



Rules for the Classification of Crew Boat

January 2018

**Guidance Note
NR490 DT R02 E**

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**BUREAU
VERITAS**

MARINE & OFFSHORE - GENERAL CONDITIONS

1. INDEPENDENCY OF THE SOCIETY AND APPLICABLE TERMS

- 1.1. The Society shall remain at all times an independent contractor and neither the Society nor any of its officers, employees, servants, agents or subcontractors shall be or act as an employee, servant or agent of any other party hereto in the performance of the Services.
- 1.2. The operations of the Society in providing its Services are exclusively conducted by way of random inspections and do not, in any circumstances, involve monitoring or exhaustive verification.
- 1.3. The Society acts as a services provider. This cannot be construed as an obligation bearing on the Society to obtain a result or as a warranty. The Society is not and may not be considered as an underwriter, broker in Unit's sale or chartering, expert in Unit's valuation, consulting engineer, controller, naval architect, manufacturer, shipbuilder, repair or conversion yard, charterer or shipowner; none of them above listed being relieved of any of their expressed or implied obligations as a result of the interventions of the Society.
- 1.4. The Services are carried out by the Society according to the applicable Rules and to the Bureau Veritas Code of Ethics. The Society only is qualified to apply and interpret its Rules.
- 1.5. The Client acknowledges the latest versions of the Conditions and of the applicable Rules applying to the Services' performance.
- 1.6. Unless an express written agreement is made between the Parties on the applicable Rules, the applicable Rules shall be the rules applicable at the time of the Services' performance and contract's execution.
- 1.7. The Services' performance is solely based on the Conditions. No other terms shall apply whether express or implied.

2. DEFINITIONS

- 2.1. "Certificate(s)" means class certificates, attestations and reports following the Society's intervention. The Certificates are an appraisal given by the Society to the Client, at a certain date, following surveys by its surveyors on the level of compliance of the Unit to the Society's Rules or to the documents of reference for the Services provided. They cannot be construed as an implied or express warranty of safety, fitness for the purpose, seaworthiness of the Unit or of its value for sale, insurance or chartering.
- 2.2. "Certification" means the activity of certification in application of national and international regulations or standards, in particular by delegation from different governments that can result in the issuance of a certificate.
- 2.3. "Classification" means the classification of a Unit that can result or not in the issuance of a class certificate with reference to the Rules.
- 2.4. "Client" means the Party and/or its representative requesting the Services.
- 2.5. "Conditions" means the terms and conditions set out in the present document.
- 2.6. "Industry Practice" means International Maritime and/or Offshore industry practices.
- 2.7. "Intellectual Property" means all patents, rights to inventions, utility models, copyright and related rights, trade marks, logos, service marks, trade dress, business and domain names, rights in trade dress or get-up, rights in goodwill or to sue for passing off, unfair competition rights, rights in designs, rights in computer software, database rights, topography rights, moral rights, rights in confidential information (including know-how and trade secrets), methods and protocols for Services, and any other intellectual property rights, in each case whether capable of registration, registered or unregistered and including all applications for and renewals, reversions or extensions of such rights, and all similar or equivalent rights or forms of protection in any part of the world.
- 2.8. "Parties" means the Society and Client together.
- 2.9. "Party" means the Society or the Client.
- 2.10. "Register" means the register published annually by the Society.
- 2.11. "Rules" means the Society's classification rules, guidance notes and other documents. The Rules, procedures and instructions of the Society take into account at the date of their preparation the state of currently available and proven technical minimum requirements but are not a standard or a code of construction neither a guide for maintenance, a safety handbook or a guide of professional practices, all of which are assumed to be known in detail and carefully followed at all times by the Client.
- 2.12. "Services" means the services set out in clauses 2.2 and 2.3 but also other services related to Classification and Certification such as, but not limited to: ship and company safety management certification, ship and port security certification, training activities, all activities and duties incidental thereto such as documentation on any supporting means, software, instrumentation, measurements, tests and trials on board.
- 2.13. "Society" means the classification society 'Bureau Veritas Marine & Offshore SAS', a company organized and existing under the laws of France, registered in Nanterre under the number 821 131 844, or any other legal entity of Bureau Veritas Group as may be specified in the relevant contract, and whose main activities are Classification and Certification of ships or offshore units.
- 2.14. "Unit" means any ship or vessel or offshore unit or structure of any type or part of it or system whether linked to shore, river bed or sea bed or not, whether operated or located at sea or in inland waters or partly on land, including submarines, hovercrafts, drilling rigs, offshore installations of any type and of any purpose, their related and ancillary equipment, subsea or not, such as well head and pipelines, mooring legs and mooring points or otherwise as decided by the Society.

