INTERNATIONAL STANDARD

ISO 11336-1

Second edition
2023-11

Large yachts — Strength, weathertightness and watertightness of glazed openings —

Part 1: Design criteria, materials, framing and testing of independent glazed openings

Grands yachts — Résistance, étanchéité aux intempéries et étanchéité à l'eau des ouvertures vitrées —

Partie 1: Critères de conception, matériaux, encadrement et essais des ouvertures vitrées indépendantes

Reference number
ISO 11336-1:2023(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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

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

This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 12, *Ships and marine technology — Large yachts*.

This second edition cancels and replaces the first edition (ISO 11336-1:2012), which has been technically revised.

The main changes are as follows:

— the Scope has been expanded to include length, number of passengers and glazing materials;

— the design pressure model has been parameterized and adapted to cover larger yachts;

— more advanced scantling calculation methods have been added;

— a new approach on robustness of superstructure and hull glazing has been added;

— Annex H has been replaced with information on the main changes since the first edition;

— Annexes I and J have been added.

A list of all parts in the ISO 11336 series can be found on the ISO website.

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

Large yachts — Strength, weathertightness and watertightness of glazed openings —

Part 1: Design criteria, materials, framing and testing of independent glazed openings

1 Scope

This document specifies technical requirements for independent glazed openings on large yachts, taking into account navigation conditions, the location of the opening and the materials, framing and testing.

Large yachts are yachts with length of the hull, L_H, higher or equal to 24 m, used for sport or pleasure and commercial operations.

This document is suitable for the design of glazed openings on all large yachts. However, where yachts carry more than 12 passengers, the additional requirements (set by the appropriate marine administration) for fire integrity and damage stability are outside the scope of this standard.

The opening and the associated closing appliances considered in this document are only those that are above the deepest waterline (dsw) and are critical for the ship integrity related to weathertightness and watertightness, i.e. those that can lead to ingress of water in the hull in case of rupture, dislocation or loss of the pane or its mounting. This document is related and limited to independent glazed openings in which the pane is supported solely by simple linear support at the edges. Glazing in which the rotation at the edges is constrained more than it would be by a single bond line is not covered by this document. This document, excluding annexes, is limited to glazing of any shape, which is simply supported along all edges. Horizontally positioned glazing is excluded.

NOTE This document is based on the experience of ship window and glass manufacturers, shipbuilders and authorities who apply to ships the regulations of SOLAS, as amended[7], and of the International Convention of Load Lines, as amended[6], noting the provisions by the SOLAS Protocol of 1988, Article 8, as agreed by the appropriate Marine Administration, and on the experience gained with application of the Large Commercial Yacht Code and the REG Yacht Code[16].

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 178, *Plastics — Determination of flexural properties*

ISO 1751, *Ships and marine technology — Ships' side scuttles*

ISO 3903, *Ships and marine technology — Ships' ordinary rectangular windows*

ISO 5797, *Ships and marine technology — Windows and side scuttles for fire-resistant constructions*

ISO 6345, *Shipbuilding and marine structures — Windows and side scuttles — Vocabulary*

ISO 12543-1, *Glass in building — Laminated glass and laminated safety glass — Part 1: Vocabulary and description of component parts*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 21005, *Ships and marine technology — Thermally toughened safety glass panes for windows and side scuttles*

ISO 6721-10, *Plastics — Determination of dynamic mechanical properties — Part 10: Complex shear viscosity using a parallel-plate oscillatory rheometer*

EN 1288-3, *Glass in building — Determination of the bending strength of glass — Part 3: Test with specimen supported at two points (four point bending)*

EN 1990:2008, *Eurocode — Basis of structural design*

EN 12150-1:2000, *Glass in building — Thermally toughened soda lime silicate safety glass — Part 1: Definition and description*

EN 12337-1, *Glass in building — Chemically toughened soda lime silicate safety glass — Part 1: Definition and description*

EN 13195-1, *Aluminium and aluminium alloys. Specifications for wrought and cast products for marine applications (shipbuilding, marine and offshore)*

EN 16612, *Glass in building. Determination of the lateral load resistance of glass panes by calculation*

ISO 29584, *Glass in building — Pendulum impact testing and classification of safety glass*

ISO 11336-2, *Large yachts — Strength, weathertightness and watertightness of glazed openings — Part 2: Glazed opening integrated into adjacent structure (elastically bonded to bulkhead or shell) design criteria, structural support, installation and testing*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6345 and the following apply.

