

---

---

**Small craft — Hull construction  
and scantlings —**

Part 5:

**Design pressures for monohulls, design  
stresses, scantlings determination**

*Petits navires — Construction de la coque et échantillonnage —*

*Partie 5: Pressions de conception pour monocoques, contraintes de  
conception, détermination de l'échantillonnage*



**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.

This document is a preview generated by EVS



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2008

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

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.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

Page

Foreword.....	v
Introduction.....	vi
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions.....	2
4 Symbols.....	4
5 General.....	6
6 Dimensions, data and areas.....	7
6.1 Dimensions and data.....	7
6.2 Areas.....	7
7 Pressure adjusting factors.....	9
7.1 General.....	9
7.2 Design category factor $k_{DC}$ .....	9
7.3 Dynamic load factor $n_{CG}$ .....	9
7.4 Longitudinal pressure distribution factor $k_L$ .....	10
7.5 Area pressure reduction factor $k_{AR}$ .....	11
7.6 Hull side pressure reduction factor $k_Z$ .....	12
7.7 Superstructure and deckhouse pressure reduction factor $k_{SUP}$ .....	13
7.8 Light and stable sailing craft pressure correcting factor for slamming $k_{SLS}$ .....	13
8 Design pressures.....	14
8.1 Motor craft design pressure.....	14
8.2 Sailing craft design pressure.....	16
8.3 Watertight bulkheads and integral tank boundaries design pressure.....	16
8.4 Design pressures for structural components where $k_{AR}$ would be $\leq 0,25$ .....	18
9 Dimensions of panels and stiffeners.....	19
9.1 Dimensions of plating panels.....	19
9.2 Dimensions of stiffeners.....	23
10 Plating — Scantling equations.....	25
10.1 Thickness adjustment factors for plating.....	25
10.2 FRP single-skin plating.....	28
10.3 Metal plating — Aluminium alloy and steel.....	29
10.4 Laminated wood or plywood single-skin plating.....	30
10.5 FRP sandwich plating.....	31
10.6 Single-skin plating minimum thickness.....	35
11 Stiffening members requirements.....	36
11.1 General.....	36
11.2 Properties adjustment factors for stiffeners.....	37
11.3 Design stresses for stiffeners.....	37
11.4 Requirements for stiffeners made with similar materials.....	38
11.5 Requirements for stiffeners made with dissimilar materials.....	39
11.6 Effective plating.....	40
11.7 Overall dimensions of stiffeners.....	41
11.8 Structural bulkheads.....	43
11.9 Structural support for sailing craft ballast keel.....	44

<b>12</b>	<b>Owner's manual</b> .....	<b>44</b>
<b>12.1</b>	<b>General</b> .....	<b>44</b>
<b>12.2</b>	<b>Normal mode of operation</b> .....	<b>44</b>
<b>12.3</b>	<b>Possibility of outer skin damage</b> .....	<b>44</b>
<b>Annex A</b>	<b>(normative) Simplified method for scantling determination</b> .....	<b>45</b>
<b>Annex B</b>	<b>(normative) Drop test for boats of &lt; 6 m</b> .....	<b>49</b>
<b>Annex C</b>	<b>(normative) FRP laminates properties and calculations</b> .....	<b>52</b>
<b>Annex D</b>	<b>(normative) Sandwich mechanical core properties and sandwich calculation</b> .....	<b>63</b>
<b>Annex E</b>	<b>(normative) Wood laminate properties and wood calculations</b> .....	<b>69</b>
<b>Annex F</b>	<b>(normative) Mechanical properties of metals</b> .....	<b>78</b>
<b>Annex G</b>	<b>(normative) Geometric properties of stiffeners</b> .....	<b>80</b>
<b>Annex H</b>	<b>(normative) Laminate stack analysis</b> .....	<b>97</b>
<b>Bibliography</b>	.....	<b>108</b>

This document is a preview generated by EVS

## 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 2.

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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12215-5 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 for monohulls, design stresses, scantlings determination*
- *Part 6: Structural arrangements and details*
- *Part 7: Scantling determination of multihulls*
- *Part 8: Rudders*
- *Part 9: Sailing boats — Appendages and rig attachment*

## Introduction

The reason underlying the preparation of this part of ISO 12215 is that standards and recommended practices for loads on the hull and the dimensioning of small craft differ considerably from one to another, thus limiting the general worldwide acceptability of boat scantlings. This part of ISO 12215 has been set towards the lower boundary of the range of current practice.

The objective of this part of ISO 12215 is to achieve an overall structural strength that ensures the watertight and weathertight integrity of the craft. It is intended to be a tool to assess the scantlings of a craft against lower bound practice and it is not intended to be a structural design procedure.

The scantling requirements are based principally on providing adequate local strength. Serviceability issues such as deflection under normal operating loads, global strength and its connected shell and deck stability are not addressed. The criteria contained within may need to be supplemented by additional considerations deemed necessary by the designer of the structure.

The mechanical property data supplied as default values make no explicit allowance for deterioration in service nor provide any guarantee that these values can be obtained for any particular craft. The responsibility for the decision to use this part of ISO 12215 as part of the design procedure rests solely with the designer and/or manufacturer.

