200 N, acting on the two outside corners (or horizontal diameter) of the opening part of the hatch.

The test is considered as passed if there is no permanent deformation or damage to the plate, its framing or hinges.

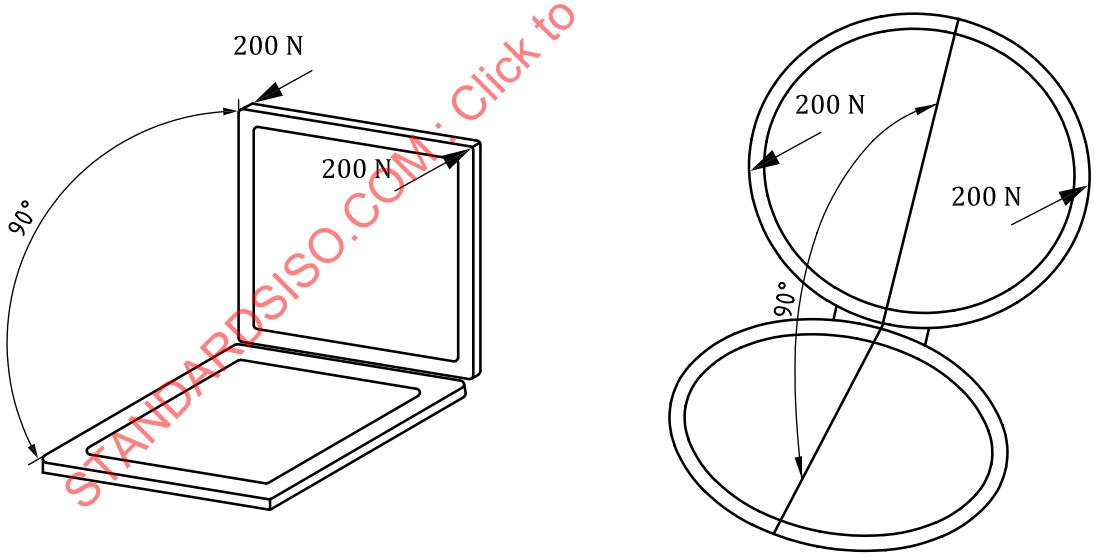


Figure 5 — Hatch and hinge strength test

6.3.3 Flush deck companionway opening sill heights

6.3.3.1 Flush deck companionway deck hatch up to 45°

A companionway deck hatch up to 45° shall have:

— a sill according to Table 4, column 3, for monohull sailing boats; or

— a sill according to Table 4, column 4, for non-sailing boats and multihull; or

— a warning in the owner's manual, and the hatch on the craft shall be labelled according to Table 4, column 5, if this is not the main companionway.

6.3.3.2 Flush deck companionway deck hatch above 45°

A companionway deck hatch above 45 ° shall have:

— a sill according to Table 4, column 3, for sailing boats;

— a sill according to Table 4, column 4, for non-sailing boats and multihull; or

— a warning in the owner's manual, and the hatch on the craft shall be labelled according to Table 4, column 5, if this is not the main companionway.

Table 4 — Sill heights and labels for flush deck hatches

Dimensions in meter [m].

1	2	3	4	5
Design category	Area	Sailing monohull	Non-sailing and sailing multihull	Label for horizontal opening appliances for sailing and non-sailing craft.
		Top of sill	Top of sill	
A	IIa & IIb	0,20	0,15	Keep closed while under way in category A and B conditions.
	III & IV	0,15	0,10	
B	IIa & IIb	0,15	0,10	Keep closed while under way in category B conditions.
	III & IV	0,10	0,075	
C	IIa & IIb	0,10	0,075	Keep closed while under way in category C conditions.
	III & IV	0,075	0,05	
D	IIa & IIb	not req.	not req.	n.a.
	III & IV	not req.	not req.	n.a.
The sill may be semi-fixed or fixed.				

For the definitions of sill, fixed sill, semi-fixed sill and how to measure sill height, ISO 11812:2020 applies.

In the case where a foot-basin is located to lower the sill height to the companionway, the drainage of the foot-basin shall comply with ISO 11812:2020 for multi-bottom recess drainage.

6.3.4 Sliding appliances

6.3.4.1 Rabbet depth

The depth of the rabbet shall be sufficient to prevent any disengagement of the plate under the pressure loads defined in Clause 7, taking into account the size of the appliance, the material of which it is made, and the rigidity of the structure it is fixed on. For unframed plates made of PMMA, PC, or materials with similar modulus of elasticity, this depth shall be at least 12 mm.

6.3.4.2 Stops

The appliance shall be fitted with stops at each end of its stroke to prevent any disengagement of the sliding part of the frame.

6.3.5 Washboards

Washboards shall be:

a) fitted with a device maintaining them in place, when in use, and shall at least be operable from inside; and

b) they shall meet the strength requirements of Clause 7; and

c) provision shall be made for washboards to be stowed in the vicinity of the door opening, and easily and safely reached without the use of tools.

Craft of design category A shall be equipped with a device connecting the boards together when not in use.

EXAMPLE Lanyards.

6.3.6 Securing system

Any appliance shall have a securing device which maintains it in a closed position, operable at least from the inside.

On doors, this system shall be operable from both sides.

In boats of design categories A and B, if the companionway door is used together with a companionway hatch, the securing device needs only be efficient when both the door and the hatch are closed together. In this case, if the companionway door is made with washboards, the securing device may only act between the upper panel of the washboard and the hatch.

In addition, a securing device for the open position is also required on sliding hatches and sliding cabin doors.

6.3.7 Deadlights

The deadlight, without the primary appliance, shall meet the requirements of Clause 4 and 6.2. Deadlights of windows fitted in area I, if required, shall be permanently attached to the appliance, its framing, or the craft structure, and be operative even in the case of rupture of the opening part of the window.

6.3.8 Multihull escape hatches

When required by ISO 12217-1:2015, ISO 12217-2:2015 or ISO 12217-3:2015, as applicable, on habitable multihulls susceptible to inversion, escape hatches shall have the characteristics given in 6.3.8.1 to 6.3.8.3.

6.3.8.1 Minimum dimensions

Dedicated escape hatches when inverted shall have the minimum clearing characteristics according to ISO 12217-1:2015, ISO 12217-2:2015 or ISO 12217-3:2015, as applicable.

6.3.8.2 Material

Glass shall not be used, unless it is high-impact-resistance glass or the opening shall be fitted with a permanently installed deadlight. High-impact-resistance glass types are listed in Annex E with corresponding requirements.

6.3.8.3 Opening

Multihull escape hatches shall be free to open from the inside and the outside when secured unlocked.

Any "break-out panel" comprising either a predefined area of hull skin which can be broken through in an emergency using special tools, or a fixed panel that can be broken with a sharp implement shall ensure the tools required are in the vicinity of the panel.

The hinge or hinges of an escape hatch that opens outwards shall be such that the hatch cannot be torn out and lost by the action of the sea if it is partially, or totally, opened.

6.3.9 Prefabricated appliances

Prefabricated appliances shall, at the time of purchase, have an information notice which indicates, for the benefit of the fitter and consumer, the upper design category, boat type and location area allowed, and the installation guidance required from clause 6.3.2.2.1. This notice may be a sticker glued on the appliance, a label on the appliance box, a leaflet or any other type of information device.

6.3.10 Appliance systems (composite appliances)

Systems in areas I and IIb comprise appliances (portlights) situated within plates that are themselves affixed to the vessel by direct bonding or mechanical fastening. The system shall be pressure tested to a minimum of the basic design pressure of the installation area for not less than 180 s.

The appliances within the system are to be adequately sealed closed for the test, ensuring the test is with regard to the strength of the overall system, and not to the watertightness of the appliance within. During this minimum period at the basic design pressure, there shall be no failure of the system.

7 Strength assessment

7.1 Assessment methods for appliances strength

The appliances strength shall be assessed according to one of the methods listed in Table 5.

Table 5 — Strength assessment methods for appliances

Type of appliance	Direct calculations	Advanced calculations	Pressure test
Monolithic plate	7.2	7.4	7.5
Laminated glass plate	7.3	7.4	7.5
Sandwich, stiffened and/or supported	N.A.	7.4	7.5

7.2 Monolithic plates — Direct calculation methods

The formulas given in this section are valid for rectangular plates. For circular plates, replace *b* by *d*, which is the unsupported diameter.

For plates having unsupported shapes different from a rectangle or a circle, the approximations of Annex C shall be used to determine "equivalent" unsupported dimensions.

7.2.1 Monolithic semi-fixed plates — Direct calculation method

This section considers "semi-fixed" rectangular plates, i.e. held all around their periphery (on 4 sides).

The plate shall be designed to comply with the allowable stress criterion:

$$t_r = bk_c \sqrt{\frac{k_r \psi p}{\sigma_a}} \quad (1)$$

where

t_r is the basic plate thickness using allowable stress criterion, expressed in millimetres;

b is the unsupported short side of a rectangular plate or "equivalent short side" of a plate, in millimetres;

k_c is the curvature coefficient (non-dimensional) (see 7.2.6);

k_r is the plate-aspect ratio coefficient for stress calculation (non-dimensional) (see 7.2.3);

Ψ is the pressure reduction factor (non-dimensional) (see 7.2.5);

p is the basic design pressure, expressed in pascals (see 7.2.4);

σ_a is the allowable flexural stress of the material, expressed in pascals (see 7.2.7, 7.2.8, F.1 and F.2).

The same units must be used for p and σ_a (both expressed in pascals, or kilopascals), as the term under the square root must be non-dimensional.

The appliance shall be designed to comply with the allowable deflection criterion also:

$$t_f = 0,45\left(t_r + bk_c \sqrt[3]{\frac{k_f \psi p}{0,02E}}\right) \quad (2)$$

where

t_f is the basic plate thickness using the relative deflection criterion, expressed in millimetres;

k_f is the plate aspect-ratio coefficient for deflection calculation (non-dimensional) (see 7.2.3);

E is the elasticity modulus (Young's modulus), expressed in pascals (see 7.7, F.1 and F.2).

The calculation of t_r considers that a certain amount of membrane behaviour is taking place.

NOTE The same units must be used for p and E (both expressed in pascals or kilopascals) as the term under the cubic root must be non-dimensional.

7.2.2 Selection of monolithic plate thickness

The value of the actual plate thickness, t_a, expressed in millimetres, to be used, shall be the greatest of the following:

— the monolithic plate thickness using the allowable stress criterion, t_r [see 7.2.1, Formula (1)];

— the monolithic plate thickness using the allowable deflection criterion, t_f [see 7.2.1, Formula (2)];

— the minimum plate thickness, t_m (see 7.2.8 and Table 9).

With commercially available plates, the nominal commercial thickness shall be at most 0,5 mm below the calculated thickness. The following examples illustrate this requirement.

EXAMPLE 1 If the calculation gives 6,5 mm, a commercially available thickness of 6 mm, in metric dimensions, or 6,35 mm (1/4 in in imperial dimensions), can be chosen.

EXAMPLE 2 If the calculation gives 6,51 mm, a commercially available thickness of 7 mm, in metric dimensions, or 8 mm if 7 is not available, or 6,35 mm (1/4 in in imperial dimensions), can be chosen.

EXAMPLE 3 If the calculation gives 6,85 mm, in a country where only imperial dimensions are commercially available, one may use 6,35 mm (1/4 in in imperial dimensions), but if the calculation gives 6,86, choose a plate thicker than 1/4 in, i.e. 5/16 in, for example.

The precalculated thickness tables given in Annex F for poly(methyl)methacrylate (PMMA) and thermally tempered glass (TG) flat plates can be used instead of the above calculations.

7.2.3 Plate aspect-ratio coefficients, k_r and k_f

The plate aspect-ratio coefficient for stress calculation, k_r, and for deflection calculation, k_f, shall be chosen from Table 6 for rectangular plates and Table 7 for circular plates.