3. SCOPE AND PERFORMANCE

- 3.1. The Society shall perform the Services according to the applicable national and international standards and Industry Practice and always on the assumption that the Client is aware of such standards and Industry Practice.

3.2. Subject to the Services performance and always by reference to the Rules, the Society shall:

- review the construction arrangements of the Unit as shown on the documents provided by the Client;
- conduct the Unit surveys at the place of the Unit construction;
- class the Unit and enters the Unit's class in the Society's Register;
- survey the Unit periodically in service to note that the requirements for the maintenance of class are met. The Client shall inform the Society without delay of any circumstances which may cause any changes on the conducted surveys or Services.

The Society will not:

- declare the acceptance or commissioning of a Unit, nor its construction in conformity with its design, such activities remaining under the exclusive responsibility of the Unit's owner or builder;
- engage in any work relating to the design, construction, production or repair checks, neither in the operation of the Unit or the Unit's trade, neither in any advisory services, and cannot be held liable on those accounts.

4. RESERVATION CLAUSE

- 4.1. The Client shall always: (i) maintain the Unit in good condition after surveys; (ii) present the Unit after surveys; (iii) present the Unit for surveys; and (iv) inform the Society in due course of any circumstances that may affect the given appraisal of the Unit or cause to modify the scope of the Services.
- 4.2. Certificates referring to the Society's Rules are only valid if issued by the Society.
- 4.3. The Society has entire control over the Certificates issued and may at any time withdraw a Certificate at its entire discretion including, but not limited to, in the following situations: where the Client fails to comply in due time with instructions of the Society or where the Client fails to pay in accordance with clause 6.2 hereunder.

5. ACCESS AND SAFETY

- 5.1. The Client shall give to the Society all access and information necessary for the efficient performance of the requested Services. The Client shall be the sole responsible for the conditions of presentation of the Unit for tests, trials and surveys and the conditions under which tests and trials are carried out. Any information, drawings, etc. required for the performance of the Services must be made available in due time.
- 5.2. The Client shall notify the Society of any relevant safety issue and shall take all necessary safety-related measures to ensure a safe work environment for the Society or any of its officers, employees, servants, agents or subcontractors and shall comply with all applicable safety regulations.

6. PAYMENT OF INVOICES

- 6.1. The provision of the Services by the Society, whether complete or not, involve, for the part carried out, the payment of fees thirty (30) days upon issuance of the invoice.
- 6.2. Without prejudice to any other rights hereunder, in case of Client's payment default, the Society shall be entitled to charge, in addition to the amount not properly paid, interests equal to twelve (12) months LIBOR plus two (2) per cent as of due date calculated on the number of days such payment is delinquent. The Society shall also have the right to withhold certificates and other documents and/or to suspend or revoke the validity of certificates.
- 6.3. In case of dispute on the invoice amount, the undisputed portion of the invoice shall be paid and an explanation on the dispute shall accompany payment so that action can be taken to solve the dispute.

7. LIABILITY

- 7.1. The Society bears no liability for consequential loss. For the purpose of this clause consequential loss shall include, without limitation:
 - Indirect or consequential loss;
 - Any loss and/or deferral of production, loss of product, loss of use, loss of bargain, loss of revenue, loss of profit or anticipated profit, loss of business and business interruption, in each case whether direct or indirect.