The design pressures given in this part of ISO 12215 are only used with the given equations.

Considering future development in technology and boat types and small craft currently outside the scope of this part of ISO 12215, provided methods supported by appropriate technology exist, consideration may be given to their use provided equivalent support for this part of ISO 12215 is achieved.

The dimensioning according to this part of ISO 12215 is regarded as reflecting current practice, provided the craft is correctly handled in the sense of good seamanship and operated at a speed appropriate to the prevailing sea state.

### Important notice:

- 1) ISO/TC 188/WG 18 believes that this part of ISO 12215 is the best that can be achieved at the time of publication. It has therefore decided to publish this document as an ISO Standard. It is anticipated that wider usage may reveal a number of issues that require modification. It is for this reason that WG 18 has asked for a revision of the document at the same time as its publication. This revision agreement will enable the group to amend this part of ISO 12215 quickly should this prove necessary.
- 2) In furtherance of this, this part of ISO 12215 needs to be applied with a critical mind, and users are invited to report to the TC secretariat, or national standardization body, any items that are considered to require correction, together with supporting evidence, be that theoretical or based on satisfactory, long-term service experience with actual boats operating in the appropriate design category sea states.

## Small craft — Hull construction and scantlings —

### Part 5:

## Design pressures for monohulls, design stresses, scantlings determination

### 1 Scope

This part of ISO 12215 applies to the determination of design pressures and stresses, and to the determination of the scantlings, including internal structural members of monohull small craft constructed from fibre-reinforced plastics, aluminium or steel alloys, glued wood or other suitable boat building material, with a length of hull,  $L_H$ , in accordance with ISO 8666, between 2,5 m and 24 m. It only applies to boats in the intact condition.

It only applies to craft with a maximum speed  $\leq 50$  knots in  $m_{LDC}$  conditions.

The assessment shall generally include all parts of the craft that are assumed watertight or weathertight when assessing stability, freeboard and buoyancy in accordance with ISO 12217 and are essential to the safety of the craft and of persons on board.

For the complete scantlings of the craft, this part of ISO 12215 is used in conjunction with Part 6, for details, Part 7 for multihulls, Part 8 for rudders and Part 9 for appendages and rig attachment.

The scantling determination of windows, portlights, deadlights, hatches and doors, is in accordance with ISO 12216. The structure supporting these elements is in accordance with this part of ISO 12215.

NOTE 1 Scantlings derived from this part of ISO 12215 are primarily intended to apply to recreational craft including recreational charter vessels and may not be suitable for performance racing craft.

NOTE 2 This part of ISO 12215 is based on the assumption that scantlings are governed solely by local loads.

NOTE 3 The scantling requirements of this part of ISO 12215 are considered to correspond to the minimum strength requirements of motor and sailing craft which are operated in a safe and responsible manner, having due cognisance of the prevailing conditions.

Pressures and stresses are normally expressed in pascals, kilopascals or megapascals. For the purposes of a better understanding for the users of this part of ISO 12215, the pressures are expressed in kilonewtons per square metre ( $1\text{kN/m}^2 = 1\text{kPa}$ ) and stresses or elastic moduli are expressed in newtons per square millimetre ( $1\text{N/mm}^2 = 1\text{MPa}$ ).

### 2 Normative references

The following referenced documents are indispensable for the application 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 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*

ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

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

ISO 845, *Cellular plastics and rubbers — Determination of apparent density*

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

ISO 8666:2002, *Small craft — Principal data*

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

ISO 12215-6, *Small craft — Hull construction and scantlings — Part 6: Structural arrangements and details*

ISO 12215-7, *Small craft — Hull construction and scantlings — Part 7: Scantling determination of multihulls*

ISO 12215-9, *Small craft — Hull construction and scantlings — Part 9: Sailing boats — Appendages and rig attachment*

ISO 12216, *Small craft — Windows, portlights, hatches, deadlights and doors — Strength and watertightness requirements*

ISO 12217 (all parts), *Small craft — Stability and buoyancy assessment and categorization*

ASTM C393, *Standard Test Method for Flexural Properties of Sandwich Constructions*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

**3.1 design categories**  
sea and wind conditions for which a boat is assessed by this part of ISO 12215 to be suitable, provided the craft is correctly handled in the sense of good seamanship and operated at a speed appropriate to the prevailing sea state

**3.1.1 design category A (“ocean”)**  
category of boats considered suitable to operate in seas with significant wave heights above 4 m and wind speeds in excess of Beaufort Force 8, but excluding abnormal conditions, e.g. hurricanes

NOTE For the application of this part of ISO 12215, the calculation wave height is 7 m.

**3.1.2 design category B (“offshore”)**  
category of boats considered suitable to operate in seas with significant wave heights up to 4 m and winds of Beaufort Force 8 or less

**3.1.3 design category C (“inshore”)**  
category of boats considered suitable to operate in seas with significant wave heights up to 2 m and a typical steady wind force of Beaufort Force 6 or less