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

**Part 5:
Design pressures for monohulls,
design stresses, scantlings
determination**

Petits navires — Construction de coques et échantillonnage —

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





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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.

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 documents 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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 188, *Small craft*.

This second edition cancels and replaces the first edition (ISO 12215-5:2008, including its amendment ISO 12215-5:2008/Amd 1:2014), which has been technically revised.

One of the main reasons to achieve this revision, after a decade implementing the first edition, was to allow other scantlings calculation methods than those given in the 2008 edition, noting the huge development of finite element analysis methods and software, and the trend already applied in ISO 12215-9 (keels and appendages) and ISO 12215-7 (multihulls).

Therefore, in this new edition, like in many other scantlings standards, the design pressure loads, and the design stresses are given in the main body of the standard and, where needed, the scantlings calculation methods are detailed in Annexes.

The main changes compared to the previous edition are as follows:

- clarification of the scope and of many definitions, dimensions, and assessment;
- definition of a theoretical hull/deck limit height Z_{SDT} in [Table 3](#);
- renaming of n_{GC} into k_{DYN} in [Table 7](#);
- lowering of the values of k_L in the aft part of the craft in [Table 8](#);
- deletion of $k_{AR\ min}$, to better consider large panels, mainly sandwiches, in [Table 9](#);
- improvement of the values of k_{SUP} in [Table 10](#);
- modification of design pressures for motor and sailing craft in [Tables 12 & 13](#);
- modification of design stresses introducing k_{BB} and k_{AM} factors in [Tables 15 to 17](#);
- incorporation of requirements for work boats in [Table 2](#), [Clause 12](#) and [Annex J](#);
- possibility to use a wider range of assessment methods detailed in [Table 18](#);

- move of the previous assessment method (now called "simplified") in [Annex A](#);
- improvements/clarification of the simplified method (panel assessment, hard chined sections, frameless sections, simple and double curvature, attached plating, requirements for core, etc.);
- development of [Annex C](#) for the determination of mechanical properties of composites;
- reminder in [A.14](#) of the requirements of ISO 12215-9 on reinforcement of the hull in way of ballast keel attachment;
- new [Annex I](#) only recommending minimum thickness for single skin and sandwich that are no longer mandatory;
- new [Annex J](#) defining different types of commercial craft and workboats and their requirements;
- new [Annex K](#) defining loads induced by outboard engines;
- new [Annex L](#) proposing an application sheet of this document to explain how it has been used;
- for clarity, this edition generally uses tables to present formulas and requirements.

A list of all parts in the ISO 12215 series can be found in the ISO website.

NOTE The mechanical properties of ISO 12215-1 to -3 are largely superseded by the ones of this document.

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.

Introduction

The reason underlying the preparation of this document is that standards and recommended practices for loads on the hull and the dimensioning of small craft differ considerably, thus limiting the general worldwide acceptability of craft scantlings. This document has been set towards the minimal requirements of the current practice.

The implementation of this document allows to achieve an overall structural strength that ensures the watertight and weathertight integrity of the craft. This document is intended to be a tool to determine the scantlings of a craft as per minimal requirements. It is not intended to be a structural design procedure.

It is also emphasized that this document should only be used to check the main structural features of a craft but should not be used as a scantlings guide. Users of this document should have practical and theoretical experience in strength of materials and engineering, even if calculation software are available. Many details can have a significant influence on the final stresses and strength of the structure, ISO 12215-6 shows "established practice".

The scantlings requirements aim at 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 in this document. The related criteria may need to be addressed by additional considerations, as deemed necessary by the users of this document.

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. Considering the future development in technology and the boat types and small craft outside the scope of this document, other methods than those described in this document exist, supported by appropriate technology, that can be used provided that they lead to equivalent results.

The dimensioning according to this document 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.

Small craft — Hull construction and scantlings —

Part 5:

Design pressures for monohulls, design stresses, scantlings determination

1 Scope

This document defines the dimensions, design local pressures, mechanical properties and design stresses for the scantlings determination of monohull small craft with a hull length (L_H) or a load line length (see NOTE 1) of up to 24 m. It considers all parts of the craft that are assumed to be watertight or weathertight when assessing stability, freeboard and buoyancy in accordance with ISO 12217.

NOTE 1 The load line length is defined in the IMO "International Load Lines Convention 1966/2005", it can be larger than L_H for craft with overhangs. This length also sets up at 24 m the lower limit of several IMO conventions.

The main core of this document determines the local design pressures and stresses for monohulls and details the possible scantlings methods derived from these pressures and stresses, both for monohulls and multihulls (see NOTE 2). The assessment process requires, where relevant, the application of Annexes.