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

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

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

3.1
glazed opening
opening in the hull, *superstructure* (3.26) or deckhouse of a ship structure to be fitted with a transparent or translucent material

3.2
independent glazed opening
glazed opening (3.1) where the mechanical behaviour of the *pane* (3.5) can be considered independent from adjacent structure because the pane is mounted in such a way that it is isolated from deformations of the supporting structure, and the only loads on the pane are lateral pressure and effect of gravity and inertia

3.3
not independent glazed opening
glazed opening (3.1) where the mechanical behaviour of the *pane* (3.5) cannot be considered independent from adjacent structure, e.g. pane bonded directly into a seat in such a way that it is carrying in-plane loads or is subjected to out-of-plane deformations of the supporting structure

3.4
appliance
device made of a *pane* (3.5) and a fixing system, used to cover an opening in the hull, *superstructure* (3.26) or deckhouse

3.5
pane
sheet of material fixed within or to a supporting structure

3.6
glazing
transparent or translucent *pane* (3.5)

3.7
unsupported dimensions
clear dimensions between the supports bearing the *pane* (3.5)

Note 1 to entry: See Annex A.

3.8
deadlight
secondary watertight closure fitted to a *glazed opening* (3.1) and which is fitted on the inside of the vessel

3.9
storm shutter
portable protective closure fitted to a *glazed opening* (3.1) and which is fitted on the outside (weatherside) of the vessel

3.10
flag administration
government of the state whose flag the yacht flies

3.11
certifying authority
flag administration (3.10) or organization to whom the flag administration delegates certifying authority

3.12
service
description of the service limitations for which a yacht is assessed to be suitable

3.13
commercial operation
operation for commercial use, involving yachts carrying no cargo and generally not more than 12 passengers or not needing to comply with passenger ship requirements

3.14
pleasure operation
operation involving private yachts not engaged in trade

3.15
operational range
range for which a yacht is assessed to be suitable

Note 1 to entry: For unrestricted range yachts, the operational range is the extended distance from safe haven where conditions experienced can exceed wind force 8 (Beaufort scale), excluding extreme conditions.

Note 2 to entry: For intermediate range yachts, the operational range is a distance of not more than 200 nautical miles from a safe haven.

Note 3 to entry: For a short range yacht, the operational range is a distance of not more than 60 nautical miles from a safe haven.

3.16
freeboard deck
uppermost complete deck exposed to weather and sea, which has permanent means of closing all openings in the weather part thereof, and below which all openings in the sides of the ship are fitted with permanent means of watertight closing

Note 1 to entry: At the decision of the owner and subject to the approval of the administration, a lower deck can be designated as a freeboard deck, provided it is a complete and permanent deck continuous in a fore and aft direction at least between the machinery space and peak bulkheads and continuous athwart-ships.

3.17
standard superstructure height
h_{std}
height parameter expressed in meters (m) which is used for the calculation of the design load

Note 1 to entry: For vessels up to 75 m load line length, the height is taken as 1,8 m.

Note 2 to entry: For vessels over 125 m load line length, the height is taken as 2,3 m.

Note 3 to entry: For vessels of intermediate lengths, the height is obtained by linear interpolation.

3.18
load line length
L
96 % of the total length on a waterline at 85 % of the least moulded depth measured from the top of the keel, or as the length from the fore side of the stem to the axis of the rudder stock on that waterline, if that is greater

Note 1 to entry: For ships without a rudder stock, the length, L, is taken as 96 % of the waterline at 85 % of the least moulded depth.

3.19
limits in glazed openings
maximum size of *glazed openings* (3.1) below a line 0,05 times ship length, measured from dsw (deepest seagoing waterline) or less than $L/4$ aft of a line drawn at the intersection of the 0,05 L and the stem, and below a line drawn at 0,05 L +h_{std}, not exceeding 0,85 m^2

Note 1 to entry: See Figure 1.

