ISO 12215-5:2019 (E)

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

Contents

Foreword

Introduction

1 Scope

2 Normative references

3 Terms and definitions

4 Symbols

5 General

5.1 Materials
5.2 Overall procedure for scantlings determination

6 Main dimensions, data and areas

6.1 Dimensions and data
6.2 Areas
6.2.1 General

7 Dimensions of panels and stiffeners

7.1 General
7.2 Rectangular grid of panels and stiffeners
7.3 Non-rectangular panels
7.3.1 Trapezoidal or triangular panels
7.3.2 Other shapes
7.4 Pressure on a panel or a stiffener

8 Pressure adjusting factors

8.1 General
8.2 Design category factor kDC
8.3 Dynamic load factor kDYN
8.4 Longitudinal pressure distribution factor kL
8.5 Area pressure reduction factor kAR
8.6 Superstructures and deckhouse pressure reduction factor kSUP
8.7 Pressure correcting factor kSLS for slamming of light and stable sailing craft

9 Design pressures

9.1 Design pressure for motor craft
9.2 Design pressure for sailing craft
9.3 Watertight bulkheads and integral tank boundaries design pressure
9.3.1 General
9.3.2 Integral tanks wash plates
9.3.3 Collision bulkheads
9.3.4 Non-watertight or partial bulkheads
9.3.5 Centreboards of lifting keel wells
9.3.6 Transmission of pillar loads
9.3.7 Loads from outboard engines

10 Mechanical properties and design stresses

10.1 Boat building quality factor kBB
10.2 Assessment method factor kAM

10.3 Design stresses according to material and calculation method

11 Methods for structural analysis and scantlings determination

11.1 The six available methods
11.2 Method 1: "Simplified" method
11.3 Method 2: "Enhanced" method (ply by ply analysis)
11.4 Method 3: "Developed" method for any laminate, including non-balanced laminates
11.5 Method 4: "Direct test method"
11.6 Method 5: "FEM" Finite Element Method
11.6.1 General considerations
11.6.2 General guidance for assessment by 3-D numerical procedures
11.6.3 Boundary assumptions and load application
11.6.4 Model idealisation
11.7 Method 6: Alternative test: Drop test
11.8 "Good practice" minimal thickness

12 Craft for professional use: Commercial craft and workboats

13 Owner's manual

13.1 General
13.2 Normal mode of operation
13.3 Information to take care of sandwich plating
13.4 Information required by Annex J for commercial craft and workboats

14 Application form

Annex A (normative) Application of methods of analysis 1 to 3 of Table 18

A.1 Purpose of this Annex
A.2 Panel assessment
A.2.1 General case: Dedicated and regularly spaced secondary stiffeners
A.2.2 Panel assessment in other cases
A.3 Determination of the short dimension and curvature of a panel
A.4 Very large panels
A.5 Case where round bilged and hard chined panels act as "natural" stiffeners
A.5.1 General
A.5.2 Case a: For curved or U-shaped panels:
A.5.3 Case b: Where a centred circle can be inscribed in the bottom panel
A.5.4 Hard chined sections
A.6 Examples of stiffener dimension assessment
A.6.1 General
A.6.2 Explanation of Figures A.4 a) to A.4 f)
A.7 Calculation of the scantlings of a panel or stiffener across several areas
A.7.1 General
A.7.2 Examples of determination of panels or stiffeners with constant thickness or section modulus
A.7.3 Same example but with variable thickness or section modulus
A.7.4 Non-structural or redundant stiffeners
A.8 Plating and stiffeners — Scantlings formulas for methods 1 to 3 of Table 2
A.8.1 Preliminary
A.8.2 Thickness adjustment factors for plating
A.8.2.1 Aspect ratio factors k2 for bending moment and shear force kSH
A.8.2.2 Curvature correction factor for plating
A.8.2.3 kC
A.9 Design shear force and bending moment on a rectangular panel
A.10 Requirement for thickness or bending moment due to pressure
A.10.1 General
A.10.2 Use of bulking material and of "effective" core in bending
A.10.2.1 General
A.10.2.2 Resin-saturated foam/felt and syntactic foam
A.10.2.3 Plywood “cores” and other "effective" cores
A.10.3 Detail for assessment of metal plating
A.10.4 Detail for assessment of wood or plywood plating
A.11 FRP sandwich plating
A.11.1 General

