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Small craft — Hull construction and scantlings —

Part 10: Rig loads and rig attachment in sailing craft

Petit navires — Construction de la coque et échantillonnage —

Partie 10: Charges dans le gréement et points d'attache du gréement dans les bateaux à voiles

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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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by ISO/TC 188, S*mall craft*.

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

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 the ISO 12215 series is that scantlings rules and recommended practices for small craft differ considerably, thus limiting the general worldwide acceptability of craft.

This document has been set towards the minimal requirements of the current practice.

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 equipped and operated at a speed appropriate to the prevailing sea state.

This document is not a design standard and designers/builders are strongly cautioned from attempting to design craft such that nearly all structural components only just comply.

The connection between the rig attachment and the structure is required to be stronger than the rig attachment itself. It is therefore considered that unforeseen overload will not entail its detachment from the structure, and that the watertight integrity will be maintained.

Small craft — Hull construction and scantlings —

Part 10:
Rig loads and rig attachment in sailing craft

1 Scope

This document specifies methods for the determination of:

— the design loads and design stresses on rig elements; and

— the loads and scantlings of rig attachments and mast steps/pillars;

on monohull and multihulls sailing craft.

It also gives, in Annexes, "established practices" for the assessment of mast steps/pillars or chainplates

NOTE 1 Other engineering methods can be used provided the design loads and design stresses are used.

This document is applicable to craft with a hull length L_H up to 24 m but it can also be applied to craft up to 24 m load line length.

NOTE 2 The load line length is defined in the OMI "International Load Lines Convention 1966/2005", it is smaller than L_H. This length also sets up, at 24 m, the lower limit of several IMO conventions.

Scantlings derived from this document are primarily intended to apply to recreational craft, including charter vessels.

This document is not applicable to racing craft designed only for professional racing.

This document only considers the loads exerted when sailing. Any loads that may result from other situations are not considered in this document.

Throughout this document, and unless otherwise specified, dimensions are in (m), areas in (m^2), masses in (kg), forces in (N), moments in (N m), stresses and elastic modulus in N/mm^2 (1 N / mm^2 = 1 Mpa). Unless otherwise stated, the craft is assessed in fully loaded ready for use condition.

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 12215-5:2019, *Small craft — Hull construction and scantlings — Part 5: Design pressures for monohulls, design stresses, scantlings determination*

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 the design categories are in line with the European Recreational Craft Directive 2013/53/EU.

[SOURCE: ISO 12215-5:2019, 3.1]

3.2
loaded displacement
m_{LDC}
mass of water displaced by the craft, including all appendages, when in the fully loaded ready-for-use condition

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

[SOURCE: ISO 12215-5:2019, 3.2]

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.

[SOURCE: ISO 12215-5:2019, 3.3, modified — Note 2 to entry deleted.]

3.4
monohull
craft with only one hull

3.5
multihull
craft with two or more hulls with a connecting wet deck/platform or beams above the loaded waterline, as opposed to a tunnel boat or scow

3.6
mast step
element fitted at the bottom of the mast that supports the mast compression and transmits it to the rest of the structure

3.7
mast pillar
pillar
in a deck stepped rig, structural element that transmits the mast compression to the rest of the structure

3.8
chainplate
rig attachment
component(s) to which the rig elements are attached, transmitting their load to the rest of the structure, including tie rods where relevant

EXAMPLE Metal chainplate, strapped composite chainplate,

Note 1 to entry: See Annex D.

3.9
connection
<of mast step, pillar or chainplate to the structure> all elements or group of elements connecting the rig attachment to the structure of the craft

EXAMPLE Bolts, lamination.

Note 1 to entry: Some of these elements can be part of the chainplate.

3.10
m_{LDC} condition
maximum load condition corresponding to the *loaded displacement* (3.2)

4 Symbols

Unless specified otherwise, the symbols, factors and parameters given in Table 1 apply.