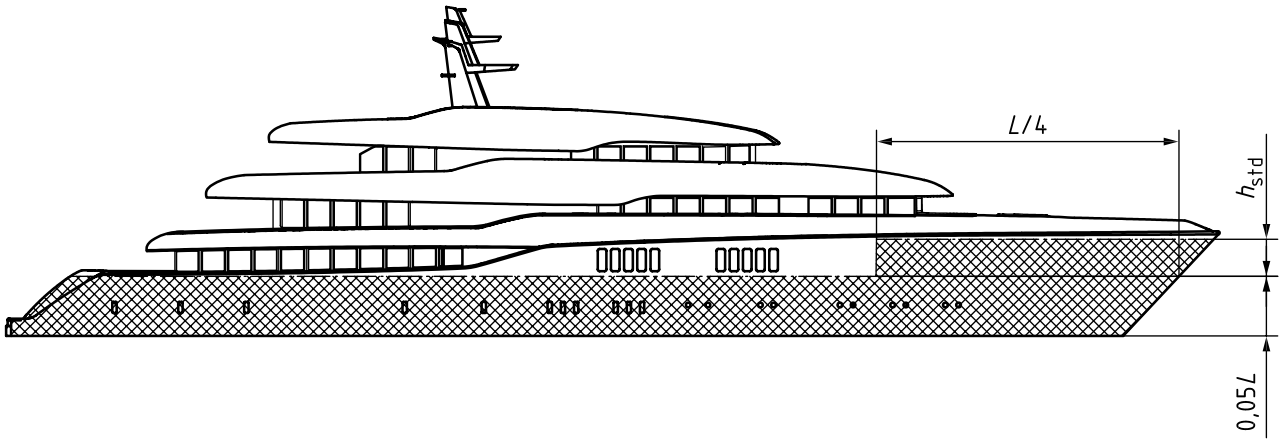

Figure 1 — Area in which glazed openings are limited to 0,85 m^2

3.20
large yacht
yachts in use for sport or *pleasure* (3.14) and *commercial operations* (3.13), with a length of the hull, $L_{H,}$ higher or equal to 24 m

Note 1 to entry: The length of the hull, L_H is measured according to ISO 8666.

3.21
weathertightness
capacity to prevent that, in any sea conditions, water will penetrate into the ship

Note 1 to entry: This definition has been adapted from the term "weathertight" taken from the International Convention on Load Lines (ICLL), Annex I, Regulation 3 (12). This is interpreted generally as indicating that weathertightness is required from the exterior only, as opposed to *watertightness* (3.22), indicating the ability to withstand from both inside and outside.

3.22
watertightness
capacity of an appliance to prevent the passage of water through the structure in any direction under a head of water for which the surrounding structure is designed

3.23
strength
capacity of a structure to maintain full structural integrity under the action of loads

3.24
design loads
external hydrostatic loads according to which glazed openings strength is assessed

3.25
hull
part of the yacht within the envelope of the side shell and decks taken into account for the assignment of freeboard and for stability evaluation

3.26
superstructure
decked structure on the freeboard deck, extending from side to side of the yacht or with side plating not being inboard of the shell plating more than 4 % of the yacht breadth

[SOURCE: ICLL 1966, Regulation 3, 10 (a), modified — "ship" replaced with "yacht".]

3.27
deckhouse
structure enclosing a space that is normally accessible and used for accommodation or service and that does not qualify as a *superstructure* (3.26) and that can be positioned on the freeboard deck, and/or the tiers above

3.28
wheelhouse
control position occupied by the officer of the watch

3.29
glass ply
plate made of an inorganic non-crystalline solid exhibiting a glass transition behaviour

3.30
thermally toughened safety glass
glass where strength increase is obtained by a thermal treatment resulting in the introduction of permanent compression stress on both sides of its cross section

3.31
chemically toughened glass
glass where strength increase is obtained by chemical treatment resulting in the introduction of permanent compression stress on both sides of its cross section

3.32
monolithic pane
monolithic construction
glazing (3.6) consisting of one ply of glass

3.33
laminated glass
multi-layer *pane* (3.5) made of glass plies, plastic plies or other *glazing* (3.6) materials, which are kept together by suitable plastic adhesive films or curable resins

3.34
safety glass
monolithic thermally toughened glass, fully tempered, or *laminated glass* (3.33) built from thermally or chemically toughened *panes* (3.5)

3.35
insulating glazing unit
IGU
window *panes* (3.5) (usually glass) separated by a gas-filled space to reduce heat transfer across a part of the vessel envelope

Note 1 to entry: Insulating *glazing* (3.6) units consist of two or more window panes.