The Client shall save, indemnify, defend and hold harmless the Society from the Client's own consequential loss regardless of cause.

- 7.2. In any case, the Society's maximum liability towards the Client is limited to one hundred and fifty per-cents (150%) of the price paid by the Client to the Society for the performance of the Services. This limit applies regardless of fault by the Society, including breach of contract, breach of warranty, tort, strict liability, breach of statute.
- 7.3. All claims shall be presented to the Society in writing within three (3) months of the Services' performance or (if later) the date when the events which are relied on were first discovered by the Client. Any claim not so presented as defined above shall be deemed waived and absolutely time barred.

8. INDEMNITY CLAUSE

- 8.1. The Client agrees to release, indemnify and hold harmless the Society from and against any and all claims, demands, lawsuits or actions for damages, including legal fees, for harm or loss to persons and/or property tangible, intangible or otherwise which may be brought against the Society, incidental to, arising out of or in connection with the performance of the Services except for those claims caused solely and completely by the negligence of the Society, its officers, employees, servants, agents or subcontractors.

9. TERMINATION

- 9.1. The Parties shall have the right to terminate the Services (and the relevant contract) for convenience after giving the other Party thirty (30) days' written notice, and without prejudice to clause 6 above.

9.2. In such a case, the class granted to the concerned Unit and the previously issued certificates shall remain valid until the date of effect of the termination notice issued, subject to compliance with clause 4.1 and 6 above.

10. FORCE MAJEURE

10.1. Neither Party shall be responsible for any failure to fulfil any term or provision of the Conditions if and to the extent that fulfilment has been delayed or temporarily prevented by a force majeure occurrence without the fault or negligence of the Party affected and which, by the exercise of reasonable diligence, the said Party is unable to provide against.

10.2. For the purpose of this clause, force majeure shall mean any circumstance not being within a Party's reasonable control including, but not limited to: acts of God, natural disasters, epidemics or pandemics, wars, terrorist attacks, riots, sabotages, impositions of sanctions, embargoes, nuclear, chemical or biological contaminations, laws or action taken by a government or public authority, quotas or prohibition, expropriations, destructions of the worksite, explosions, fires, accidents, any labour or trade disputes, strikes or lockouts

11. CONFIDENTIALITY

11.1. The documents and data provided to or prepared by the Society in performing the Services, and the information made available to the Society, are treated as confidential except where the information:

- is already known by the receiving Party from another source and is properly and lawfully in the possession of the receiving Party prior to the date that it is disclosed;
- is already in possession of the public or has entered the public domain, otherwise than through a breach of this obligation;
- is acquired independently from a third party that has the right to disseminate such information;
- is required to be disclosed under applicable law or by a governmental order, decree, regulation or rule or by a stock exchange authority (provided that the receiving Party shall make all reasonable efforts to give prompt written notice to the disclosing Party prior to such disclosure).

11.2. The Society and the Client shall use the confidential information exclusively within the framework of their activity underlying these Conditions.

11.3. Confidential information shall only be provided to third parties with the prior written consent of the other Party. However, such prior consent shall not be required when the Society provides the confidential information to a subsidiary.

11.4. The Society shall have the right to disclose the confidential information if required to do so under regulations of the International Association of Classifications Societies (IACS) or any statutory obligations.

12. INTELLECTUAL PROPERTY

- 12.1. Each Party exclusively owns all rights to its Intellectual Property created before or after the commencement date of the Conditions and whether or not associated with any contract between the Parties.
- 12.2. The Intellectual Property developed for the performance of the Services including, but not limited to drawings, calculations, and reports shall remain exclusive property of the Society.

13. ASSIGNMENT

- 13.1. The contract resulting from these Conditions cannot be assigned or transferred by any means by a Party to a third party without the prior written consent of the other Party.
- 13.2. The Society shall however have the right to assign or transfer by any means the said contract to a subsidiary of the Bureau Veritas Group.

