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ISO 12215-2

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Small craft — Hull construction and scantlings —

Part 2: Materials: Core materials for sandwich construction, embedded materials

Petits navires — Construction de coques et échantillons —

Partie 2: Matériaux: Matériaux d'âme pour les constructions de type sandwich, matériaux enrobés

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Foreword

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 12215 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12215-2 was prepared by Technical Committee ISO/TC 188, *Small craft*.

ISO 12215 consists of the following parts, under the general title *Small craft — Hull construction and scantlings*:

— *Part 1: Materials: Thermosetting resins, glass-fibre reinforcement, reference laminate*

— *Part 2: Materials: Core materials for sandwich construction, embedded materials*

— *Part 3: Materials: Steel, aluminium alloys, wood, other materials*

— *Part 4: Workshop and manufacturing*

— *Part 5: Design pressures, design stresses, scantling determination*

— *Part 6: Structural arrangements and details*

Annex A forms a normative part of this part of ISO 12215.

Small craft — Hull construction and scantlings —

Part 2: Materials: Core materials for sandwich construction, embedded materials

1 Scope

This part of ISO 12215 specifies requirements for core materials for structural use and materials that are embedded in sandwich construction. It is applicable to small craft with a hull length (L_H) according to ISO 8666 of up to 24 m.

NOTE The underlying reason for preparing this part of ISO 12215 is that sandwich structures of small craft require careful selection of core materials from a multitude of choices, and that the manufacturing has to follow certain procedures to achieve the intended long-term durability under the expected loads and environmental conditions.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 12215. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 12215 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 844:2001, *Rigid cellular plastics — Determination of compression properties*

ISO 845:1988, *Cellular plastics and rubbers — Determination of apparent (bulk) density*

ISO 1922:2001, *Rigid cellular plastics — Determination of shear strength*

ISO 1926:—[1)] , *Cellular plastics — Determination of tensile properties of rigid materials*

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

ISO 3131:1975, *Wood — Determination of density for physical and mechanical tests*

ISO 3132:1975, *Wood — Testing in compression perpendicular to grain*

ISO 3345:1975, *Wood — Determination of ultimate tensile stress parallel to grain*

ISO 3346:1975, *Wood — Determination of ultimate tensile stress perpendicular to grain*

ISO 4589 (all parts):1996, *Plastics — Determination of burning behaviour by oxygen index*

1) To be published. (Revision of ISO 1926:1979)

ISO 8666:—[2)], *Small craft — Principal data*

ISO 12215-5:—[2)], *Small craft — Hull construction and scantlings — Part 5: Design pressures, design stresses, scantling determination*

ASTM C365:2000, *Standard test method for flatwise compressive properties of sandwich cores*

3 Sandwich core properties

3.1 Sandwich structure

A sandwich structure is a composite composed of lightweight core material to which two relatively thin, dense and high-strength functional laminate skins are adhered.

3.2 Structural requirements

3.2.1 Core materials for sandwich construction of small craft shall only be used if the following requirements of the final structure are fulfilled.

The material shall have adequate properties to enable the sandwich structure to fulfil the requirements specified in ISO 12215-5 for a normal service life in a marine environment, with special regard to

— in-plane forces, acting in the direction of the sandwich layers, e.g. tension, compression, shear;

— out-of-plane forces, acting transversely to the sandwich layers, e.g. compression, tension, shear.

3.2.2 Fatigue performance must be considered when choosing the core material.

3.3 Material requirements, general

3.3.1 Core materials shall have stable mechanical properties consistent with the designated use of the craft.

3.3.2 Resin applied to the core material or its protective sheathing/coating shall be compatible with its surface.

3.3.3 Core materials forming part of a sandwich structure shall

— limit the penetration of water beyond the area of a possible fracture of the skin laminate. This requirement does not apply for core materials that consist of a three-dimensional open structure bonded to both skin laminates, e.g. honeycomb or three-dimensional fabrics.

— not emit significant amounts of gases that would compromise the bond or laminate.

3.3.4 Core materials shall be capable of transferring the shear loads specified in ISO 12215-5.

3.3.5 The core material manufacturer shall provide written information on the mechanical and other properties relevant for the intended application, as well as their variation in temperature and thermal limit of application where relevant.

The boat manufacturer shall keep the information with the technical documentation established for the boat.

[2)] To be published

3.4 Material requirements, specific

3.4.1 Expanded foam

3.4.1.1 Expanded foam plastics used in structural sandwich cores of the craft shall be of a closed cell type.

3.4.1.2 The mechanical properties of PVC (polyvinyl chloride) and SAN (styrene acrylic nitrile) type foam cores, intended to be used in the structural laminate of hull, deck and first tier of the superstructure, if this is open to the atmosphere, shall at least comply with the properties of Grade I of Table A.1.

3.4.1.3 The mechanical properties as delivered, intended to be used for other parts of the craft, shall comply at least with the properties of Grade II of Table A.1.

