INTERNATIONAL STANDARD

ISO 12215-4

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Small craft — Hull construction and scantlings —

Part 4: Workshop and manufacturing

Petits navires — Construction de coques et échantillons —
Partie 4: Ateliers de construction et fabrication

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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 12215-4 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*

Small craft — Hull construction and scantlings —

Part 4: Workshop and manufacturing

1 Scope

This part of ISO 12215 specifies workshop conditions, material storage and handling, and requirements for the manufacturing of the craft. It applies, to small craft with a (L_H) length according to ISO 8666 of up to 24 m.

This part of ISO 12215 does not cover health and safety requirements.

NOTE The underlying reason for preparing this part of ISO 12215 is that workshop conditions have a significant influence on the mechanical short- and long-term properties of recreational craft and that the scantling determination according to ISO 12215-5 is based on conditions that are appropriate for the material used as well as the manufacturing process applied.

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

ISO 12215-1:2000, *Small craft — Hull construction and scantlings — Part 1: Materials: Thermosetting resins, glass-fibre reinforcement, reference laminate*

ISO 12215-3:2002, *Small craft — Hull construction and scantlings — Part 3: Materials: Steel, aluminium alloys, wood, other materials*

3 Fibre-reinforced plastics (FRP) boat production

3.1 Workshop conditions

3.1.1 General

The buildings used for production and storage shall be of suitable construction, and equipped to provide the environment specified by the material manufacturer or supplier.

1) To be published.

To minimize contamination or impairment of the laminate, the production area shall be separate from the storage area and, wherever practicable, the various manufacturing processes shall be carried out in separate sections.

The workshop and equipment shall be properly maintained and kept in a clean condition, substantially free from debris, surplus material, and equipment that is not essential for the production process.

3.1.2 Temperature and humidity

Where a conventional manual lay-up or spray-up process is used, the moulding shop temperature shall be maintained within the limits specified by the resin manufacturer during lay-up and curing periods.

Should the temperature vary outside the specified limits, the boat builder shall establish with the resin manufacturer that the resulting laminate will meet the requirements upon which scantlings and design are based.

The relative humidity in the moulding shop shall be maintained within the limit recommended by the material manufacturers.

Materials shall be brought up to the workshop temperature prior to use.

The temperature and humidity shall be monitored in appropriate locations, and records shall be kept.

3.1.3 Ventilation

Adequate ventilation shall be provided in the laminating area, in order to minimize accumulation of monomer fumes in the mould. The ventilation shall not significantly reduce the surface temperature of the mould or laminate.

The design of the ventilation system shall take account of the size of the laminating shop, possible subdivision and the amount of resin under cure.

The ventilation arrangements shall not cause excessive evaporation of the resin monomer. Precautions shall be taken to ensure freedom from draughts.

3.1.4 Dust control

Provisions shall be made to minimize harmful accumulation of dust on moulds and laminates.

3.1.5 Illumination

Provisions shall be made to avoid any harmful effects on the resin cure due to direct sunlight or artificial lighting.

3.2 Material storage and handling

3.2.1 General requirements

Storage areas shall be arranged and equipped in such a way that the material manufacturer's requirements for storage and handling can be followed.

The procedures for the reception, verification against certificates of conformity, storage and handling of materials shall be detailed in the conformity assurance procedures provided by the boat builder (see clause 10) to ensure that the materials suffer no contamination or degradation and carry adequate identification at all times.

Storage shall be arranged so that wherever possible materials are used in order of receipt.

Structural parts shall be manufactured from materials that have not passed the material manufacturers' date of expiry.

Materials found to be defective or not in compliance with the specifications of raw-material supplier(s) shall be rejected unless treated in accordance with the conformity assurance procedure, provided by the boat builder.

Unused resin and ancillary materials exposed to the workshop atmosphere shall not be returned to the parent stock or bulk storage.

3.2.2 Resin

Resins shall be stored under controlled conditions in accordance with the resin manufacturer's requirements.

Where a resin contains an ingredient that can settle within the resin system, it is the builder's responsibility to ensure that the resin manufacturer's recommendations for mixing and conditioning are complied with prior to use.

3.2.3 Catalysts and accelerators

Catalysts and accelerators shall be stored according to the material manufacturer's requirements.

3.2.4 Fillers and additives

Fillers and additives used in the moulding process shall be stored in closed containers to protect them from dust and humidity.

3.2.5 Reinforcing and core materials

Reinforcing and core materials shall be stored in clean and dry conditions, in accordance with the material manufacturer's recommendations.

3.3 Moulds

3.3.1 Construction

Moulds shall be constructed of a suitable material and adequately stiffened to maintain their shape and fairness of form.

The materials used in the construction of moulds shall not adversely affect the resin cure.