The aspect ratio is the ratio a/b of the unsupported dimensions: a and b are respectively the long and short unsupported dimensions (or their equivalent dimensions determined according to Annex C) of a rectangular plate, expressed in millimetres.

Table 6 — Values of k_r and k_f for rectangular plates supported on 4 sides

SF plates		Ratio	SS plates	
k_r	k_f	a/b	k_r	k_f
0,298	0,029	1,0	0,287	0,044
0,34	0,035	1,1	0,333	0,053
0,38	0,04	1,2	0,376	0,062
0,415	0,045	1,3	0,416	0,07
0,446	0,05	1,4	0,454	0,077
0,472	0,054	1,5	0,487	0,084
0,494	0,058	1,6	0,518	0,091
0,513	0,061	1,7	0,545	0,096
0,529	0,064	1,8	0,569	0,102
0,542	0,067	1,9	0,591	0,106
0,554	0,069	2,0	0,61	0,111
0,563	0,071	2,1	0,627	0,114
0,572	0,073	2,2	0,642	0,118
0,578	0,074	2,3	0,655	0,121
0,584	0,076	2,4	0,667	0,123
0,59	0,077	2,5	0,677	0,126
0,594	0,078	2,6	0,687	0,128
0,598	0,079	2,7	0,695	0,129
0,601	0,08	2,8	0,702	0,131
0,604	0,080	2,9	0,708	0,131
0,607	0,081	3,0	0,713	0,134
0,607	0,081	3,0	0,713	0,134
0,609	0,082	3,1	0,718	0,135
0,611	0,082	3,2	0,723	0,136
0,613	0,082	3,3	0,726	0,136
0,614	0,083	3,4	0,73	0,137
0,616	0,083	3,5	0,733	0,138
0,617	0,083	3,6	0,735	0,138
0,618	0,084	3,7	0,737	0,139

NOTE For $a/b > 5$, k_r and k_f are constant.

Table 6 *(continued)*

SF plates		Ratio	SS plates	
k_r	k_f	a/b	k_r	k_f
0,619	0,084	3,8	0,739	0,139
0,62	0,084	3,9	0,741	0,14
0,62	0,084	4,0	0,743	0,14
0,621	0,084	4,1	0,744	0,14
0,622	0,084	4,2	0,745	0,141
0,622	0,085	4,3	0,746	0,141
0,623	0,085	4,4	0,747	0,141
0,623	0,085	4,5	0,748	0,141
0,624	0,085	4,6	0,748	0,141
0,624	0,085	4,7	0,749	0,141
0,624	0,085	4,8	0,749	0,141
0,625	0,085	4,9	0,75	0,142
0,625	0,085	5,0	0,75	0,142
NOTE For $a/b > 5$, k_r and k_f are constant.				

Table 7 — Values of k_r and k_f for SF and SS circular plates

SF circular plates		SS circular plates	
k_r	k_f	k_r	k_f
0,248	0,027	0,309	0,043

7.2.4 Design pressure

The basic design pressure for calculation of the plate thickness shall be selected from Table 8.

Table 8 — Basic design pressure p

Application location area	I	IIb	IIb	IIb	IIa	III	III	III	III	III	III	III	III	IV	IV
Boat type	Any	Any	Any	Any	Any	Sail	Sail	Motor	Motor	Motor	Motor	Motor	Motor	Sail	Motor
Design category	Any	A	B	C, D	Any	A, B	C, D	A	B	A	B	C	D	Any	Any
Particular (front, side, any)	Any	Any	Any	Any	Any	Any	Any	Front	Front	Side	Side	Any	Any	Any	Any
Pressure, p, kPa	70	70	50	28	28	18	12	12	9	9	6	6	6	12	6
To simplify the figures, the pressure in this table is expressed in kilopascals, but pascals shall be used in 7.2.1.															

7.2.5 Pressure reduction factor

The pressure reduction factor, Ψ, is introduced to take into account the fact that the pressure is lower on a large surface than on a small one (distribution of local impact loads).

For a rectangular plate, $\Psi = 1{,}102 - 0{,}0004b$.

For a circular plate, b is replaced by d.

Ψ shall be within the following limits: $0{,}33 \leq \Psi \leq 1{,}0$.

7.2.6 Curvature coefficient

The curvature coefficient, k_c, for a convex plate shall be determined from Figure 6 a) and the formula:

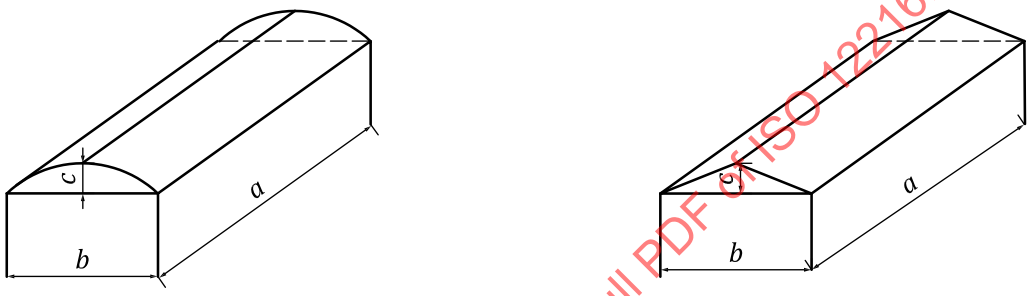
$$k_c = 1 - c/b \quad (3)$$

where

k_c is within the following limits: $0{,}33 \leq k_c \leq 1$;

c is the crown height of a curved plate, assessed in accordance with Figure 6 a), or the angle height of an angled plate assessed in accordance with Figure 6 b).

The formula is only applicable if the curvature or angle is in the b direction.



a) Curved plate **b) Angled plate**

Figure 6 — Crown height and angle height

7.2.7 Flexural strength and modulus of elasticity

The values of flexural strength and modulus of elasticity (Young's modulus) of the plate material are the manufacturer's stated nominal (not minimal) values. In the absence of such data, the average values given in Tables F.1 and F.2 may be used.

7.2.8 Safety factor and minimum plate thickness

The allowable flexural stress of the material, σ_a, is determined from

$$\sigma_a = \sigma_u/\gamma \quad (4)$$

where γ is the value of the safety factor given in Table 9.

The safety factor, γ, used in this calculation of the allowable flexural stress (and minimum thickness values) takes into account the relative brittleness of the material and its ageing characteristics due to environmental conditions.

Safety factors and minimum thickness for materials other than those listed below shall be evaluated by comparing their impact energy at maximum force to that of glass-reinforced plastic (GRP) according to ISO 6603–1:2000.

Table 9 — Safety factor and minimum thickness of monolithic plates

Dimensions in millimetres

Material	Acronym	Safety factor γ	Minimum thickness of monolithic plates, t_m			
			Design categories			
			Any		A and B	C and D
			Area I[a]	Area II	Areas III and IV	Areas III and IV
Poly(methyl)methacrylate	PMMA	3,5	6 + 0,1 (L_H − 4)	6	5	4
Polycarbonate	PC	3,5	6 + 0,1 (L_H − 4)	6	5	4
Monolithic tempered glass	TG	4,0	5 + 0,1 (L_H − 4)[b]	4	4	3
Laminated glass	LG	4,0	5 + 0,1 (L_H − 4)[b]	4	4	3
All mahogany plywood	AMPW	2,0	8 + 0,1 (L_H − 4)	6	5	4
GRP mat 30 % glass	GRP M 30	2,0	4 + 0,1 (L_H − 4)	3	3	2
GRP mat/roving 35 % glass	GRP MR 35	2,0	4 + 0,1 (L_H − 4)	3	3	2
Aluminium alloy 5083-H111	—	2,0	3 + 0,05 (L_H − 4)	3	3	2
Mild steel	MS	2,0	2,5 + 0,025 (L_H − 4)	2,5	2,5	2

[a] The minimum thickness in area I is related to the length of hull, L_H, in metres and as defined in ISO 8666:2016.

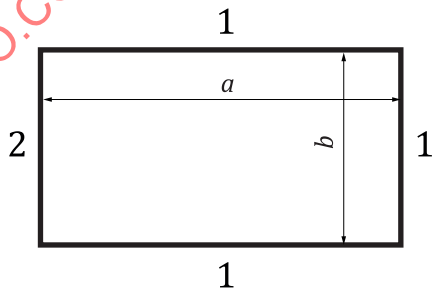
[b] Glass is only allowed in area I if equipped with a deadlight, or if it is highly resistant to impact (see 6.3.1.2).

7.2.9 Monolithic simply supported on 2 sides — Direct calculation

Rectangular plates only held on two sides shall be calculated considering $a = 5b$ in 7.2.2 to 7.2.8.

7.2.10 Monolithic simply supported on 3 sides — Direct calculation

Rectangular plates simply supported on three sides (see Figure 7) shall be calculated using Formulae (1) and (2) in 7.2.1, for the allowable stress and allowable deflection, respectively, substituting the corresponding aspect ratio coefficients from Table 10, and using 7.2.2 to 7.2.8



Key

1 supported side

2 free side

Figure 7 — Rectangular plates simply supported on three sides

Table 10 — Values of k_r and k_f for rectangular plates supported on three sides

Values of k_r and k_f for rectangular plates supported on three sides		
	Ratio	
k_r	a/b	k_f
0,36	0,5	0,080
0,45	0,667	0,106
0,67	1,0	0,140
0,77	1,5	0,160
0,79	2,0	0,165
0,80	4,0	0,167

NOTE This can be the case of companionway washboards and some sliding windows.

7.3 Laminated glass — Direct calculation

In order to calculate the thickness of laminated glass (3.7.5), the thickness, t_{eq}, of a monolithic plate made of the same type of glass material as the laminated glass plies, is calculated. Then:

For area II/III/IV applications:

a) if the difference in thickness between any two glass plies is less than or equal to 2 mm and the thickness of the plastic interlayer is less than, or equal to 0,76 mm:

   — for 2 glass plies, the total thickness of the glass plies t_1 and t_2 shall be:

   $t_1 + t_2 \geq 1{,}2t_{eq}$

   — for more than 2 glass plies, the total thickness of the glass plies, t_1, t_2, t_3, ..., t_n, shall be:

   $t_1 + t_2 + t_3 + \ldots + t_n \geq 1{,}5t_{eq}$

For area I applications, to omit deadlights:

b) if the conditions of a) above are not met, each ply shall be considered as stressed according to its section modulus and shall be analysed according to 7.4;

   or,

   apply the T factor shown in Table 11 to the monolithic requirement; the factor T depends on vessel category (t x T = tT).

Table 11 — T factor

Category of vessel	T factor for use with ISO 11336-1:2012 laminates calculations
A	1,33
B	1,33
C	1,26
D	1,16

The resulting tT value is the required minimum monolithic thickness equivalent as per ISO 11336-1:2012 collaborating plies calculations (ISO 11336-1:2012, 5.6.3.1.2).

The lamination is acceptable when equivalent monolithic thickness (t_{eq}) as per ISO 11336-1:2012 is equal to or greater than tT, and all of the following conditions are met:

— the glass plies are made of the same material;

— annealed glass is not used in a system with toughened glasses;

— glass ply thickness shall be a minimum of 4 mm;

— no two adjacent glass plies shall differ by more than 4 mm in nominal thickness;

— no one glass ply within a two-ply system shall be less than 42 % of the tT value in thickness;

— the interlayer thickness shall meet the additional requirements of Annex E, Table E.1;

— a purely cosmetic ply (for instance: a third glass ply included on the environmental side of a two-ply glazing solution for tint/finish purposes, where all other plies and interlayers of the system at least meet the minimum required equivalence without the third ply calculated) is permissible.

7.4 Advanced calculation method

Monolithic, sandwich and stiffened plates, excluding glazing, may be assessed using ISO 12215-5:2019 for monohulls[1)], considering the material safety factors from 7.2.8.