This document is applicable to small craft, in intact condition, of the two following types:

- recreational craft, including recreational charter vessels;
- small commercial craft and workboats, see [Clause 12](#) and [Annex J](#).

It is not applicable to racing craft designed only for professional racing.

NOTE 2 Local pressures and stresses for multihulls are given in ISO 12215-7.

This document is applicable to the structures supporting windows, portlights, hatches, deadlights, and doors.

For the complete scantlings of the craft, this document is intended to be used with ISO 12215-8 for rudders, ISO 12215-9 for appendages and ISO 12215-10 for rig loads and rig attachments.

This document covers small craft built from the following materials:

- fibre-reinforced plastics, either in single skin or sandwich construction;
- aluminium or steel alloys;
- glued wood or plywood (single skin or sandwich), excluding traditional wood construction;
- non-reinforced plastics for craft with a hull length less than 6 m (see [Annex D](#)).

Throughout this document, unless otherwise specified, dimensions are in (m), areas in (m^2), masses in (kg), forces in (N), moments in (N.m), pressures in kN/m^2 ($1 kN/m^2 = 1 kPa$), stresses and elastic modulus in N/mm^2 ($1 N/mm^2 = 1 Mpa$). Max(a;b;c) means that the required value is the maximum of a, b, and c; and min(d;e;f) means that the required value is the minimum of d, e, and f.

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 8666:2016, *Small craft — Principal data*

ISO 12215-9:2012, *Small craft — Hull construction and scantlings — Part 9: Sailing craft appendages*

ISO 12217-1:2015, *Small craft — Stability and buoyancy assessment and categorization — Part 1: Non-sailing boats of hull length greater than or equal to 6 m*

ISO 12217-2:2015, *Small craft — Stability and buoyancy assessment and categorization — Part 2: Sailing boats of hull length greater than or equal to 6 m*

ISO 12217-3:2015, *Small craft — Stability and buoyancy assessment and categorization — Part 3: Boats of hull length less than 6 m*

3 Terms and definitions

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

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 design categories

description of the sea and wind conditions for which a craft is assessed to be suitable

Note 1 to entry: The design categories are defined in ISO 12217 (all parts).

Note 2 to entry: The definitions of design categories are in line with the European Recreational Craft Directive 2013/53/EU.

3.2 loaded displacement

m_{LDC}

mass of water displaced by the craft, including all appendages, when in fully loaded ready for use condition

Note 1 to entry: The fully loaded ready for use condition is further defined in ISO 8666.

3.3 sailing craft

craft for which the primary means of propulsion is wind power

Note 1 to entry: It is further defined in ISO 8666.

Note 2 to entry: In this document, non-sailing craft are considered as motor craft.

3.4 second moment of area second moment

I

for a homogeneous material, sum of the component areas multiplied by the square of the distance from centre of area of each component area to the neutral axis, plus the second moment of area of each component area about an axis passing through its own centroid

Note 1 to entry: The second moment of area is also referred to in other documentation as the moment of inertia.

Note 2 to entry: It is expressed in mm⁴ or cm⁴.

3.5 section modulus

SM

for a homogeneous material, second moment of area divided by the distance to any point from the neutral axis at which the bending stress is calculated, expressed in mm³ or cm³

Note 1 to entry: The minimum section modulus is calculated to the furthest point from the neutral axis.

3.6 craft speed

V

for motor craft, maximum speed in calm water and in m_{LDC} condition that is declared by the manufacturer, expressed in knots

3.7 displacement craft

craft whose maximum speed in flat water and m_{LDC} condition, declared by its manufacturer, is such that $V < 5\sqrt{L_{WL}}$

3.8 displacement mode

mode of running of a craft in the sea such that its mass is mainly supported by buoyancy forces

Note 1 to entry: This is the case where the actual speed in a seaway in m_{LDC} condition is such that its speed/length ratio makes the craft behave as a displacement craft.

3.9 planing craft

craft whose maximum speed in flat water and in m_{LDC} condition, declared by its manufacturer, is such that $V \geq 5\sqrt{L_{WL}}$

Note 1 to entry: This speed/length ratio limit has been arbitrarily set up in this document, but it may vary from one craft to another according to hull shape and other parameters.

3.10 planing mode

mode of running of a craft in the sea such that its mass is significantly supported by forces coming from dynamic lift due to speed in the water

Note 1 to entry: A planing craft in calm water runs in planing mode, but it may be obliged to significantly reduce its speed when the sea gets worse, running in that case in displacement mode.

3.11 non-walking area

area of the working deck, cockpit or superstructures of a monohull at an inclination of more than 25° to the horizontal in the longitudinal direction or more than 55° to the horizontal in the transverse direction

Note 1 to entry: All other areas of the deck, cockpit bottom and superstructures are deemed walking areas.