14. SEVERABILITY

14.1. Invalidity of one or more provisions does not affect the remaining provisions.

14.2. Definitions herein take precedence over other definitions which may appear in other documents issued by the Society.

14.3. In case of doubt as to the interpretation of the Conditions, the English text shall prevail.

15. GOVERNING LAW AND DISPUTE RESOLUTION

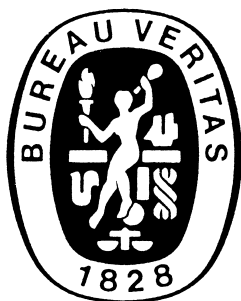
15.1. The Conditions shall be construed and governed by the laws of England and Wales.

15.2. The Society and the Client shall make every effort to settle any dispute amicably and in good faith by way of negotiation within thirty (30) days from the date of receipt by either one of the Parties of a written notice of such a dispute.

15.3. Failing that, the dispute shall finally be settled by arbitration under the LCIA rules, which rules are deemed to be incorporated by reference into this clause. The number of arbitrators shall be three (3). The place of arbitration shall be London (UK).

16. PROFESSIONAL ETHICS

- 16.1. Each Party shall conduct all activities in compliance with all laws, statutes, rules, and regulations applicable to such Party including but not limited to: child labour, forced labour, collective bargaining, discrimination, abuse, working hours and minimum wages, anti-bribery, anti-corruption. Each of the Parties warrants that neither it, nor its affiliates, has made or will make, with respect to the matters provided for hereunder, any offer, payment, gift or authorization of the payment of any money directly or indirectly, to or for the use or benefit of any official or employee of the government, political party, official, or candidate.
- 16.2. In addition, the Client shall act consistently with the Society's Code of Ethics of Bureau Veritas, <http://www.bureauveritas.com/home/about-us/ethics-and-compliance>



RULE NOTE NR 490

Rules for the Classification of Crew Boat

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SECTION 1GENERAL

1 General

1.1 Application

1.1.1 Requirements of these Rules are applicable to crew boats as defined in [2.1.1] of less than 500 GRT, with hull made of steel, aluminium or composite materials, and proceeding in the course of their voyage not more than four hours at operational speed from a place of refuge.

The present Rules are normally applicable to crew boats having a maximum service speed V , in knots, greater or equal to $7,16 \Delta^{1/6}$, where Δ is the moulded full load displacement, in tonnes.

Craft for which $V \geq 10 L^{0.5}$ shall be individually considered by the Society.

1.1.2 Provisions not specially covered in these Rules are to comply with applicable requirements stipulated in NR467 Steel Ships, Part A, NR600 and NR566.

1.1.3 Ship covered by the present Rules Note are assigned the service notation **crew boat**, as defined in NR467 Steel Ships, Pt A, Ch 1, Sec 2.

1.2 Navigation Notations

1.2.1 As a rule, one of the following navigation notations is to be assigned with reference to significant wave heights H_s which are exceeded for an average of not more than 10 per cent of the year as defined in Sec 2, [6.1.3]:

- sea area 1
- sea area 2
- sea area 3
- sea area 4.

The shipyard's table of the maximum allowed ship speed relative to the sea states, characterised by their significant wave height, is indicated in a memoranda.

1.3 Rules application

1.3.1 In the present Rules, references to other Rules of the Society are defined in Tab 2.

1.3.2 Summary table

The applicable Rules of the Society to be considered are indicated in Tab 1.

2 Definitions

2.1 Crew boats

2.1.1 Crew boats are basically vessels dedicated to transport of offshore personnel from harbours to moored offshore installations or vessels.

They may be also involved in supplying such installations with goods and stores.

They are, in general, single deck ships arranged with large superstructures forward and a broad open deck aft intended for cargo.

2.2 Operational conditions

2.2.1 Crew boats are to be operated in relation to the navigation notation assigned as defined in [1.2] within operating conditions defined in Sec 2, [6.3].