7.5 Pressure test assessment method

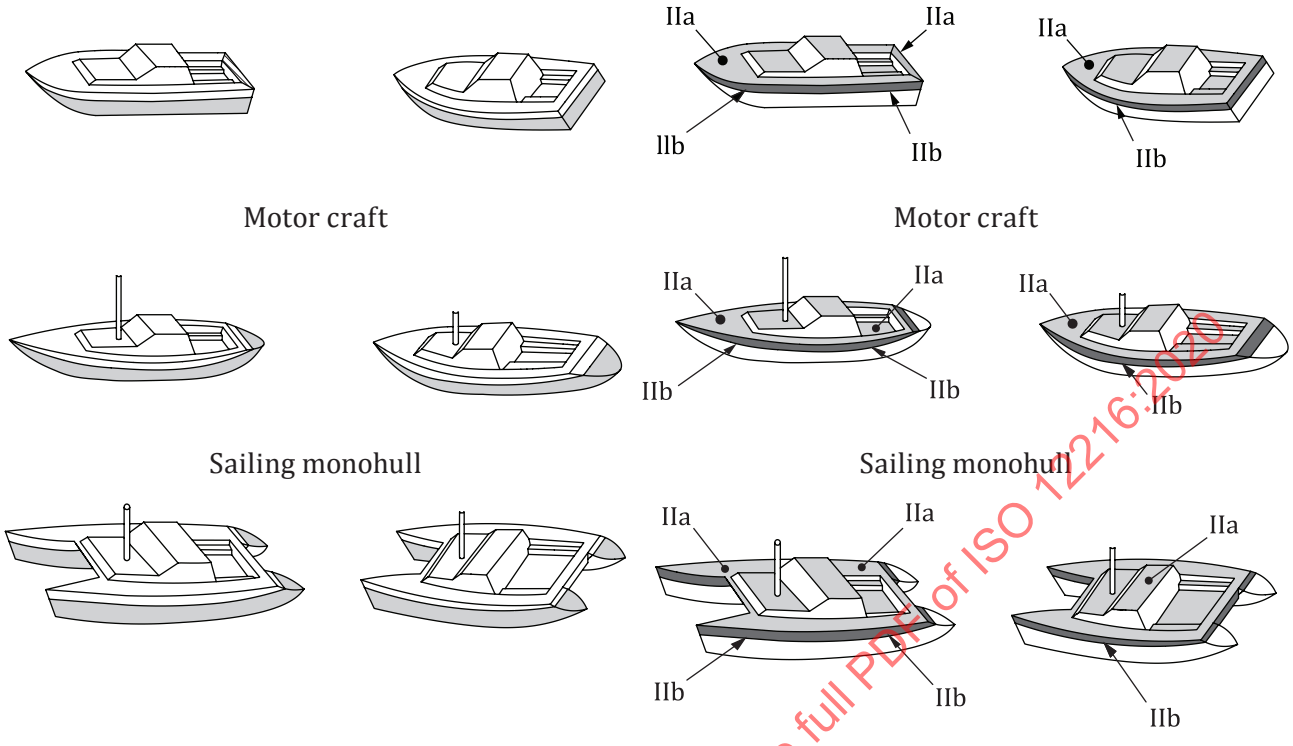
All types of appliances in the scope of this document can be assessed by the mean of a pressure test, according to basic design pressure from 7.2.4, for 3 min, without failure nor permanent deformation.

1) ISO 12215-7, *Small craft — Hull construction and scantlings — Part 7: Determination of loads for multihulls and of their local scantlings using ISO 12215-5*, is in preparation for multihulls (current stage: FDIS)."

Annex A
(informative)

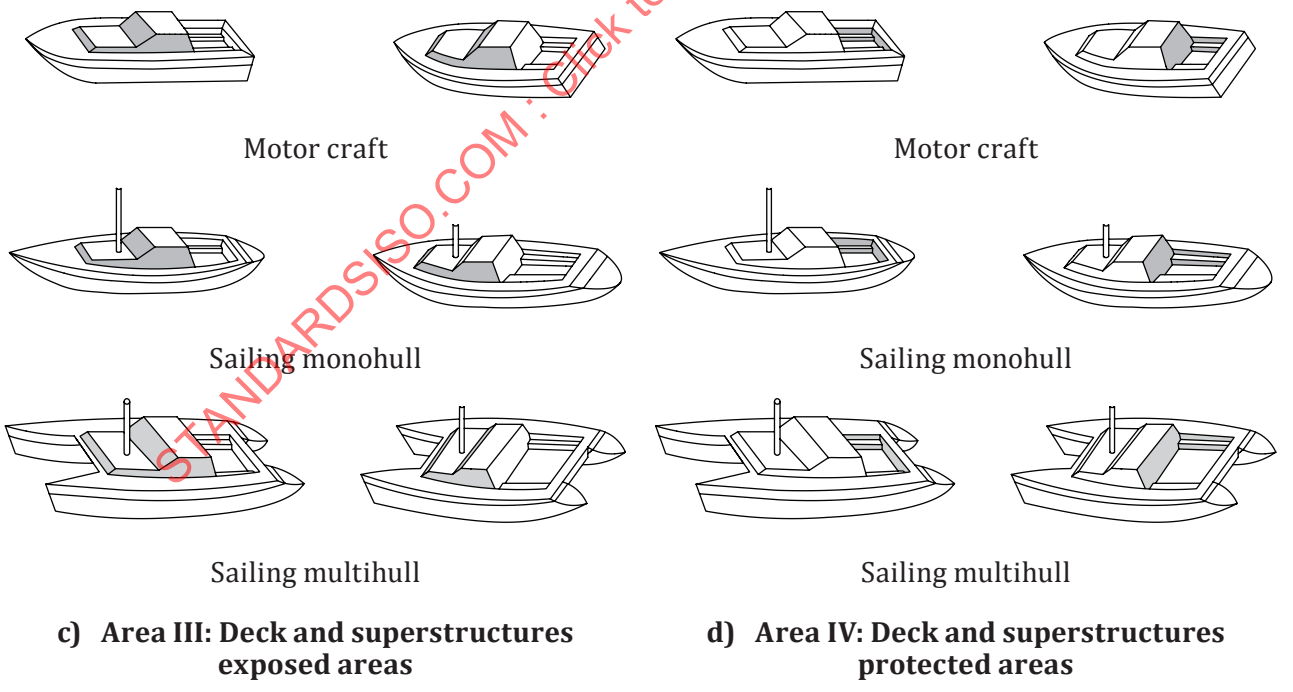
Location areas of appliances above WL_{REF}

Examples of the appliance location areas as defined in 3.5 are shown in Figure A.1 as hatched areas.



a) Area I: Lower hull side

b) Area II: Upper hull side



c) Area III: Deck and superstructures exposed areas

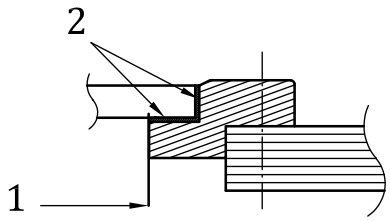
d) Area IV: Deck and superstructures protected areas

NOTE The sketches summarize the different location areas. Where unclear, the definitions in 3.5.2 prevail.

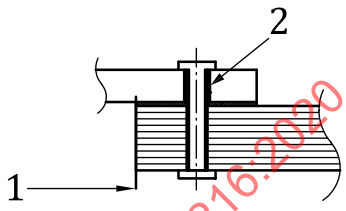
Figure A.1 — Sketches of areas I to IV

Annex B
(informative)

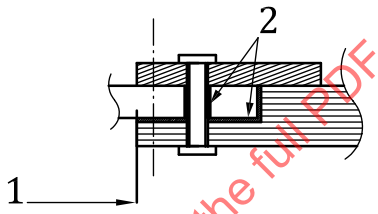
Types of plate edge connection



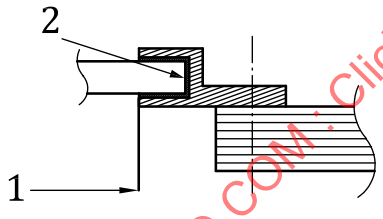
a) Glued on a frame



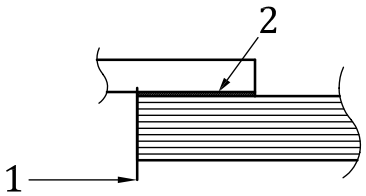
b) Bolted and jointing compound



c) Bolted with counter frame and jointing compound



d) Glued or elastomer in a frame



e) Glued

Key

1 unsupported dimensions

2 glued on side and/or face

Figure B.1 — Typical semi-fixed connections

a) Sliding in a frame or a rabbet

b) Supported connection

Key

1 unsupported dimensions

2 elastomer

Figure B.2 — Typical simply supported connections

a) Car windscreen joint

b) Flexible connection

Key

1 unsupported dimensions

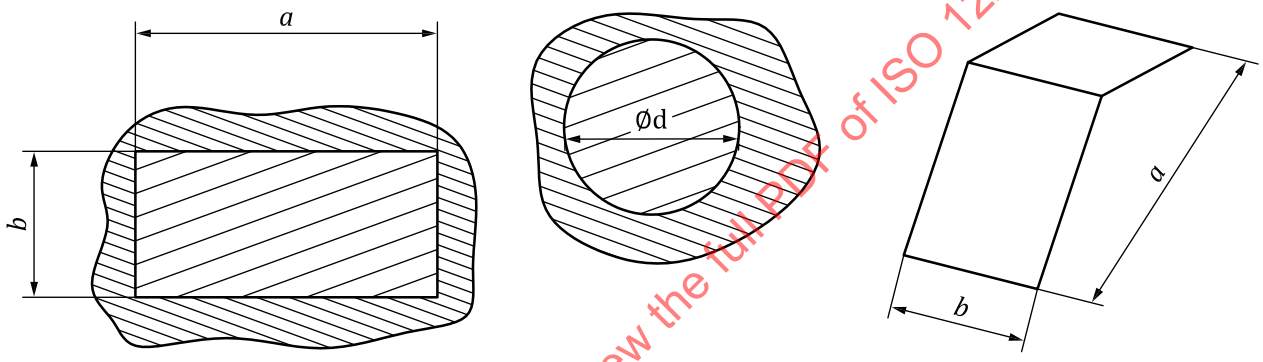
2 elastomer

Figure B.3 — Typical flexible connections

Annex C
(normative)

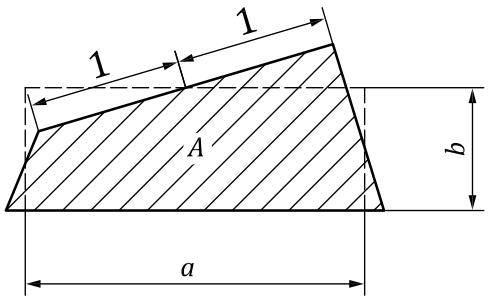
Unsupported plate dimensions

For a rectangular plate, the small and large unsupported dimensions are *b* and *a* respectively, as shown in Figure C.1 a). For a folded plate, the small and large unsupported dimensions are *b* and *a* respectively, as shown in Figure C.1 c). For a circular plate, the unsupported diameter is *d*, as shown in Figure C.1 b). For non-rectangular or non-circular plate shapes, use "equivalent" dimensions of a rectangular or circular plate having an area equal to that of the plate being considered (see Figure C.2).