Table 1 — Symbols, factors, parameters

Symbol	Unit	Designation/Meaning of symbol	Reference
1 - Main dimensions of the craft			
B_{CB}	m	Beam between centers of buoyancy: between center of buoyancy of hulls, for catamarans; and between C_B of center hull and C_B of float, for trimarans	Table 5, Fig 3
B_{CP}	m	Beam between chainplates (from port to starboard)	Table C.1, Fig 3
B_H	m	Beam of hull	It 1 of Table 5
GZ_{30}	m	Righting lever at 30° heel for monohulls	Table 5
L_{WL}	m	Length of waterline in m_{LDC} condition	7.5, Table 10
V_{CG}	m	Height of craft center of gravity above T_C bottom	Table 5, Fig 3
m_{LDC}	kg	Loaded displacement mass (3.2) or condition (3.10)	3.2, Clause 13
n_{PH}	1	Number of persons hiking	It 1 of Table 5
T_C	m	Draught of canoe body	Table 5, Fig 3
2 - Main dimensions of the rig and connected data			
A_i	m^2	Sail area, index *i* defining the sail name or combination	Tables 5 to 8 etc.
F_{Ai}	N	Aerodynamic force, index *i* defining which force it corresponds to	Tables 5 to 8
F_{DMC}	N	Design compression force on single mast step/pillar	8.4. Annex C
F_{DMCi}	N	Design compression force on mast step/pillar of two-masted rig where index *i* = 1 or 2	8.4. Annex C
M_D	Nm	Design moment under sail	Tables 5 and 6
M_{Hi}	Nm	Heeling moment, where index *i* = $_{UP, MAX, BROACH,DOWN}$,	Tables 5 and 6
M_{Ri}	Nm	Righting moment, where index *i* = $_{UP}$, $\phi_{UP, MAX}$	Table 5
$V_{ACEK\ i}$	knots	Design apparent wind speed, in knots, at the center of area of sails, where index *i* stands for sail configuration S_{Ci}	Tables 5 and 7
$V_{ACEM\ i}$	m/s	Design apparent wind speed, in m/s, at the center of area of sails, where index *i* stands for sail configuration S_{Ci}	Tables 5 and 7
$V_{AMT\ i}$	m/s (knots)	Design apparent wind speed at mast top, where index *i* stands for sail configuration S_{Ci}	Note 5 in Table 5
See Table 8 for detailed dimensions of rig, areas, etc.			

Table 1 *(continued)*

Symbol	Unit	Designation/Meaning of symbol	Reference
3 - Factors			
k_{DCR}	1	Design category factor for rig	It 5 of Table 3
k_{DSR}	1	Dynamic sail and rig factor	It 1 of Table 10
k_{HF}	1	Foresail center of pressure height factor	It 1of Table 9
k_{HMS}	1	Mainsail center of pressure height factor	It 3 of Table 9
k_{LC}	1	Load case factor	Tables 3 and 7
k_{MAT}	1	Material factor	It 3 of Table 3
k_{ROACH}	1	Roach factor	Table 8
k_{SAGF}	1	Forestay or inner forestay sag factor = stay sag sagitta/stay length	It 3 of Table 10
k_{SAGM}	1	Mainsail leech sag factor	It 3 of Table 10
k_{ϕ}	1	Factor assessing heel angle of multihulls	It 1 of Table 5
4 - Other variables			
S_{Ci}	1	Sail configuration where *i* is the configuration index	Table 7
S_{Fi}	1	Safety factor against *i*, the index *i* being y (yield) or u (ultimate)	Table 4
σ_i, τ_i	N/mm^2	Direct or shear stress, where *i* may be LIM, u, uw, yw, uc, ut, uf	Table 3
ϕ	degree	Heel angle, which may be 30° for monohulls or ϕ_{LIM} for multihulls	Table 5

5 Application of the document

5.1 General

This document allows the determination of the design loads and design stresses on rig elements of sailing small craft and to assess the design loads on mast step/pillar and chainplates and their connection to the craft's structure:

1) by a simplified method, or

2) by a developed method.

These methods are defined step by step in Table 2.

The developed method also allows to determine the rig loads needed to assess the global loads in the structure of multihulls in ISO 12215-7:2020.

5.2 The simplified method

Clause 14 requires that the mast/rig manufacturer provide the design load on mast steps/pillars and on each rig element, the dimensions of end fittings, etc. assessed according to 7.1.3. If this information is not available, the "Simplified method" applies through "Established practice" Annexes: Annex C for "basic" or "enhanced" methods for mast steps/pillars, or Annex D for chainplates or their connections.

5.3 The developed method

This method involves the full determination of the design loads on mast steps/pillars and on each rig element, the dimensions of end fittings, etc. assessed according to Clause 7. The assessment of the mast step(s), mast pillar(s), chainplates, and their connections to the craft shall then be checked either by the