2.2.2 Operational speed is 90% of maximum speed.

Table 1 : Summary table

Main subject	Reference
Hull	Sec 2
General arrangement design	NR566, Ch 1, Sec 2
Stability	NR566, Ch 1, Sec 3
Hull integrity	NR566, Ch 1, Sec 4
Outfittings	Sec 3
Machinery	NR566, Ch 2
Electrical and automation	NR566, Ch 3
Fire safety	NR566, Ch 4

Table 2 : References to other Rules of the Society

Reference	Title
NR467 Steel Ships	Rules for the Classification of Steel Ships
NR600	Hull Structure and Arrangement for the Classification of Cargo Ships less than 65 m and Non Cargo Ships less than 90 m
NR566	Hull Arrangement, Stability and Systems for ships less than 500 GT
NR546 Composite Ships	Rules for Hull in Composite Materials and Plywood, Material Approval, Design Principles, Construction and Survey
NR561 Aluminium Ships	Rules for Hull in Aluminium Alloys, Design Principles, Construction and Survey
NR216 Materials & Welding	Rules on Materials and Welding for the Classification of Marine Units

SECTION 2HULL SCANTLINGS

1 Documents to be submitted

1.1 General

1.1.1 Tab 1 lists the structural plans that are to be submitted to the Society for examination and approval.

1.1.2 In addition, the following informations are to be submitted:

- draught and trim of the craft at sea, at rest and at its maximum speed in calm water
- any direct calculations performed.

When deemed necessary, the following informations may be required:

- results of model tests and full-scale measurements
- longitudinal weight distribution and position of the longitudinal centre of gravity of the craft
- design loading conditions including:
 - still water bending moments (SWBM) distribution
 - still water shear force (SF) distribution
 - description of corresponding loading cases.

1.1.3 For hull made of composite materials, additional informations defined in NR546 Composite Ships, Sec 1, [4.2] are to be submitted.

2 General

2.1 Introductory comments

2.1.1 This Section contains the requirements for the determination of the hull scantling.

Attention is drawn to the selection of building materials which is not only to be determined from strength consideration, but should also give consideration to structural fire protection and associated class requirements or Flag Administration requirements where applicable.

2.2 Direct calculations

2.2.1 The Society may require direct calculations to be carried out, if deemed necessary according to the provisions of Article [9].

Such calculations are to be carried out based on structural modelling, loading and checking criteria described in Article [9]. Calculations based on other criteria may be accepted if deemed equivalent to those laid down by the Society.

Table 1 : Structural plans to be submitted

Plan	Containing information relevant to:
Midship section Main sections	• moulded dimensions, maximum service speed V, design acceleration a_{CG} and, if known, limit wave height (see [6.3]) • materials • typical structural details
Longitudinal sections	• structural details • openings in longitudinal girders
Decks	• typical structural details • openings • deck loads, if different from Rule loads
Shell expansion	• plating • materials • typical structural details • position of butt and seam welds • openings
Machinery space structure	• machinery mass and position of centre of gravity • typical structural details • openings
Watertight bulkheads	• openings • typical structural details • openings • pipe passages
Deckhouses	• materials • details of connections between different materials • typical structural details
Rudder	• rudder stock material and scantlings
Propeller shaft brackets	• materials, scantlings, connection details
Equipment	• calculation of equipment number • equipment specification
Testing plan	• position of air vents • testing pressures

2.3 Units

2.3.1 Unless otherwise specified, the following units are used in the Rules:

- thickness of plating, in mm
- section modulus of stiffeners, in cm^3
- shear area of stiffeners, in cm^2
- span and spacing of stiffeners, in m
- stresses, in N/mm^2
- concentrated loads, in kN
- distributed loads, in kN/m or kN/m^2 .

2.4 Definitions and symbols

2.4.1 The definitions of the following terms and symbols are applicable throughout this Section and are not, as a rule, repeated in the different paragraphs. Definitions applicable only to certain paragraphs are specified therein.