A.11.2 Requirements for sandwich: Design stress in skins, core shear stress, and stability
A.11.3 Local reinforcement of the inner skin to improve wrinkling resistance
A.12 Requirements for stiffeners
A.12.1 General
A.12.2 Shear force and bending moment due to pressure loads
A.12.3 Stresses in stiffeners
A.12.4 Curvature factor for stiffeners kCS
A.12.5 Attached plating effective breadth be
A.12.6 Overall dimensions of stiffeners
A.12.6.1 Geometry
A.12.6.2 Maximum proportions between dimensions within a stiffener
A.12.6.3 Connection between the stiffener and the plating
A.13 Structural bulkheads
A.13.1 General
A.14 Structural support for sailing craft ballast keel
A.14.1 General
A.14.2 Reminder of requirements of ISO 12215-9

Annex B (normative) Mechanical properties and design stress of metals

Annex C (normative) FRP laminates properties and calculations

C.1 Status of this Annex
C.2 Determination of the mechanical properties
C.2.1 Tests and test standards
C.2.2 Topics on tests and calculation
C.2.3 Use of flexural strain and strength
C.2.4 Mechanical properties for the simplified method
C.2.5 Elastic constants using 'CLT' method (classical laminate theory)
C.2.6 Elastic constants using 'SRM' method (simplified regression method)
C.2.7 Final mechanical properties
C.2.8 Breaking strains — Both methods CLT or SRM
C.2.9 Practical use of CLT & SRM methods
C.2.9.1 Preliminary
C.2.9.2 Use of CLT and SRM methods
C.2.10 Ply thickness
C.3 Final calculation of E, G and ultimate stress
C.3.1 General calculation
C.3.2 Builder's responsibility
C.4 Determination of mechanical properties of materials not quoted in Tables C.5 to C.10
C.4.1 General
C.4.2 Example

Annex D (normative) Drop test for craft <6 m

D.1 Theoretical background
D.1.1 Theory of drop test
D.1.2 Wave conditions
D.1.3 Relative impact speed
D.1.4 Verification of “drop height”
D.1.5 Safety margin
D.1.6 Fatigue
D.2 Test and compliance
D.2.1 General
D.2.2 Test procedure
D.2.3 Inspection and pass/fail requirements

Annex E (normative) Sandwich calculations

E.1 Sandwich formulas
E.1.1 General
E.2 Sandwich pre-calculated tables and figures

Annex F (normative) Wood/plywood laminate properties and calculations

F.1 Wood laminates
F.1.1 General
F.1.2 Plywood

F.1.3 Moulded in-situ veneers
F.1.4 Strip planking
F.2 Wood laminate mechanical properties
F.2.1 Tested properties
F.2.2 Non-tested properties
F.3 Laminated wood calculation examples

Annex G (normative) Geometric properties of stiffeners

G.1 General
G.2 Glass-reinforced plastic
G.2.1 General
G.2.2 "Squat" former top hats
G.2.3 "Square" former top hats
G.2.4 "Tall" former top hats
G.3 Metal hull stiffeners
G.4 Wood stiffeners
G.4.1 General
G.4.2 Wood stiffeners pre-calculated tables
G.4.3 Method to assess wood stiffeners

Annex H (normative) Laminate stack analysis for plating and stiffeners

H.1 General
H.1.1 Presentation
H.2 Calculation of the parameters for a panel
H.2.1 Geometric aspect ratio, ARG, and effective aspect ratio, ARE
H.2.2 Presentation of Table H.2
H.2.3 Cells/columns (1) to (24) in Table H.2: Preliminary calculation: Shear force and bending moment
H.2.4 Cells (25) to (60) in Table H.2 Panel laminate analysis
H.2.5 Bending stiffness EI
H.2.6 Bending stress analysis
H.2.7 Shear stress analysis
H.2.8 Example shown in Table H.2
H.2.9 General topics
H.3 Sandwich plating
H.3.1 Core only taking shear load
H.3.2 Core effective in bending
H.3.3 Presentation of Tables H.3 and H.4
H.4 Stiffener analysis — Tables H.5 to H.8
H.4.1 General
H.4.2 Tables H.6 to H.8 Worked example for a top hat stiffener

Annex I (informative) "Good practice " values for minimum thickness or dry fibre mass

I.1 Background
I.2 " Good practice" values for minimum thickness or fibre dry mass

Annex J (normative) Commercial craft and workboats — Additional requirements

J.1 Types of commercial craft and workboats
J.2 Additional requirements for commercial craft and workboats
J.2.1 General
J.2.2 Requirements for heavy duty workboats
J.3 Owner's manual
J.3.1 General
J.3.2 Speed reduction table for heavy duty workboats

Annex K (informative) Loads induced by outboard engines

K.1 Loads induced by outboard engines supports

Annex L (informative) Application form of ISO 12215-5

Page count: 126