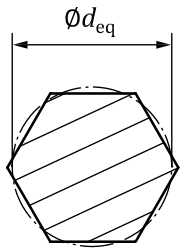
a) Rectangular plate **b) Circular plate** **c) Folded plate**

Figure C.1 — Unsupported plate dimensions



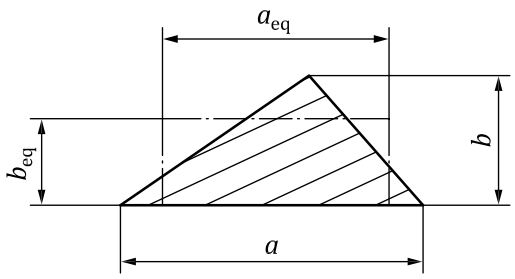
The rectangle has the same area — $a = A/b$

1) Quadrangle



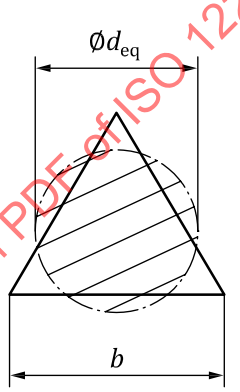
The circle has the same area

4) Polygon



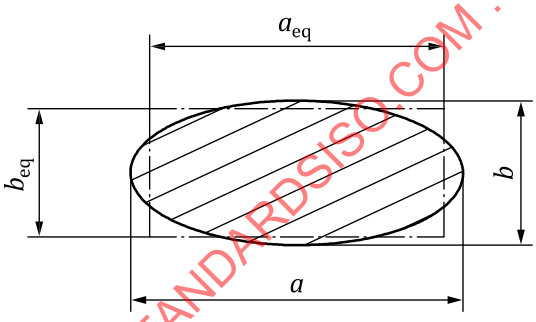
$a_{eq} = 2a/3 \quad b_{eq} = 3b/4$

2) Triangle



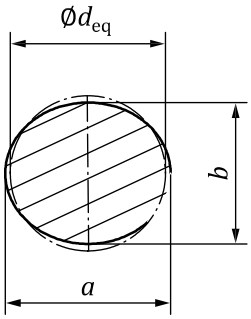
$d_{eq} = 3b/4$

5) Equilateral triangle



$a_{eq} = 0{,}87a \quad b_{eq} = 0{,}87b$

3) Flat ellipse



$d_{eq} = \sqrt{ab}$

6) Round ellipse

Key

1 cord length / 2

Figure C.2 — Equivalent dimensions

Annex D
(normative)

Test methods

D.1 General

The tests specified in this annex shall be performed on at least one sample of the appliance installed on a boat or a panel representative of the construction and according to the manufacturer's recommendations.

D.2 Pressure and watertightness tests

D.2.1 Pressure test for watertight appliances (watertightness degree 2)

The purpose of this sub-clause is to ensure that the deflection of the device while under pressure does not impair its watertightness. This shall be demonstrated by either test, calculation or combination of both.

This test shall be performed on each type of appliance before its installation on the craft.

A sample of each type of prefabricated appliance shall be tested in a suitable pressure jig for at least 3 min, with an outside water pressure of at least:

— 35 kPa for appliances to be placed in area I;

— 14 kPa for appliances to be placed in area II;

No leak, nor permanent deformation of any part of the appliance shall be observed during the test.

Appliances having already performed successfully in one test do not need to be subjected to the test at lower pressure values.

The above tests may not be suitable for:

— appliances constituted by a single plate fitted on the craft;

— companion-way hatches;

— sliding appliances.

For these appliances, the tests in D.2.2 are deemed an acceptable equivalence.

Either of the above test shall only be performed on a test sample made with the same process as the actual appliance, or on a sample taken from the production line. These tests shall be repeated if any significant change is made to the manufacturing process or materials. For curved appliances, this test may be performed on samples of flat appliances made with the same material and process.

If the appliance has ventilation devices which are either built-in, or fitted by the appliance manufacturer before commercialization, these ventilation devices may be made inoperative, e.g. sealed with jointing compound, to perform the tests defined in D.2.

After performance of these tests, the appliance, with its ventilation device made operative, shall have its watertightness degree required by Table 3 tested by the appliance manufacturer before commercialization, using the test methods defined in D.2.2.

If the ventilation device is equipped with a system intended to limit or shut the rate of air passage, it may be used when applying the latter test.

Appliances in area IIa which are unable to be tested due to design shall pass the watertightness test as described in D.2.2.1 with a 30 kg/m^2 mass applied evenly over the appliance.

These tests shall be repeated on the new test sample if any significant changes are made to the manufacturing process, the geometry or materials used.

NOTE Appliances considered unable to be tested as per D.2.1 are those which, due to size limitations, cannot undergo the simulated pressure test.

D.2.2 Watertightness tests

D.2.2.1 Determination of degrees of watertightness and weathertightness

The appliance shall be tested with a water jet positioned from the exterior of the appliance and angled from 90 ° down to 45 ° and up to 45° from the perpendicular of all the appliance faces.

The water jet shall be a dense thin water jet delivering a flow of at least 10 l/min, aiming everywhere in an area located within 0,05 m each side of the periphery of the appliance (see Figure D.1).

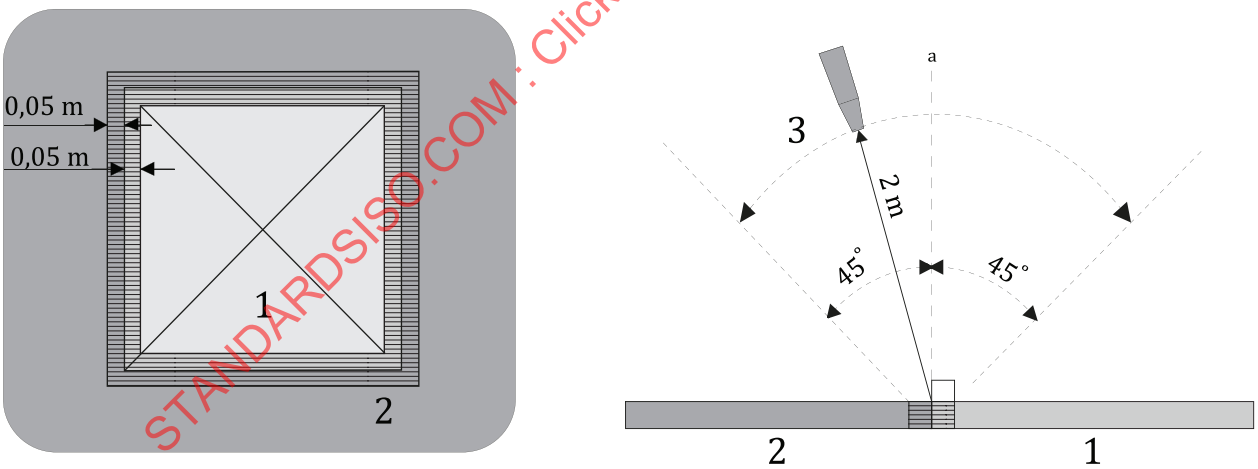
NOTE This jet is normally attained when connecting a garden hose with an adjustable nozzle to a tap, the static pressure of which, when the tap is closed, is 200 kPa.

Spraying shall continue for at least 3 min in a uniform manner in the testing zone described in Figure D.1. After this duration, the ingress of water shall not exceed:

— 0,05 l for appliances that are to be certified as watertight;

— 0,5 l for appliances that are to be certified as weathertight.

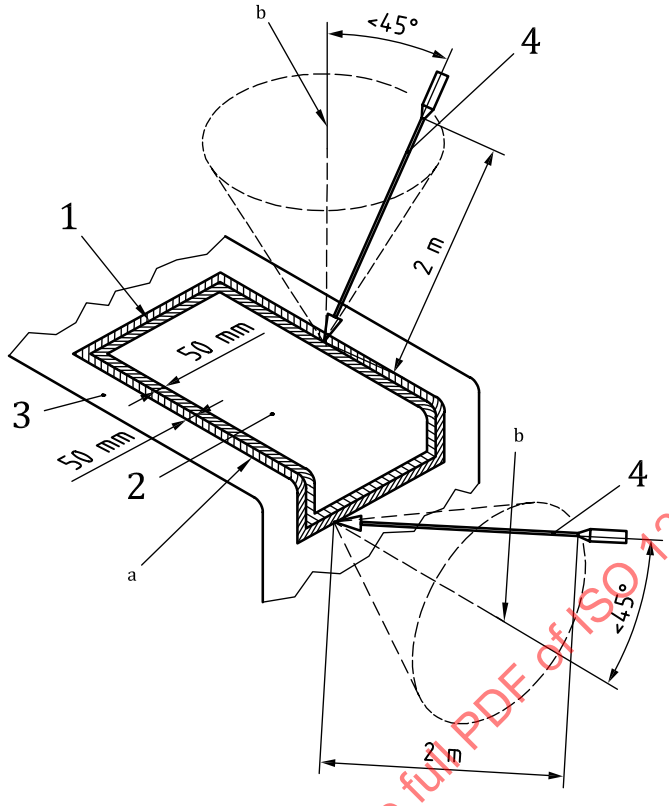
Dimensions in metres



Key

▨	testing zone
1	appliance
2	area
3	water jet
a	Perpendicular of the plate face.

Figure D.1 — Test arrangement



Key

1 periphery of the appliance
2 appliance
3 structure
4 nozzle
a Jet to be aimed around the periphery of the appliance within the hatched area.
b Perpendicular of the plate face.

Figure D.2 — Test arrangement

D.2.2.2 Test for "spraytight" level

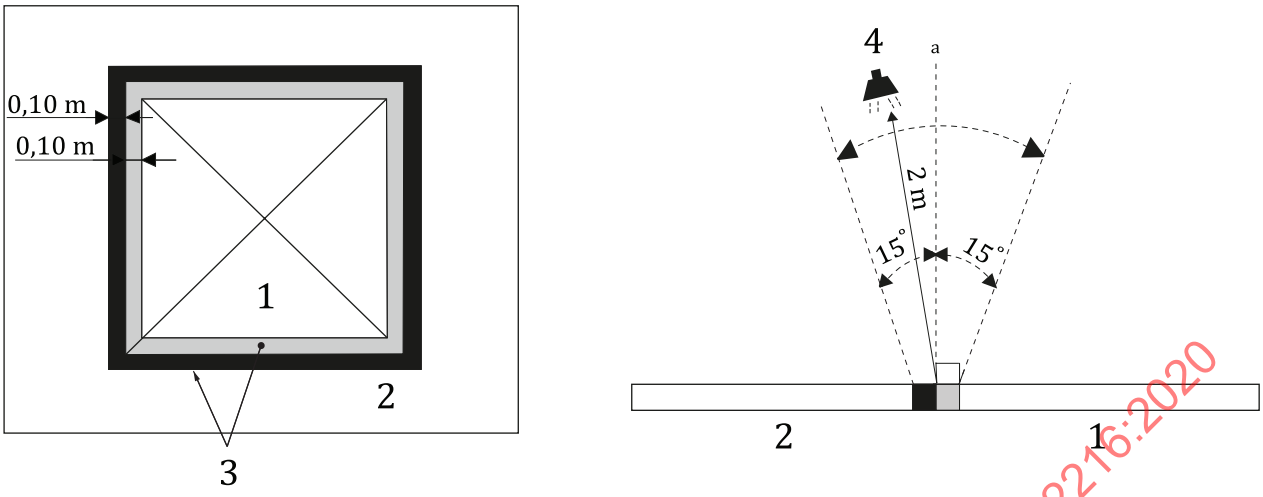
The appliance, as installed in the craft or in a similar arrangement, shall be tested with a spray nozzle aiming all around the periphery of the appliance with an angle from vertical to 15 ° from the vertical on both sides (see Figure D.3).

This spray nozzle shall be able to simulate heavy rain. No water pressure is specified.

The water spray shall be aimed everywhere in an area located within 0,10 m each side of the periphery of the appliance (see Figure D.3).

Spraying shall continue for at least 3 min. After this duration, the ingress of water shall not exceed 0,5 l.

Dimensions in metres



1 appliance
2 area
3 test area
4 water spray
a Perpendicular of the plate face.

Figure D.3 — Test for "spraytight" level

D.3 Test or calculation for mechanical links

This test or calculation is only required for appliances opening inwards, or when there is a doubt as to the resistance of some elements of the mechanical links (see Figure D.4).

Appliance opening outwards, such as folding doors made of several panels connected by hinges, can require this test as the hinges take a large part of the pressure force.