Note 2 to entry: A window with insulating glass is commonly known as double glazing or a double-paned window, triple glazing or a triple-paned window, or quadruple glazing or a quadruple-paned window, depending on how many panes of glass are used in its construction.

3.36
depth of compression layer
glass case depth
l_{CD}
depth measured from the surface to the inner cross section point where compression stress is zero, when a *glass ply* (3.29) is toughened by the introduction of permanent compression stress on both sides of its cross section

3.37
glass surface compression
S_C
value of compression stress taken at the surface, when a *glass ply* (3.29) is toughened by the introduction of permanent compression stress on both sides of its cross section

3.38
plastic ply
rigid plate, made of a polymeric material, where “rigid” means that the plastic material has a modulus of elasticity in flexure or, if not applicable, then in tension, greater than 700 MPa

3.39
interlayer
laminating adhesive material that holds together the plies of a laminated *glazing* (3.6)

Note 1 to entry: It can be a thermoplastic adhesive film or a curable resin.

3.40
characteristic failure strength
σ_C
ultimate flexural strength of *glass pane* (3.41) or *plastic material* (3.42)

3.41
glass pane
ultimate flexural strength at rupture of glass measured, on a statistical basis, in a flexural testing arrangement with a defined method of data reduction taking in account statistical dispersion

3.42
plastic material
ultimate flexural strength at rupture or flexural strength at yield, whichever is lower

Note 1 to entry: The choice between the value at rupture or at yield depends on the mechanical characteristics of the plastic material; as a general indication brittle plastic material breaks before yielding without apparent plastic deformation while non-brittle plastic material yields before breaking.

3.43
main structural section
monolithic or laminated *pane* (3.5) construction that meets strength requirements

Note 1 to entry: to entry The strength requirements are specified in 5.2.

3.44
additional functional plies
additional glass or plastic plies or *panes* (3.5) not included in the frame that can be coupled to the main structural section, do not have structural functionalities and do not affect structural functionality of the main structural section

Note 1 to entry: The flexural modulus/flexural strength, E/σ_c, is substantially less (50 %) than that of the main structural section.

3.45
deepest seagoing waterline
dsw
assigned waterline for commercial yachts or the deepest seagoing waterline for private yachts

3.46
superstructure type A
superstructure (3.26) not considered buoyant in the stability calculations

3.47
superstructure type B
superstructure (3.26) considered buoyant in the stability calculations

3.48
aft perpendicular
position of the aft end of the *deepest seagoing waterline* (3.45)

4 Symbols and abbreviated terms

p_D	design pressure following from the location on board the ship
p_{DE}	design pressure for engineering the glass panels
p_{D0}	base design pressure
p_{ULS}	ultimate limit state pressure - $p_{ULS} = \gamma \cdot p_{DE}$.
a	factor relating to location and vessel length
b	factor based on longitudinal location
f	factor based on vessel length

c	factor based on width of superstructure or deckhouse
h	height of centre of pane from dsw
h_0	height above the waterline where design pressure equals p_{D0}
h_{std}	standard superstructure height
I_s	shear collaboration factor in laminated glazing
k_s	service factor
L_H	length of the hull
L	load line length
L_p	length between perpendiculars on summer load waterline
x	distance of centre of pane or storm shutter from aft perpendicular
t_O	basic pane thickness
a_P	unsupported long side of a rectangular pane or “equivalent long side” of a pane
b_P	unsupported short side of a rectangular pane or “equivalent short side” of a pane
β_S	pane aspect-ratio coefficient for stress
β_D	pane aspect-ratio coefficient for deflection
σ_A	allowable design flexural stress of the material
d	diameter of a circular glazed opening
σ_C	characteristic breaking strength of a material or laminate
γ	design factor
t_a	actual pane thickness
t_{min}	minimum pane thickness
$t_{p1}, t_{p2}, \ldots, t_{pn}$	ply thicknesses of a laminated pane
$t_{eq,j}$	equivalent thickness of each ply of the laminate
t_{eq}	equivalent thickness of laminated construction
t_{Lam}	physical thickness of a laminate
δ_{max}	maximum pane deflection
M	pane stiffness
l_{CD}	depth of compression layer
S_C	glass surface compression
N	number of test specimens
n	number of independent plies