INTERNATIONAL STANDARD

ISO 12215-1

First edition
2000-09-01

Small craft — Hull construction and scantlings —

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

Petits navires — Construction de coques et échantillons —

Partie 1: Matériaux: Résines thermodurcissables, renforcement de fibres de verre, stratifié de référence

Reference number
ISO 12215-1:2000(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

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.

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.

International Standard ISO 12215-1 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*

The following will be the subjects of future parts of ISO 12215:

— *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*

Small craft — Hull construction and scantlings —

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

1 Scope

This part of ISO 12215 is applicable to thermosetting resins and glass-fibre reinforcement used in the construction of small craft with a length of the hull (L_H) of up to 24 m, in accordance with ISO 8666. This part of ISO 12215 specifies the minimum requirements for material properties of glass reinforcement and resin matrix and the reference laminate made thereof.

This part of ISO 12215 may be applicable to materials other than those specified, provided that the minimum requirements and properties of the reference laminate are met.

NOTE The underlying reason for preparing this International Standard is to harmonize existing standards and recommended practices for loads on the hull and the dimensioning of small craft because they differ too considerably and thus limit general worldwide acceptability of boats.

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 62:1999, *Plastics — Determination of water absorption*.

ISO 75-1:1993, *Plastics — Determination of temperature of deflection under load — Part 1: General test method*.

ISO 75-2:1993, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite*.

ISO 178:1993, *Plastics — Determination of flexural properties*.

ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*.

ISO 527-4, *Plastics — Determination of tensile properties — Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites*.

ISO 1675:1985, *Plastics — Liquid resins — Determination of density by the pyknometer method*.

ISO 1887:1995, *Textile glass — Determination of combustible-matter content*.

ISO 1889:1997, *Reinforcement yarns — Determination of linear density*.

ISO 2078:1993, *Textile glass — Yarns — Designation*.

ISO 2535:1997, *Plastics — Unsaturated polyester resins — Measurement of gel time at* 25 °C.

ISO 2555:1989, *Plastics — Resins in the liquid state or as emulsions or dispersions — Determination of apparent viscosity by the Brookfield Test method*.

ISO 2811-1:1997, *Paints and varnishes — Determination of density — Part 1: Pyknometer method*.

ISO 2884-1:1999, *Paints and varnishes — Determination of viscosity using rotary viscometers — Part 1: Cone-and-plate viscometer operated at a high rate of shear*.

ISO 3344:1997, *Reinforcement products — Determination of moisture content*.

ISO 3374:2000, *Reinforcement products — Mats and fabrics — Determination of mass per unit area*.

ISO 3521:1997, *Plastics — Unsaturated polyester and epoxy resins — Determination of overall volume shrinkage*.

ISO 4901:1985, *Reinforced plastics based on unsaturated polyester resins — Determination of residual styrene monomer content*.

ISO 8666:—[1)], *Small craft — Principal data*.

ISO 14130:1997, *Fibre-reinforced plastic composites — Determination of apparent interlaminar shear strength by short-beam method*.

EN 59:1977, *Glass reinforced plastics — Measurement of hardness by means of a Barcol-impressor*.

DIN 16945:1989, *Testing of resins, hardeners and accelerators, and catalysed resins*.

ASTM D 4255, *Testing in-plane shear properties of composite laminates*.

3 Terms and definitions

For the purposes of this part of ISO 12215, the following terms and definitions apply.

3.1
reinforcement
strong, inert material, usually fibres, strongly bonded into a resin to achieve enhanced strength, stiffness and impact resistance

NOTE Reinforcement fibres are commonly available in the following forms:

— chopped strand mat, formed of strands cut to a short length, randomly distributed, without intentional orientation, and held together by a binder;

— continuous mat, formed of strands, randomly distributed, without intentional orientation, and held together by a binder that is not soluble in styrene;

— roving, which is a collection of parallel strands (multistrand roving) or parallel filaments (multifilament roving) assembled without intentional twist;

— woven roving, which is a fabric woven from rovings;

— multidirectional roving, which is a fabric of crossply rovings in two or more directions;

— unidirectional roving, which is a fabric of rovings arranged in one direction;

— cloth, which is a fabric woven from yarn.