By means of testing or calculation, determine whether the hinges and locks (the system of mechanical devices) can support, without breaking or structural damage, the force F calculated by the following formula:

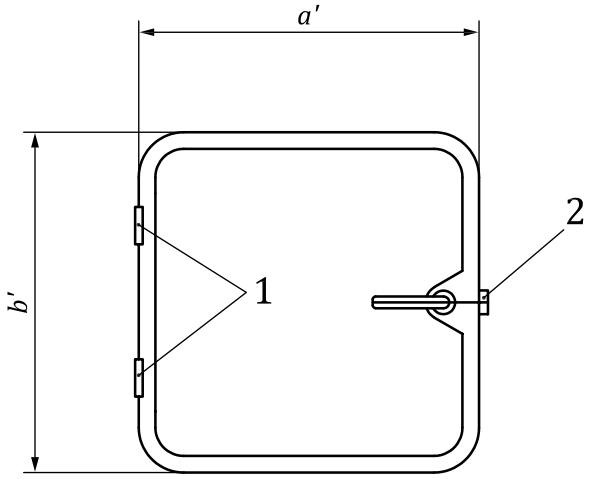
$$F = 2\, a'\, b'\, \Psi\, p \qquad \text{(D.1)}$$

where

a' and b' are the unsupported dimensions of the appliance, expressed in metres;

Ψ is the pressure reduction factor (non-dimensional) (7.2.5);

p is the basic design pressure, expressed in pascals (7.2.4).



Key

1	hinges
2	lock
a' and b'	unsupported dimensions of the appliance

Figure D.4 — Example of an appliance which opens inwards

D.4 Gluing tests

D.4.1 General

Appliance manufacturers should follow the glue manufacturers application recommendations.

Plates retained by a non-glued outside framing, such as those shown in Figure B.1 d), need not be subjected to the test.

D.4.2 Inside pressure test

D.4.2.1 Sample

The sample shall consist of a flat plate with an unsupported area between 0,02 m^2 and 0,16 m^2, glued with the same jointing procedure, plate and support material as used by the manufacturer of the appliance (see Figure D.5).

The test sample gluing area, A_{sg}, expressed in square metres, is determined from

$$A_{sg} = l_p \, (a_f + a_s) \qquad \text{(D.2)}$$

where

l_p is the plate perimeter, expressed in metres;

a_f is the face gluing dimension, expressed in metres;

a_s is the side gluing dimension, expressed in metres.

Figure D.5 shows the position of the dimensions a_f and a_s.

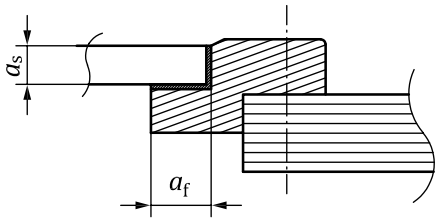


Figure D.5 — Glued joint dimensions sketch

D.4.2.2 Test procedure

Use a suitable jig to apply an inside water pressure corresponding to at least 625 × A_{sg}, expressed in kilopascals, tending to push the plate out of its support.

The test pressure shall be maintained for at least 3 min.

D.4.2.3 Test result

The test is passed if there is no apparent damage to the glue joint and no sign of leakage.

D.4.3 Separation test

D.4.3.1 Sample

Two test blades, 300 mm by 25 mm, shall be made from the same material and surface finish as the appliances bonding area and opposite structure to be glued together. The thicknesses of the blades shall be the same as those of the actual plate and structure.

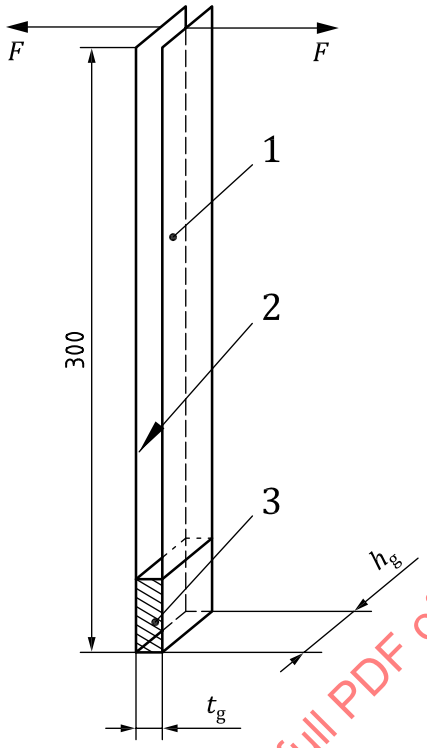
The test blades shall be glued together with the same glue joint dimensions (thickness, t_g, and height, h_g) and gluing procedure as used on the craft, as shown in Figure D.6.

D.4.3.2 Test procedure

Apply two equal and opposite forces, F, to the sample as shown in Figure D.6.

The forces are applied up to the point of breaking or permanent deformation of one element of the blades of the sample. The separation forces may be induced manually.

Dimensions in millimetres



Key

1 plate blade
2 structure blade
3 glued joint

Figure D.6 — Arrangement for the separation test

D.4.3.3 Test result

The test is passed if one of the three following conditions is met:

— one of the test blades yields or breaks before any visible yielding or breaking of the glue joint during the test;

— no permanent deformation nor break is shown inside the glue joint after the test;

— the glue joint disconnects from one of the test blades, and some part of the blade (delamination, wood breaking, etc.) has been torn away.

Annex E
(normative)

High-impact-resistance glass

A list of high-impact-resistance glasses is given in Table E.1 together with additional requirements that each type of glass shall meet.

Table E.1 — High-impact-resistance glass types

Glass type	Additional requirements
Laminated glass (faces AG, TG or CG)	Minimum thickness of faces 4 mm, minimum interlayer thickness 2,3 mm
Bullet-resistant glass	Class FB2 to FB7 tested in accordance with EN 1063:1999
Impact-resistant glass	Class 4 tested in accordance with EN 356:1999
NOTE AG = annealed glass, TG = thermally tempered glass, CG = chemically reinforced glass.	

Other glass types can be accepted if a 400 mm × 400 mm flat plate can bear an impact energy of 300 J yielded by the fall of a hard object (steel dart or ball) and have a degree of watertightness 1, 2 or 3, when tested in accordance with D.2.

Annex F
(informative)

Precalculated tables

F.1 Mechanical properties of typical materials

See Table F.1.

Table F.1 — Average mechanical properties of typical materials

Material	Abbreviation	Ultimate flexural strength σ_u MPa	Modulus of elasticity E MPa
Polymethylmethacrylate	PMMA	110	3 000
Polycarbonate	PC	90	2 400
Tempered glass	TG	200	72 600
Chemically reinforced glass	CG	300[a]	72 600
Annealed glass	AG	40	72 600
All mahogany plywood	AMPW	50	7 000
GRP all mat 30 % glass	GRP M 30	140	7 500
GRP mat/roving 35 % glass	GRP MR 35	175	10 000
Aluminium alloy 5083-H111	—	280	70 000
Mild steel	MS	400	200 000
Stainless steel AISI 316 L[b]	AISI 316L	510	200 000

To simplify the figures, σ_u and E are expressed in megapascals, but pascals shall be used in 7.2.1 and 7.2.2.

[a] This value corresponds to a case depth (chemical reinforcement depth) of 30 µm.

[b] Steel 20 according to ISO/TR 15510.

F.2 Use of pre-calculated tables

As a complementary instrument to solve the complexity of the formulae given in Clause 7, the attached pre-calculated Tables F.6 to F.29 for PMMA and TG displaying plate thickness can be used.

Table F.2 lists these tables, which give the plate thickness, calculated with the specifications of Table 8.

In order to help builders or designers to obtain a desired thickness by adjusting unsupported dimensions, the plate thicknesses are given with one digit after the commas, but after that shall be rounded as indicated.

Table F.2 — Design specifications

Calc spec	Material	Basic design pressure	Appliance location area	Boat type	Design category	Modulus of elasticity	Ultimate flexural strength	Factor of safety	Allow flexural strength	Table N° for plate type:	
						E	σu	Fs	σa	SF	SS
		kPa				Mpa	Mpa	*	Mpa		
P 70	PMMA	70	I	Any	Any	3 000	110	3,5	31,4	F.6	F.20
//	PMMA	70	IIb	Any	A	//	//	//	//	//	//
P50	PMMA	50	IIb	Any	B	//	//	//	//	F.7	F.21
P 28	PMMA	28	IIa	Any	Any	//	//	//	//	F.8	F.22
//	PMMA	28	IIb	Any	C, D	//	//	//	//	//	//
P 18	PMMA	18	III any	Sail	A, B	//	//	//	//	F.9	F.23
P 12	PMMA	12	III any	Sail	C, D	//	//	//	//	F.10	F.24
//	PMMA	12	III front	Motor	A	//	//	//	//	//	//
//	PMMA	12	IV	Sail	Any	//	//	//	//	//	//
P 9	PMMA	9	III front	Motor	B	//	//	//	//	F.11	F.25
//	PMMA	9	III side	Motor	A	//	//	//	//	//	//
P 6	PMMA	6	III side	Motor	B	//	//	//	//	F.12	F.26
//	PMMA	6	III any	Motor	C, D	//	//	//	//	//	//
//	PMMA	6	IV	Motor	Any	//	//	//	//	//	//
T 70	TG	70	I	Any	Any	72 600	200	4	50	F.13	F.27
//	TG	70	IIb	Any	A	//	//	//	//	//	//
T 50	TG	50	IIb	Any	B	//	//	//	//	F.14	F.28
T 28	TG	28	IIa any	Any	Any	//	//	//	//	F.15	F.29
//	TG	28	IIb any	Any	C, D	//	//	//	//	//	//
T 18	TG	18	III any	Sail	A, B	//	//	//	//	F.16	F.30
T 12	TG	12	III any	Sail	C, D	//	//	//	//	F.17	F.31
//	TG	12	III front	Motor	A	//	//	//	//	//	//
//	TG	12	IV	Sail	Any	//	//	//	//	//	//
T 9	TG	9	III front	Motor	B	//	//	//	//	F.18	F.32
//	TG	9	III side	Motor	A	//	//	//	//	//	//
T 6	TG	6	III side	Motor	B	//	//	//	//	F.19	F.33
//	TG	6	III any	Motor	C, D	//	//	//	//	//	//
//	TG	6	IV	Motor	Any	//	//	//	//	//	//

Table F.3 — Values of tmin for PMMA in area I

L_H, m	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
t_{min}, mm	6,2	6,3	6,4	6,5	6,6	6,7	6,8	6,9	7,0	7,1	7,2	7,3	7,4	7,5	7,6	7,7	7,8	7,9	8,0

Table F.4 — Values of tmin for TG in area I

L_H, m	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
t_{min}, mm	5,2	5,3	5,4	5,5	5,6	5,7	5,8	5,9	6,0	6,1	6,2	6,3	6,4	6,5	6,6	6,7	6,8	6,9	7,0

Table F.5 — Values of the pressure reduction factor, Ψ, for all design specifications

b or d mm	≤ 250	300	320	350	370	400	450	500	550	600	620	700	720	800	900	1 000	1 100	1 200
Ψ	1,0	0,98	0,97	0,96	0,95	0,94	0,92	0,90	0,88	0,86	0,85	0,82	0,81	0,78	0,74	0,70	0,66	0,62

Table F.6 — Thickness of SF plate for design specification P70 (PMMA and P=70 kPa)

Rectangular flat plate

a	Values of b (short dimension) mm																		
mm	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
250	In this area $t = t_{min}$ [a]		6,0	6,5	In area I, b shall not exceed 300 mm														
300			6,5	7,3	7,8														
350			6,8	7,9	8,6														
400			7,0	8,3	9,2														
450			7,2	8,6	9,7														
500			7,3	8,8	10,0														
550			7,4	9,0	10,3														
600			7,4	9,1	10,5														
650			7,4	9,2	10,6														
700			7,5	9,2	10,8														
750			7,5	9,3	10,9														
800			7,5	9,3	10,9														
900			7,5	9,3	11,0														
1 000			7,5	9,4	11,1														
1 100			7,5	9,4	11,1														
1 200			7,5	9,4	11,2														
1 300			7,5	9,4	11,2														
1 400			7,5	9,4	11,2														
1 500			7,5	9,4	11,2														
1 600			7,5	9,4	11,2														
1 800			7,5	9,4	11,2														
2 000			7,5	9,4	11,2														

Circular flat plate

Values of d mm																		
100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
$t = t_{min}$ [a]			6,2	7,4	In area I, b shall not exceed 300 mm													

Note 1 Rounding is to the closest mm, for example 5,4 rounds to 5 and 5,6 to 6.