- Aft end:
hull region abaft of 0,1 L from the aft perpendicular
 - Bottom:
the bottom is the part of the hull between the keel and the chines
 - Chine:
for hulls that do not have a clearly identified chine, the chine is the hull point at which the tangent to the hull is inclined 50° to the horizontal
 - Deadrise angle α_d :
for hulls that do not have a clearly identified deadrise angle, α_d is the angle between the horizontal and a straight line joining the keel and the chine
 - Deckhouse:
the deckhouse is a decked structure located above the main deck, with lateral walls inboard of the side of more than 4 per cent of the local breadth. Structure located on the main deck and whose walls are not in the same longitudinal plane as the under side shell may be regarded as a deckhouse
 - Fore end:
hull region forward of 0,9 L from the aft perpendicular
 - Hull:
the hull is the outer boundary of the enclosed spaces of the craft, except for the deckhouses, as defined below
 - Main deck:
the main deck is the uppermost complete deck of the hull. It may be stepped
 - Midship area:
hull region between 0,3 L and 0,7 L from the aft perpendicular.
 - Moulded base line:
the line parallel to the summer load waterline, crossing the upper side of keel plate or the top of skeg at the middle of length L
 - Side:
the side is the part of the hull between the chine and the main deck
- AP : Aft perpendicular, i.e. the perpendicular located at a distance L abaft of the forward perpendicular
- B : The greatest moulded breadth, in m, of the craft
- B_w : The greatest moulded breadth, in m, measured on the waterline at draught T
- B_{wm} : The greatest moulded breadth, in m, measured below or on the waterline at draught T

C_B : Total block coefficient, defined as follows:

$$C_B = \frac{\Delta}{(1,025 \cdot L \cdot B_w \cdot T)}$$

For catamarans, B_w is to be measured at one float and Δ is to be taken equal to half the total displacement value

- D : Depth, in m, measured vertically in the transverse section at the middle of length L from the moulded base line of the hull to the top of the deck beam at one side of the main deck (if the main deck is stepped, D will be defined in each separate case at the discretion of the Society)
- Δ : Moulded displacement at draught T, in sea water (mass density = 1,025 t/m³), in tonnes
- FP : Forward perpendicular, i.e. the perpendicular at the intersection of the waterline at draught T and the foreside of the stem
- g : Acceleration of gravity, equal to 9,81 m/s²
- L : Rule length, in m, equal to L_{WL} where L_{WL} is the waterline measured with the craft at rest in calm water
- LCG : Longitudinal centre of gravity of the craft
- T : Draught of the craft, in m, measured vertically on the transverse section at the middle of length L, from the moulded base line of the hull to the full load waterline, with the craft at rest in calm water
- V : Maximum service speed, in knots.

2.5 Protection against corrosion

2.5.1 Scantlings stipulated in Article [10] assume that the materials used are chosen and protected in such a way that the strength lost by corrosion is negligible.

2.5.2 The Shipyard is to give the Society a document specifying all the arrangements made to protect the material against corrosion at the construction stage (e.g. coating types, number and thickness of layers, surface preparation, application conditions, control after completion, anodic protection, etc.).

This document must also include maintenance arrangements to be made in service to restore and maintain the efficiency of this protection, whatever the reasons of its weakening, whether incidental or not.

All such maintenance operations are to be listed in a book shown to the Surveyor at each visit.

2.6 Rounding-off

2.6.1 Values for thickness as deduced from formulae are to be rounded off to the nearest standard value, without such a reduction exceeding 3 per cent.

3 Steel and aluminium alloys materials and connections

3.1 General requirements

3.1.1 This Article defines the main characteristics to take into account for steels and aluminium alloys within the scope of the determination of the hull scantling as defined in the present Rules.

3.1.2 Materials with different characteristics may be considered, provided their specification (manufacture, chemical composition, mechanical properties, welding,...) is submitted to the Society for approval.