1) To be published.

3.2
resin
reactive synthetic that in its initial stage is a liquid, but during cure is transformed into a solid

NOTE Resins are used in different formulations:

— as gelcoat for the mould side of the laminate, giving a smooth, flexible and water-resistant surface;

— as a matrix material for the reinforcing fibres of the laminate;

— as a topcoat for the non-gelcoated surface to achieve a flexible, water-resistant and tack-free surface;

— as a matrix material for fillers and putties.

3.3
laminate
material composed of successive bonded layers of resin and fibre or other reinforcing substance

4 Requirements for material properties of small craft

4.1 Reinforcement fibres

4.1.1 The reinforcement used as a reference for this International Standard shall be E-glass in accordance with ISO 2078. Other types of glass fibres may be used if the minimum properties of E-glass are met or surpassed and the laminate itself is of equal or higher mechanical property.

4.1.2 The finish and binder of glass fibres shall be compatible with the matrix material used.

4.1.3 Fibres made of material other than glass may be used, provided that their properties are suitable for the intended purpose.

The fibre reinforcement manufacturer shall declare in writing that

— the material upon delivery complies with the requirements of 4.1 and the applicable part of Table 1;

— the actual tolerances of the material as delivered are in accordance with Table 1.

Further the manufacturer shall provide written information on

— the binder and sizing, if applicable;

— the compatibility and/or non-compatibility (if known) that the material with other materials to be used in the laminate;

— the specific requirements concerning storage;

— the specific requirements concerning use.

The boat manufacturer shall keep this information with the documentation established for the small craft.

Table 1 — Properties of fibre reinforcement

Property		Test method	Requirement
Moisture content on delivery	% max.		
Roving			0,2
Chopped strand mat		ISO 3344	0,5
Fabrics			0,2
Mass per unit, tolerance on nominal value	%		
Roving (length)		ISO 1889	− 5 to + 10
Chopped strand mat (area)		ISO 3374	− 5 to + 10
Woven roving (area)		ISO 3374	− 5 to + 10
Loss on ignition, nominal value	% max.	ISO 1887	+ 20
NOTE Equivalent methods for determining moisture content and mass including permissible tolerances should be used for materials other than glass fibre.			

4.2 Resin

4.2.1 Properties

The properties of liquid gelcoat, topcoat and laminating resins shall comply with the requirements of Table 2, as applicable.

Table 2 — Properties of liquid resins

Property	Test method	Requirement Tolerance on nominal value specified by the manufacturer [a] %
Viscosity	(1) Brookfield, ISO 2555 or (2) Cone/plate, ISO 2884-1	± 20
Monomer content	ISO 4901	± 5
Gel time (specify activator and initiator and percentage of each, and ambient temperature)	ISO 2535	± 20
Density	ISO 1675 or ISO 2811-1	± 5
Mineral content (laminating resins only)	DIN 16945 [b]	± 5

[a] The tolerance stated in percent (%) shall be understood as a percentage of the specified margin.

[b] ISO standard pending.

4.2.2 Gelcoat resins

Gelcoat base resins when cured shall meet the requirements of Type A in Table 3.

For specific applications, in order to achieve superior properties as to elongation and/or reduced water absorption, resins used for gelcoats and skin coats may deviate as to their minimum properties from the requirements of Type A resin in Table 3.