Note 2 See 6.3.1 for appliances fitted in area I.

[a] See 7.2.8, Table 9.

Table F.7 — Thickness of SF plate for design specification P28 (PMMA and P=28 kPa)

Rectangular flat plate

a	Values of b (short dimension) mm																		
mm	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
250	In this																		
300	area $t = t_{min}$ = 6 mm			6,4	6,8														
350				6,9	7,5	7,9													
400			6,1	7,3	8,0	8,6	8,9												
450			6,3	7,5	8,4	9,1	9,6	9,9											
500			6,4	7,7	8,7	9,6	10,2	10,6	10,9										
550			6,4	7,8	9,0	9,9	10,7	11,2	11,6	11,9									
600			6,5	7,9	9,2	10,2	11,1	11,7	12,3	12,6	12,9								
650			6,5	8,0	9,3	10,4	11,4	12,2	12,8	13,2	13,6	13,8							
700			6,5	8,0	9,4	10,6	11,6	12,5	13,2	13,8	14,2	14,5	14,7						
750			6,5	8,1	9,5	10,7	11,8	12,8	13,6	14,2	14,8	15,2	15,4	15,6					
800			6,5	8,1	9,5	10,8	12,0	13,0	13,9	14,6	15,2	15,7	16,1	16,3	16,5				
900			6,6	8,1	9,6	11,0	12,2	13,4	14,4	15,3	16,0	16,6	17,1	17,5	17,8	18,2			
1 000			6,6	8,2	9,7	11,1	12,4	13,6	14,7	15,7	16,6	17,3	18,0	18,5	18,9	19,5	19,8		
1 100			6,6	8,2	9,7	11,2	12,5	13,8	15,0	16,1	17,0	17,9	18,6	19,3	19,8	20,6	21,0	21,2	
1 200			6,6	8,2	9,7	11,2	12,6	13,9	15,2	16,3	17,4	18,3	19,2	19,9	20,5	21,5	22,2	22,5	22,6
1 300			6,6	8,2	9,8	11,2	12,7	14,0	15,3	16,5	17,6	18,6	19,6	20,4	21,1	22,3	23,1	23,6	23,8
1 400			6,6	8,2	9,8	11,3	12,7	14,1	15,4	16,7	17,8	18,9	19,9	20,8	21,6	22,9	23,9	24,6	24,9
1 500			6,6	8,2	9,8	11,3	12,7	14,1	15,5	16,8	18,0	19,1	20,1	21,1	22,0	23,4	24,6	25,4	25,9
1 600			6,6	8,2	9,8	11,3	12,8	14,2	15,5	16,8	18,1	19,2	20,3	21,3	22,3	23,9	25,1	26,1	26,7
1 800			6,6	8,2	9,8	11,3	12,8	14,2	15,6	17,0	18,2	19,5	20,6	21,7	22,7	24,5	26,0	27,2	28,1
2 000			6,6	8,2	9,8	11,3	12,8	14,3	15,7	17,0	18,4	19,6	20,8	22,0	23,0	25,0	26,6	28,0	29,1

Circular flat plate

	Values of d mm																		
	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
	$t = t_{min}$ = 6 mm				6,4	7,5	8,5	9,4	10,4	11,3	12,2	13,1	14,0	14,9	15,7	17,3	18,8	20,2	21,5

Note Rounding is to the closest mm, for example 5,4 rounds to 5 and 5,6 to 6.

Table F.8 — Thickness of SF plate for design specification P 28 (PMMA and P=28 kPa)

	Rectangular flat plate																		
a	Values of b (short dimension) mm																		
mm	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
250																			
300	In this																		
350	area					6,2													
400	$t = t_{min}$ = 6 mm				6,4	6,8	7,0												
450					6,7	7,2	7,6	7,9											
500				6,1	6,9	7,6	8,1	8,4	8,7										
550				6,2	7,1	7,9	8,5	8,9	9,2	9,4									
600				6,3	7,2	8,1	8,8	9,3	9,7	10,0	10,2								
650				6,3	7,3	8,2	9,0	9,6	10,1	10,5	10,8	11,0							
700				6,4	7,4	8,4	9,2	9,9	10,5	10,9	11,3	11,5	11,7						
750				6,4	7,5	8,5	9,4	10,1	10,8	11,3	11,7	12,0	12,2	12,4					
800				6,4	7,5	8,6	9,5	10,3	11,0	11,6	12,1	12,4	12,7	12,9	13,1				
900				6,4	7,6	8,7	9,7	10,6	11,4	12,1	12,7	13,2	13,6	13,9	14,1	14,4			
1 000				6,5	7,7	8,8	9,8	10,8	11,7	12,5	13,1	13,7	14,2	14,7	15,0	15,4	15,7		
1 100				6,5	7,7	8,8	9,9	10,9	11,9	12,7	13,5	14,2	14,8	15,3	15,7	16,3	16,7	16,8	
1 200				6,5	7,7	8,9	10,0	11,0	12,0	12,9	13,7	14,5	15,2	15,8	16,3	17,0	17,6	17,8	17,9
1 300				6,5	7,7	8,9	10,0	11,1	12,1	13,1	13,9	14,8	15,5	16,1	16,7	17,6	18,3	18,7	18,9
1 400				6,5	7,7	8,9	10,1	11,2	12,2	13,2	14,1	15,0	15,7	16,4	17,1	18,1	18,9	19,5	19,8
1 500				6,5	7,7	8,9	10,1	11,2	12,3	13,3	14,2	15,1	15,9	16,7	17,4	18,6	19,5	20,1	20,5
1 600				6,5	7,7	8,9	10,1	11,2	12,3	13,3	14,3	15,2	16,1	16,9	17,6	18,9	19,9	20,7	21,2
1 800				6,5	7,7	8,9	10,1	11,3	12,4	13,4	14,5	15,4	16,3	17,2	18,0	19,4	20,6	21,6	22,3
2 000				6,5	7,7	8,9	10,1	11,3	12,4	13,5	14,5	15,5	16,5	17,4	18,2	19,8	21,1	22,2	23,1

	Circular flat plate																		
	Values of d mm																		
	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
	$t = t_{min}$ = 6 mm						6,7	7,5	8,2	9,0	9,7	10,4	11,1	11,8	12,4	13,7	14,9	16,0	17,1

Note Rounding is to the closest mm, for example 5,4 rounds to 5 and 5,6 to 6.

Table F.9 — Thickness of SF plate for design specification P 18 (PMMA and P=18 kPa)

	Rectangular flat plate																		
a	Values of *b* (short dimension) mm																		
mm	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
250	In this area																		
300	$t = t_{min}$ = 5 mm																		
350					5,0	5,2													
400					5,3	5,7	5,9												
450				5,0	5,6	6,1	6,4	6,6											
500				5,1	5,8	6,4	6,8	7,1	7,3										
550				5,2	6,0	6,6	7,1	7,5	7,7	7,9									
600				5,2	6,1	6,8	7,3	7,8	8,1	8,4	8,6								
650				5,3	6,2	6,9	7,5	8,1	8,5	8,8	9,0	9,2							
700				5,3	6,2	7,0	7,7	8,3	8,8	9,1	9,4	9,6	9,8						
750				5,4	6,3	7,1	7,8	8,5	9,0	9,5	9,8	10,1	10,3	10,4					
800				5,4	6,3	7,2	8,0	8,6	9,2	9,7	10,1	10,4	10,7	10,9	11,0				
900				5,4	6,4	7,3	8,1	8,9	9,5	10,1	10,6	11,0	11,4	11,6	11,8	12,1			
1 000				5,4	6,4	7,4	8,2	9,0	9,8	10,4	11,0	11,5	11,9	12,3	12,6	13,0	13,1		
1 100				5,4	6,4	7,4	8,3	9,2	9,9	10,7	11,3	11,9	12,4	12,8	13,2	13,7	14,0	14,1	
1 200				5,4	6,5	7,4	8,4	9,2	10,1	10,8	11,5	12,2	12,7	13,2	13,6	14,3	14,7	15,0	15,0
1 300				5,4	6,5	7,5	8,4	9,3	10,2	11,0	11,7	12,4	13,0	13,5	14,0	14,8	15,4	15,7	15,9
1 400				5,4	6,5	7,5	8,4	9,4	10,2	11,1	11,8	12,5	13,2	13,8	14,3	15,2	15,9	16,3	16,6
1 500				5,4	6,5	7,5	8,5	9,4	10,3	11,1	11,9	12,7	13,4	14,0	14,6	15,6	16,3	16,9	17,2
1 600				5,4	6,5	7,5	8,5	9,4	10,3	11,2	12,0	12,8	13,5	14,2	14,8	15,9	16,7	17,3	17,8
1 800				5,4	6,5	7,5	8,5	9,4	10,4	11,3	12,1	12,9	13,7	14,4	15,1	16,3	17,3	18,1	18,7
2 000				5,4	6,5	7,5	8,5	9,5	10,4	11,3	12,2	13,0	13,8	14,6	15,3	16,6	17,7	18,6	19,4
	Circular flat plate																		
	Values of *d* mm																		
	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
	$t = t_{min}$ = 5 mm					5,0	5,6	6,3	6,9	7,5	8,1	8,7	9,3	9,9	10,5	11,5	12,5	13,5	14,3
Note	Rounding is to the closest mm, for example 5,4 rounds to 5 and 5,6 to 6.																		

Table F.10 — Thickness of SF plate for design specification P 12 (PMMA and P=12 kPa)

Rectangular flat plate

a	Values of *b* (short dimension) mm																	
mm	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
250	In this area																		
300	$t = t_{min}$ = 4 or 5 mm																		
350																			
400							5,0												
450						5,2	5,4	5,6											
500						5,4	5,8	6,0	6,2										
550					5,1	5,6	6,0	6,4	6,6	6,7									
600					5,2	5,8	6,2	6,6	6,9	7,1	7,3								
650					5,2	5,9	6,4	6,9	7,2	7,5	7,7	7,8							
700					5,3	6,0	6,6	7,1	7,5	7,8	8,0	8,2	8,3						
750					5,3	6,1	6,7	7,2	7,7	8,0	8,3	8,6	8,7	8,9					
800					5,4	6,1	6,8	7,4	7,9	8,3	8,6	8,9	9,1	9,2	9,4				
900					5,4	6,2	6,9	7,6	8,1	8,6	9,0	9,4	9,7	9,9	10,1	10,3			
1 000					5,5	6,3	7,0	7,7	8,3	8,9	9,4	9,8	10,2	10,5	10,7	11,0	11,2		
1 100					5,5	6,3	7,1	7,8	8,5	9,1	9,6	10,1	10,5	10,9	11,2	11,7	11,9	12,0	
1 200					5,5	6,3	7,1	7,9	8,6	9,2	9,8	10,3	10,8	11,2	11,6	12,2	12,5	12,8	12,8
1 300					5,5	6,3	7,2	7,9	8,6	9,3	10,0	10,5	11,1	11,5	11,9	12,6	13,1	13,4	13,5
1 400					5,5	6,4	7,2	8,0	8,7	9,4	10,1	10,7	11,2	11,7	12,2	13,0	13,5	13,9	14,1
1 500					5,5	6,4	7,2	8,0	8,8	9,5	10,2	10,8	11,4	11,9	12,4	13,3	13,9	14,4	14,7
1 600					5,5	6,4	7,2	8,0	8,8	9,5	10,2	10,9	11,5	12,1	12,6	13,5	14,2	14,8	15,1
1 800					5,5	6,4	7,2	8,0	8,8	9,6	10,3	11,0	11,7	12,3	12,8	13,9	14,7	15,4	15,9
2 000					5,5	6,4	7,2	8,1	8,9	9,6	10,4	11,1	11,8	12,4	13,0	14,1	15,1	15,9	16,5

Circular flat plate

	Values of *d* mm																	
	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
	$t = t_{min}$ = 4 or 5 mm							5,3	5,9	6,4	6,9	7,5	8,0	8,4	8,9	9,8	10,7	11,5	12,2

Note Rounding is to the closest mm, for example 5,4 rounds to 5 and 5,6 to 6.