3.4.2 End-grain balsa

3.4.2.1 Where used as a structural core material of the hull, end-grain balsa wood shall fulfil the following requirements.

It shall

— be free from living organisms that may cause degradation when enclosed in a boat structure sandwich panel;

— have been homogenized;

— have an average moisture content of 12 % to 15 %, when packaged.

3.4.2.2 The mechanical properties as delivered shall comply with Grade I or II of Table A.2.

3.4.3 Other core materials

Core materials other than those given in 3.4.1 and 3.4.2 may be used if they fulfil the requirements of 3.2 and 3.3.

4 Embedded materials — inserts

4.1 General requirements

The properties of expansion and contraction of inserts shall be similar to those of the laminate so that the overall performance of the structural laminate is not impaired.

4.2 Specific requirements

Embedded plywood shall be of the waterproof and boilproof type and shall have a surface that bonds easily to the resin or adhesive.

Solid timber inserts between layers of laminate are not recommended.

5 Owner's manual

Where the core material used for structural parts may limit the mechanical properties of the sandwich panel due to extreme thermal conditions, the temperature range for safe operation of the craft shall be stated in the owner's manual.

Annex A
(normative)

Mechanical properties of some sandwich core materials

Tables A.1 and A.2 give the minimum mechanical properties of foam core materials and end-grain balsa wood, respectively.

Table A.1 — Minimum mechanical properties of foam core materials as delivered

Property	Standard, test method	Required minimum values		Unit
		Grade I	Grade II	
Tensile strength	ISO 1926[a, b]	1,0	0,6	N/mm^2
Tensile modulus	ISO 1926	60	30	N/mm^2
Compressive strength	ISO 844[a, b, c], 23 °C	1,0	0,6	N/mm^2
Compressive modulus	ISO 844[a, b, c], 23 °C	40	40	N/mm^2
Compressive strength	ISO 844[a, b, c], 45 °C	60 % of value obtained at 23 °C	50 % of value obtained at 23 °C	N/mm^2
Compressive modulus	ISO 844[a, b, c], 45 °C	70 % of value obtained at 23 °C	50 % of value obtained at 23 °C	N/mm^2
Shear strength[d]	ISO 1922	0,6	0,4	N/mm^2
Shear modulus[d]	ISO 1922	18	9	N/mm^2
Shear elongation[e]	ISO 1922	Manufacturer's specified min. value	Manufacturer's specified min. value	
Water absorption	ISO 2896, 40 °C,1 week, in water	1,5 max.	1,5 max.	% (V/V)
Water resistance	Percentage retention of compressive and tensile strength after 4 weeks in water (ISO 2896) at 23 °C	75	70	%
Density	ISO 845	Manufacturer's specified min. value	Manufacturer's specified min. value	kg/m^3
Oxygen index	ISO 4589	Stated value	Stated value	

NOTE The minimum values shall be met by all specimens.

[a] Maximum speed of deformation, mm/min: 10 % of the measured initial thickness.

[b] Dimensions of specimen: 50 mm × 50 mm × product thickness in millimetres.

[c] Test to be carried out on samples with a layer of suitable resin to stabilize the core cell walls at the loaded surfaces.

[d] Core material to be tested with and without a longitudinal adhesive joint. Joint at mid-plane of specimen, parallel to steel supports and at an equal distance from supports.

[e] Elongation at break or at the point where the load has decreased to 80 % of its maximum value.

Table A.2 — Minimum mechanical properties of enf-grain balsa wood as delivered

Property	Standard, test method	Required minimum values		Unit
		Grade I	Grade II	
Density	ISO 3131, ISO 845	Manufacturer's specified min. value	Manufacturer's specified min. value	
Tensile strength:				
longitudinal	ISO 3345 [a, b]	16	9	N/mm^2
perpendicular	ISO 3346	0, 64	0,44	
Compressive strength:				
longitudinal	ASTM C-365 [a, b], 23 °C	10	5	N/mm^2
perpendicular	ISO 3132, 23 °C	0,6	0,35	
Compressive modulus:				
longitudinal	ASTM C-365, 23 °C	4 300	2 275	N/mm^2
perpendicular	ISO 3132 [a, b, c], 23 °C	73	35	
Shear strength [d]	ISO 1922	1,84	1,1	N/mm^2
Shear modulus [d]	ISO 1922	150	105	N/mm^2

NOTE 1 Moisture content of the specimens shall be between 12 % and 15 %.

NOTE 2 The minimum values shall be met by all specimens.

[a] Max. speed of deformation, mm/min: 10 % of the measured initial thickness.

[b] Dimensions of specimen: 50 mm × 50 mm × product thickness in millimetres.

[c] Core material to be tested with and without a longitudinal adhesive joint. Joint at mid-plane of specimen, parallel to steel supports and at an equal distance from supports.

[d] Test to be carried out on samples with a layer of suitable resin to stabilize the core cell walls at the loaded surfaces.

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