Table 3 — Properties of cured resins
(after a postcure schedule of 24 h at 50 °C)

Property		Test method	Requirement Resin type		
			A	B [a]	C [a]
Ultimate tensile strength	MPa min.	ISO 527-1, ISO 527-4	55	45	45
Elongation at break	% min.	ISO 527-1, ISO 527-4	2,5	1,5	1,2
Ultimate flexural strength	MPa min.	ISO 178	100	80	80
Flexural modulus	MPa min.	ISO 178	2 700	2 700	2 700
Heat deflection temperature	°C min.	ISO 75-1, ISO 75-2:1993 Method A	60	60	53
Water absorption	mg max.	ISO 62 [b]	80	100	100
Overall volume shrinkage		ISO 3521	Nominal value specified by the manufacturer + 5 %		
Barcol hardness [c] (Impressor 934-1)	min.	EN 59	35	35	35
The requirements are not applicable to resins used in the formulations of fillers and putties. The tolerances stated in percent (%) shall be understood as a percentage of the specified margin.					

[a] The requirements for laminating resins Types B and C are minima of different applications of determining required scantlings.

[b] Test sample: 50 mm $^{+1}_{0}$ mm × 50 mm $^{+1}_{0}$ mm × 4 mm $^{+0,2}_{0}$ mm. Distilled water. Exposure time 28 days at 23 °C.

[c] Resin systems may deviate from these values, provided a minimum value of 30 is achieved and adequate cure can be demonstrated by the manufacturer.

4.2.3 Topcoat resins

The formulation of a topcoat resin as to its physical properties shall consider the specific applications for which it is intended and shall meet the respective requirements for Type A, B or C, for instance

— exposure to weathering;

— oily bilge water;

— tack-free surface only;

— suitability as a paint.

4.2.4 Laminating resins

Laminating resins, including resin blends with permissible amounts of fillers and other additives when cured shall meet the respective requirements specified in Table 3.

4.2.5 Fillers, additives

Quantities and types of fillers and/or additives shall allow sufficient wet out of reinforcement fibres within the resin manufacturer's specified gel time.

4.2.6 Catalysts, accelerators

The use of catalysts and accelerators shall be as specified or recommended by the resin manufacturer.

4.2.7 Declaration

The resin manufacturer shall declare in writing that the material upon delivery complies with the requirements of 4.2, Tables 2 and 3 appropriate to the manufacturer's specified Type A, B or C resin.

If the resin manufacturer claims for exemption according to Table 3, i.e. that the requirements are not applicable to resins used in the formulations of fillers and putties, he shall state the mechanical properties achieved and shall provide information on the intended application of the resin.

The manufacturer of the resin, catalyst, accelerator, filler or other substances used in the laminate shall each provide written information on

— the compatibility or incompatibility (if known) of the material supplied with other materials used in the laminate;

— the shelf life of the material;

— the specific requirements concerning storage;

— the specific requirements concerning use.

The boat manufacturer shall keep this information with the documentation established for the small craft.

4.3 Reference laminate

4.3.1 The mechanical properties of the reference laminate as listed in Table 4 shall be achieved by any manufacturing process.

Table 4 — Minimum mechanical properties of reference laminate [a]

Property	Test method	Requirement [b] MPa
Ultimate tensile strength	ISO 527-1, ISO 527-4	80
Tensile modulus	ISO 527-1, ISO 527-4	6 350
Ultimate flexural strength	ISO 178	135
Flexural modulus	ISO 178	5 200
In-plane shear	ASTM D 4255	50
Apparent interlaminar shear strength (short-beam shear)	ISO 14130	15

[a] The reference laminate shall consist of glass chopped-strand mat and resin with a glass content not exceeding 30 % by mass of the fully cured laminate.

[b] The test data shall be achieved after a post cure schedule of max. 24 h at max. 50 °C.

4.3.2 The resin manufacturer shall declare in writing that the mechanical properties of Table 4 are capable of being fulfilled.

The resin manufacturer shall provide detailed information with respect to other substances (e.g. catalyst, accelerator, fillers, additives, etc.) used in the fabrication process of the reference laminate.

ICS 47.080

Price based on 6 pages