Table F.11 — Thickness of SF plate for design specification P 9 (PMMA and P=9 kPa)

Rectangular flat plate

a	Values of *b* (short dimension) mm																		
mm	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
250	In this area $t = t_{min}$ = 5 mm																		
300																			
350																			
400																			
450								5,0											
500							5,1	5,4	5,5										
550						5,0	5,4	5,7	5,9	6,0									
600						5,1	5,6	5,9	6,2	6,4	6,5								
650						5,2	5,7	6,1	6,4	6,7	6,9	7,0							
700						5,3	5,9	6,3	6,7	7,0	7,2	7,3	7,5						
750						5,4	6,0	6,4	6,9	7,2	7,4	7,7	7,8	7,9					
800						5,5	6,0	6,6	7,0	7,4	7,7	7,9	8,1	8,3	8,4				
900						5,5	6,2	6,7	7,3	7,7	8,1	8,4	8,7	8,9	9,0	9,2			
1 000						5,6	6,3	6,9	7,4	7,9	8,4	8,8	9,1	9,3	9,6	9,9	10,0		
1 100						5,6	6,3	7,0	7,6	8,1	8,6	9,0	9,4	9,7	10,0	10,4	10,7	10,8	
1 200						5,7	6,4	7,0	7,7	8,2	8,8	9,2	9,7	10,0	10,4	10,9	11,2	11,4	11,5
1 300						5,7	6,4	7,1	7,7	8,3	8,9	9,4	9,9	10,3	10,7	11,3	11,7	11,9	12,1
1 400						5,7	6,4	7,1	7,8	8,4	9,0	9,5	10,0	10,5	10,9	11,6	12,1	12,4	12,6
1 500						5,7	6,4	7,1	7,8	8,5	9,1	9,6	10,2	10,6	11,1	11,8	12,4	12,8	13,1
1 600						5,7	6,4	7,2	7,8	8,5	9,1	9,7	10,3	10,8	11,2	12,1	12,7	13,2	13,5
1 800						5,7	6,5	7,2	7,9	8,6	9,2	9,8	10,4	11,0	11,5	12,4	13,2	13,8	14,2
2 000						5,7	6,5	7,2	7,9	8,6	9,3	9,9	10,5	11,1	11,6	12,6	13,5	14,2	14,7

Circular flat plate

	Values of *d* mm																		
	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
	$t = t_{min}$ = 5 mm								5,3	5,7	6,2	6,7	7,1	7,5	8,0	8,8	9,6	10,3	10,9

Note Rounding is to the closest mm, for example 5,4 rounds to 5 and 5,6 to 6.

Table F.12 — Thickness of SF plate for design specification P 6 (PMMA and P=6 kPa)

Rectangular flat plate

a	Values of *b* (short dimension) mm																		
mm	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
250	In this area																		
300	$t = t_{min}$ = 4 or 5 mm[a]																		
350																			
400																			
450																			
500																			
550									5,0	5,1									
600								5,1	5,3	5,4	5,6								
650								5,2	5,5	5,7	5,9	6,0							
700							5,0	5,4	5,7	5,9	6,1	6,3	6,4						
750							5,1	5,5	5,8	6,1	6,4	6,5	6,7	6,8					
800							5,2	5,6	6,0	6,3	6,6	6,8	6,9	7,0	7,1				
900							5,3	5,8	6,2	6,6	6,9	7,2	7,4	7,6	7,7	7,9			
1 000							5,3	5,9	6,3	6,8	7,1	7,5	7,7	8,0	8,2	8,4	8,5		
1 100							5,4	5,9	6,4	6,9	7,3	7,7	8,0	8,3	8,5	8,9	9,1	9,2	
1 200							5,4	6,0	6,5	7,0	7,5	7,9	8,2	8,6	8,8	9,3	9,6	9,7	9,8
1 300							5,4	6,0	6,6	7,1	7,6	8,0	8,4	8,8	9,1	9,6	10,0	10,2	10,3
1 400							5,5	6,1	6,6	7,2	7,7	8,1	8,6	8,9	9,3	9,9	10,3	10,6	10,8
1 500							5,5	6,1	6,7	7,2	7,7	8,2	8,7	9,1	9,5	10,1	10,6	11,0	11,2
1 600							5,5	6,1	6,7	7,3	7,8	8,3	8,8	9,2	9,6	10,3	10,8	11,3	11,6
1 800							5,5	6,1	6,7	7,3	7,9	8,4	8,9	9,4	9,8	10,6	11,2	11,7	12,1
2 000							5,5	6,1	6,7	7,3	7,9	8,4	9,0	9,5	9,9	10,8	11,5	12,1	12,6

Circular flat plate

	Values of *d* mm																		
	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
	$t = t_{min}$ = 4 or 5 mm[a]							4,1	4,5	4,9	5,3	5,7	6,1	6,4	6,8	7,5	8,2	8,8	9,3

Note Rounding is to the closest mm, for example 5,4 rounds to 5 and 5,6 to 6.

Table F.13 — Thickness of SF plate for design specification T 70 (TG and P=70 kPa)

Rectangular flat plate

a	Values of b (short dimension) mm																		
mm	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
250	$t = t_{min}$[a]			5,1															
300			5,1	5,8	6,1														
350			5,4	6,2	6,7	7,0													
400			5,6	6,6	7,3	7,7	7,9												
450			5,7	6,8	7,6	8,2	8,6	8,8											
500			5,7	7,0	7,9	8,7	9,2	9,5	9,7										
550			5,8	7,1	8,1	9,0	9,6	10,1	10,4	10,5									
600			5,8	7,2	8,3	9,2	10,0	10,5	10,9	11,2	11,4								
650			5,9	7,2	8,4	9,4	10,3	10,9	11,4	11,8	12,0								
700			5,9	7,3	8,5	9,6	10,5	11,3	11,9	12,3	12,6								
750			5,9	7,3	8,5	9,7	10,7	11,5	12,2	12,7	13,1	In area I, b shall not exceed 600 mm[1]							
800			5,9	7,3	8,6	9,8	10,8	11,7	12,5	13,1	13,6								
900			5,9	7,3	8,7	9,9	11,0	12,0	12,9	13,7	14,3								
1 000			5,9	7,4	8,7	10,0	11,2	12,2	13,2	14,1	14,8								
1 100			5,9	7,4	8,7	10,0	11,2	12,4	13,4	14,4	15,2								
1 200			5,9	7,4	8,8	10,1	11,3	12,5	13,6	14,6	15,5								
1 300			5,9	7,4	8,8	10,1	11,4	12,6	13,7	14,7	15,7								
1 400			5,9	7,4	8,8	10,1	11,4	12,6	13,8	14,9	15,9								
1 500			5,9	7,4	8,8	10,1	11,4	12,7	13,8	15,0	16,0								
1 600			5,9	7,4	8,8	10,1	11,4	12,7	13,9	15,0	16,1								
1 800			5,9	7,4	8,8	10,2	11,5	12,7	14,0	15,1	16,2								
2 000			5,9	7,4	8,8	10,2	11,5	12,8	14,0	15,2	16,3								

Circular flat plate

	Values of d mm																		
	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	1 100	1 200
	$t = t_{min}$[a]				5,5	6,4	7,2	8,1	8,8	9,6	10,4	In area I, b shall not exceed 600 mm[b]							

Note 1 Rounding is to the closest mm, for example 5,4 rounds to 5 and 5,6 to 6.

Note 2 See 6.3.1 for applications fitted in area I.

[a] See 7.2.8, Table 9.

[b] Without alternative qualification; see 7.1, Table 5.

Table F.14 — Thickness of SF plate for design specification T 50 (TG and P=50 kPa)

Rectangular flat plate

a	Values of b (short dimension) mm																		
mm	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
250																			
300					5,1														
350	In this area			5,3	5,7	5,9													
400	$t = t_{min}$ = 4 mm			5,6	6,1	6,5	6,7												
450				5,8	6,5	7,0	7,3	7,5											
500				5,9	6,7	7,3	7,7	8,0	8,2										
550				6,0	6,9	7,6	8,1	8,5	8,8	8,9									
600				6,0	7,0	7,8	8,4	8,9	9,3	9,5	9,6								
650				6,1	7,1	8,0	8,7	9,2	9,7	10,0	10,2	10,3							
700			5,0	6,1	7,2	8,1	8,9	9,5	10,0	10,4	10,7	10,8	10,9						
750			5,0	6,2	7,2	8,2	9,0	9,7	10,3	10,8	11,1	11,3	11,5	11,6					
800			5,0	6,2	7,3	8,3	9,1	9,9	10,6	11,1	11,5	11,8	12,0	12,1	12,2				
900			5,0	6,2	7,3	8,4	9,3	10,2	10,9	11,6	12,1	12,5	12,9	13,1	13,2	13,4			
1 000			5,0	6,2	7,4	8,4	9,4	10,3	11,2	11,9	12,5	13,1	13,5	13,9	14,1	14,4	14,5		
1 100			5,0	6,2	7,4	8,5	9,5	10,5	11,4	12,2	12,9	13,5	14,0	14,5	14,8	15,3	15,5	15,4	
1 200			5,0	6,2	7,4	8,5	9,6	10,6	11,5	12,3	13,1	13,8	14,4	14,9	15,4	16,0	16,3	16,4	16,3
1 300			5,0	6,3	7,4	8,5	9,6	10,6	11,6	12,5	13,3	14,0	14,7	15,3	15,8	16,6	17,1	17,3	17,3
1 400			5,0	6,3	7,4	8,6	9,6	10,7	11,6	12,6	13,4	14,2	14,9	15,6	16,2	17,1	17,7	18,0	18,1
1 500			5,0	6,3	7,4	8,6	9,7	10,7	11,7	12,6	13,5	14,4	15,1	15,8	16,4	17,5	18,2	18,7	18,9
1 600			5,0	6,3	7,4	8,6	9,7	10,7	11,7	12,7	13,6	14,5	15,3	16,0	16,6	17,8	18,6	19,2	19,5
1 800			5,0	6,3	7,4	8,6	9,7	10,8	11,8	12,8	13,7	14,6	15,5	16,2	17,0	18,2	19,3	20,0	20,6
2 000			5,0	6,3	7,4	8,6	9,7	10,8	11,8	12,8	13,8	14,7	15,6	16,4	17,2	18,6	19,7	20,6	21,3

Circular flat plate

	Values of d mm																		
	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
	$t = t_{min}$ = 4 mm				4,7	5,4	6,1	6,8	7,5	8,1	8,8	9,4	10,0	10,6	11,1	12,2	13,2	14,1	14,9

Note Rounding is to the closest mm, for example 5,4 rounds to 5 and 5,6 to 6.