3.3.2 Preparation

Moulds shall be cleaned, dried and in place so that they stabilize at the workshop temperature before the release agent is applied.

The release agent shall be compatible with the mould surface, the resins applied in the laminating process and with mould release films used previously.

Release agents containing silicon shall not be used.

NOTE Release agents containing silicone oil may interfere with adhesion or secondary bonding when using common resin types.

3.4 Resin preparation

The requirements of the resin manufacturer shall be followed.

Where blended resins are used, test specimen(s) shall be made to ensure that the blended resin is suitable for the laminating process.

Where the boat builder wishes to modify resin with additives outside the resin manufacturer's specification, the boat builder shall conduct tests to verify compliance with Table 3 of ISO 12215-1:2000.

3.5 Laminating process

3.5.1 Manual lay-up

The material type and unit weight of the first fibre reinforcement layer shall be chosen to provide for adequate penetration of the reinforcement layer by the resin system used and reduce the effect of hydrolytic attack.

The lay-up sequence and degree of resin cure between plies shall be in accordance with the resin manufacturer's recommendation. Where the degree of cure exceeds these recommendations, the surface shall be treated.

Moulds shall be arranged or access provided so that each part of the mould can be reached with the tools used to ensure consolidation and de-aeration of the laminate during lay-up.

3.5.2 Spray lay-up

Spray lay-up of resin and/or reinforcement fibres shall be limited to applications where, in general, a specified even thickness of the sprayed laminate can be achieved.

Consideration shall be given to

— exothermic heat by excessive wet laminate thickness,

— sagging or drainage of the laminate, and

— de-aereation.

The weight of glass reinforcement to be deposited between resin/glass consolidation depends upon the complexity of the mould.

In general, this shall not be more than 1 150 g/m^2 of glass fibres, unless it can be demonstrated that a satisfactory laminate can be achieved with a greater glass reinforcement weight.

The uniformity of the laminate and glass content shall be checked at regular intervals.

Where the back-up layer behind the gelcoat is sprayed-up, the type and length of the fibres shall ensure that no wicking effect can occur.

The spray equipment shall be calibrated and shall be checked for the desired setting for the resin/catalyst and resin/reinforcement fibre ratios at the beginning of each working day. To ensure that the lay-up is within tolerances, the settings shall be monitored.

3.5.3 Closed moulding

When closed moulding is applied, the system shall be designed to ensure the correct distribution of resin in the laminate.

3.5.4 Pre-impregnated laminates

Pre-impregnated laminates shall be stored, used and cured in accordance with the material manufacturer's requirements.

3.6 Surface coating

3.6.1 Coating material

Gelcoat or another suitable coating, which may be the laminating resin when designed for this purpose, shall be applied to provide some protection from solar radiation, hydrolytic attack and abrasion. Where gelcoat is used, the first layer of reinforcement shall be applied according to the resin manufacturer's specification and as soon as the gelcoat has adequately cured.

3.6.2 Spray surface coating

The spray equipment shall be calibrated and shall be checked for the desired settings for the resin/catalyst ratios and the spray pattern at the beginning of each working day or prior to the start of single-part work to ensure consistent application.

3.7 Manufacturing requirements, sandwich construction

3.7.1 Sandwich construction using female moulds

3.7.1.1 Core surface cavities and other irregularities shall be removed or coated with filler, resin or sandwich adhesive according to the material manufacturer’s specification and depending on the following skin lay-up. When using scored core material, a sufficient amount of resin or adhesive shall be used in the bond to fill the gaps.

3.7.1.2 When bonding core material to a wet laminate, sufficient resin shall be in or on the laminate to achieve a bond between the laminate and core material without resin deficiency of the laminate.

3.7.1.3 The materials shall be kept in contact while curing to ensure a structurally sufficient bond and to avoid air entrapment.

3.7.1.4 Deviations from these procedures may be made, provided that the structural requirements of ISO 12215-5 are met.

3.7.2 Sandwich construction with male moulds

3.7.2.1 Joints, scores and voids in the core material shall be filled or fixed to each other before the skin laminate is applied.

3.7.2.2 When laying the core material, it shall not be bent or deformed to such an extent that the properties of the core are adversely affected.

3.7.2.3 Irregularities on the core surface and the joints shall be removed.

3.7.2.4 The core surface shall be primed where required before the laminate is applied.

3.8 Laminate curing

3.8.1 Open-mould process

The laminate cure schedule shall follow the resin manufacturer's requirements and shall be documented.

The curing schedule for sandwich laminates shall take into account the thermal influence of the core material and the possible slower initiation of the cure due to thin laminates.

If the resin requires higher post-cure temperatures than ambient temperature, this process shall be documented.

Post-curing at an elevated temperature shall not commence until the laminate has stabilized.