Table F.15 — Thickness of SF plate for design specification T 28 (TG and P=28 kPa)

Rectangular flat plate

a	Values of *b* (short dimension) mm																		
mm	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
250																			
300					3,8														
350	In this area				4,3	4,4													
400	$t = t_{min}$ = 4 mm			4,2	4,6	4,9	5,0												
450				4,3	4,8	5,2	5,4	5,6											
500				4,4	5,0	5,5	5,8	6,0	6,1										
550				4,5	5,1	5,7	6,1	6,4	6,6	6,7									
600				4,5	5,2	5,8	6,3	6,7	6,9	7,1	7,2								
650				4,6	5,3	6,0	6,5	6,9	7,2	7,5	7,6	7,7							
700				4,6	5,4	6,0	6,6	7,1	7,5	7,8	8,0	8,1	8,2						
750				4,6	5,4	6,1	6,7	7,3	7,7	8,1	8,3	8,5	8,6	8,7					
800				4,6	5,4	6,2	6,8	7,4	7,9	8,3	8,6	8,8	9,0	9,1	9,1				
900				4,6	5,5	6,3	7,0	7,6	8,2	8,7	9,1	9,4	9,6	9,8	9,9	10,0			
1 000				4,7	5,5	6,3	7,1	7,7	8,4	8,9	9,4	9,8	10,1	10,4	10,6	10,8	10,8		
1 100				4,7	5,5	6,3	7,1	7,8	8,5	9,1	9,6	10,1	10,5	10,8	11,1	11,4	11,6	11,6	
1 200				4,7	5,5	6,4	7,2	7,9	8,6	9,2	9,8	10,3	10,8	11,2	11,5	12,0	12,2	12,3	12,2
1 300				4,7	5,6	6,4	7,2	7,9	8,7	9,3	9,9	10,5	11,0	11,4	11,8	12,4	12,8	12,9	12,9
1 400				4,7	5,6	6,4	7,2	8,0	8,7	9,4	10,0	10,6	11,2	11,7	12,1	12,8	13,2	13,5	13,6
1 500				4,7	5,6	6,4	7,2	8,0	8,8	9,5	10,1	10,7	11,3	11,8	12,3	13,1	13,6	14,0	14,1
1 600				4,7	5,6	6,4	7,2	8,0	8,8	9,5	10,2	10,8	11,4	12,0	12,5	13,3	13,9	14,4	14,6
1 800				4,7	5,6	6,4	7,3	8,1	8,8	9,6	10,3	10,9	11,6	12,2	12,7	13,7	14,4	15,0	15,4
2 000				4,7	5,6	6,4	7,3	8,1	8,9	9,6	10,3	11,0	11,7	12,3	12,9	13,9	14,8	15,4	16,0

Circular flat plate

	Values of *d* mm																		
	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
	$t = t_{min}$ = 4 mm					4,0	4,6	5,1	5,6	6,1	6,6	7,0	7,5	7,9	8,3	9,1	9,9	10,5	11,2

Note Rounding is to the closest mm, for example 5,4 rounds to 5 and 5,6 to 6.

Table F.16 — Thickness of SF plate for design specification T 18 (TG and P=18 kPa)

Rectangular flat plate

a	Values of *b* (short dimension) mm																		
mm	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
250																			
300																			
350	In this area																		
400	$t = t_{min}$ = 4 mm						4,0												
450						4,2	4,4	4,5											
500					4,0	4,4	4,6	4,8	4,9										
550					4,1	4,6	4,9	5,1	5,3	5,3									
600					4,2	4,7	5,1	5,3	5,6	5,7	5,8								
650					4,3	4,8	5,2	5,5	5,8	6,0	6,1	6,2							
700					4,3	4,8	5,3	5,7	6,0	6,2	6,4	6,5	6,6						
750					4,3	4,9	5,4	5,8	6,2	6,5	6,7	6,8	6,9	7,0					
800					4,4	5,0	5,5	5,9	6,3	6,7	6,9	7,1	7,2	7,3	7,3				
900					4,4	5,0	5,6	6,1	6,6	6,9	7,3	7,5	7,7	7,9	7,9	8,0			
1 000					4,4	5,1	5,7	6,2	6,7	7,1	7,5	7,8	8,1	8,3	8,5	8,6	8,7		
1 100					4,4	5,1	5,7	6,3	6,8	7,3	7,7	8,1	8,4	8,7	8,9	9,2	9,3	9,3	
1 200					4,4	5,1	5,7	6,3	6,9	7,4	7,9	8,3	8,6	9,0	9,2	9,6	9,8	9,8	9,8
1 300					4,5	5,1	5,8	6,4	6,9	7,5	8,0	8,4	8,8	9,2	9,5	10,0	10,2	10,4	10,4
1 400					4,5	5,1	5,8	6,4	7,0	7,5	8,1	8,5	9,0	9,3	9,7	10,2	10,6	10,8	10,9
1 500					4,5	5,1	5,8	6,4	7,0	7,6	8,1	8,6	9,1	9,5	9,9	10,5	10,9	11,2	11,3
1 600					4,5	5,1	5,8	6,4	7,0	7,6	8,2	8,7	9,2	9,6	10,0	10,7	11,2	11,5	11,7
1 800					4,5	5,1	5,8	6,5	7,1	7,7	8,2	8,8	9,3	9,7	10,2	10,9	11,6	12,0	12,3
2 000					4,5	5,1	5,8	6,5	7,1	7,7	8,3	8,8	9,4	9,8	10,3	11,1	11,8	12,4	12,8

Circular flat plate

	Values of *d* mm																		
	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
	$t = t_{min}$ = 4 mm							4,1	4,5	4,9	5,3	5,6	6,0	6,3	6,7	7,3	7,9	8,5	8,9

Note Rounding is to the closest mm, for example 5,4 rounds to 5 and 5,6 to 6.

Table F.17 — Thickness of SF plate for design specification T 12 (TG and P=12 kPa)

Rectangular flat plate

a	Values of *b* (short dimension) mm																		
mm	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
250	In this area $t = t_{min}$ = 3 or 4 mm[a]																		
300																			
350																			
400																			
450																			
500									4,0										
550							4,0	4,2	4,3	4,4									
600							4,1	4,4	4,5	4,6	4,7								
650							4,3	4,5	4,7	4,9	5,0	5,0							
700						4,0	4,3	4,7	4,9	5,1	5,2	5,3	5,4						
750						4,0	4,4	4,8	5,1	5,3	5,4	5,6	5,6	5,7					
800						4,0	4,5	4,9	5,2	5,4	5,6	5,8	5,9	5,9	6,0				
900						4,1	4,6	5,0	5,4	5,7	5,9	6,1	6,3	6,4	6,5	6,6			
1 000						4,1	4,6	5,1	5,5	5,8	6,1	6,4	6,6	6,8	6,9	7,1	7,1		
1 100						4,2	4,7	5,1	5,6	6,0	6,3	6,6	6,9	7,1	7,3	7,5	7,6	7,6	
1 200						4,2	4,7	5,2	5,6	6,0	6,4	6,8	7,1	7,3	7,5	7,8	8,0	8,0	8,0
1 300						4,2	4,7	5,2	5,7	6,1	6,5	6,9	7,2	7,5	7,7	8,1	8,4	8,5	8,5
1 400						4,2	4,7	5,2	5,7	6,2	6,6	7,0	7,3	7,6	7,9	8,4	8,7	8,8	8,9
1 500						4,2	4,7	5,2	5,7	6,2	6,6	7,0	7,4	7,7	8,0	8,6	8,9	9,1	9,2
1 600						4,2	4,7	5,3	5,7	6,2	6,7	7,1	7,5	7,8	8,2	8,7	9,1	9,4	9,6
1 800						4,2	4,7	5,3	5,8	6,3	6,7	7,2	7,6	8,0	8,3	8,9	9,4	9,8	10,1
2 000						4,2	4,8	5,3	5,8	6,3	6,8	7,2	7,6	8,0	8,4	9,1	9,7	10,1	10,4

Circular flat plate

	Values of *d* mm																		
	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
	$t = t_{min}$ = 3 or 4 mm[a]									4,0	4,3	4,6	4,9	5,2	5,5	6,0	6,5	6,9	7,3

Note Rounding is to the closest mm, for example 5,4 rounds to 5 and 5,6 to 6.

[a] See 7.2.8, Table 9.

Table F.18 — Thickness of SF plate for design specification T 9 (TG and P=9 kPa)

Rectangular flat plate

a	Values of b (short dimension) mm																		
mm	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
250	In this area $t = t_{min} = 4$ mm																		
300																			
350																			
400																			
450																			
500																			
550																			
600										4,0	4,1								
650									4,1	4,2	4,3	4,4							
700								4,0	4,3	4,4	4,5	4,6	4,6						
750								4,1	4,4	4,6	4,7	4,8	4,9	4,9					
800								4,2	4,5	4,7	4,9	5,0	5,1	5,1	5,2				
900							4,0	4,3	4,6	4,9	5,1	5,3	5,5	5,6	5,6	5,7			
1 000							4,0	4,4	4,7	5,1	5,3	5,6	5,7	5,9	6,0	6,1	6,1		
1 100							4,0	4,4	4,8	5,2	5,5	5,7	6,0	6,1	6,3	6,5	6,6	6,6	
1 200							4,1	4,5	4,9	5,2	5,6	5,9	6,1	6,3	6,5	6,8	6,9	7,0	6,9
1 300							4,1	4,5	4,9	5,3	5,6	6,0	6,2	6,5	6,7	7,0	7,2	7,3	7,3
1 400							4,1	4,5	4,9	5,3	5,7	6,0	6,3	6,6	6,9	7,2	7,5	7,6	7,7
1 500							4,1	4,5	5,0	5,4	5,7	6,1	6,4	6,7	7,0	7,4	7,7	7,9	8,0
1 600							4,1	4,6	5,0	5,4	5,8	6,1	6,5	6,8	7,1	7,5	7,9	8,1	8,3
1 800							4,1	4,6	5,0	5,4	5,8	6,2	6,6	6,9	7,2	7,7	8,2	8,5	8,7
2 000							4,1	4,6	5,0	5,4	5,9	6,2	6,6	7,0	7,3	7,9	8,4	8,8	9,0

Circular flat plate

	Values of d mm																		
	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
	$t = t_{min} = 4$ mm											4,0	4,2	4,5	4,7	5,2	5,6	6,0	6,3

Note Rounding is to the closest mm, for example 5,4 rounds to 5 and 5,6 to 6.

Table F.19 — Thickness of SF plate for design specification T 6 (TG and P=6 kPa)

Rectangular flat plate

a	Values of b (short dimension) mm																		
mm	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
250																			
300																			
350			In this area																
400			$t = t_{min}$ = 3 or 4 mm[a]																
450																			
500																			
550																			
600																			
650																			
700																			
750													4,0	4,0					
800											4,0	4,1	4,2	4,2	4,2				
900										4,0	4,2	4,3	4,5	4,5	4,6	4,6			
1 000										4,1	4,3	4,5	4,7	4,8	4,9	5,0	5,0		
1 100										4,2	4,5	4,7	4,9	5,0	5,1	5,3	5,4	5,3	
1 200									4,0	4,3	4,5	4,8	5,0	5,2	5,3	5,5	5,7	5,7	5,7
1 300									4,0	4,3	4,6	4,9	5,1	5,3	5,5	5,7	5,9	6,0	6,0
1 400									4,0	4,4	4,6	4,9	5,2	5,4	5,6	5,9	6,1	6,2	6,3
1 500									4,1	4,4	4,7	5,0	5,2	5,5	5,7	6,0	6,3	6,5	6,5
1 600									4,1	4,4	4,7	5,0	5,3	5,5	5,8	6,2	6,5	6,7	6,8
1 800									4,1	4,4	4,8	5,1	5,4	5,6	5,9	6,3	6,7	6,9	7,1
2 000									4,1	4,4	4,8	5,1	5,4	5,7	6,0	6,4	6,8	7,1	7,4

Circular flat plate

	Values of d mm																		
	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	900	1 000	1 100	1 200
	$t = t_{min}$ = 3 or 4 mm[a]															4,2	4,6	4,9	5,2

Note Rounding is to the closest mm, for example 5,4 rounds to 5 and 5,6 to 6

[a] See 7.2.8, Table 9.