3.1.3 Testing and manufacturing process

Materials are to be tested in compliance with the applicable requirements of NR216 Materials and Welding.

The requirements of this Section presume that welding and other cold or hot manufacturing processes (parent material types and welding, preheating, heat treatment after welding,...) are carried out in compliance with current sound working practice and the applicable requirements of NR216 Materials and Welding.

3.2 Steel structures

3.2.1 Steels for hull structures, forgings and castings

The characteristics of steels to be used in the construction of ships are to comply with the applicable requirements of NR216 Materials and Welding.

3.2.2 Mechanical characteristics

The mechanical characteristics of steels are to comply with the requirements of NR467 Steel Ships, Pt B, Ch 4, Sec 1, and in particular the:

- grade of steel to be used for the various strength members of the structure
- steels for forging and casting.

Tab 2 gives for information the mechanical properties of steels currently used in the construction of ships.

Higher strength steels other than those indicated in Tab 2 are considered by the Society on a case-by-case basis.

When steels with a minimum specified yield stress R_{eH} other than 235 N/mm² are used, hull scantlings are to be determined by taking into account the material factor k defined in [3.2.3].

3.2.3 Material factor k for scantlings of structural members

The value of the material factor k to be introduced into formulae to check structures given in this Section is a function of the minimum yield stress R_{eH} value specified for the steel to be used.

Tab 3 shows the values of the material factor k to be taken depending on the R_{eH} value of the various high strength steels for hull structures for which $R_{eH} \leq 390$ N/mm².

The use of steels for which $R_{eH} > 355$ N/mm² will be considered in each separate case by the Society, which may stipulate special acceptance conditions.

If, for special structures, the use of steels for which $R_{eH} < 235$ N/mm², has been accepted by the Society, the material factor is to be determined by:

$k = 235 / R_{eH}$

In the case where the use of steels with R_{eH} values which are intermediate between those indicated in Tab 3 is allowed, the values of the material factor k may be determined by means of linear interpolation.

3.2.4 Welding

The requirements for the scantling and joint design of welded connection of ships built in steel materials are defined in NR600, Chapter 6, Section 2.

Table 2 : Mechanical characteristics

Steel grades t ≤ 100 mm	Minimum yield stress R_{eH} , in N/mm ²	Ultimate minimum tensile strength R_m , in N/mm ²
A-B-D-E	235	400 - 520
AH32-DH32-EH32 FH32	315	440 - 590
AH36-DH36-EH36 FH36	355	490 - 620
AH40-DH40-EH40 FH40	390	510 - 650
Note 1: Refer to NR216 Materials and Welding, Ch 2, Sec 1, [2].		

Table 3 : k factor

R_{eH} (N/mm ²)	k
235	1,00
315	0,78
355	0,72
390	0,70

3.3 Aluminium alloy structures

3.3.1 Aluminium alloys for hull structures, forgings and castings

The characteristics of aluminium alloys to be used in the construction and their testing process are to comply with the applicable requirements of the following Rules:

- NR216 Materials and Welding
- NR561 Aluminium Ships.

The list of aluminium alloys given in Tab 4 and Tab 5 for information only is not exhaustive. Other aluminium alloys may be considered, provided the specification (manufacture, chemical composition, temper, mechanical properties, welding, etc.) and the scope of application be submitted to the Society for review.

Unless otherwise specified, the Young's modulus for aluminium alloys is equal to 70000 N/mm² and the Poisson's ratio equal to 0,33.

The main symbols considered in the present article are:

- R_m : Tensile strenght, in N/mm², of the parent metal in delivery condition, as specified (see Tab 4 or Tab 5)
- R_m : Tensile strenght, in N/mm², of the parent metal in as-welded condition
- $R_{p0,2}$: Proof stress (yielding strenght), in N/mm², of the parent metal in delivery condition, as specified (see Tab 4 or Tab 5)
- $R_{p0,2}$: Proof stress (yield strenght), in N/mm², of the parent metal in as welded condition.

The mechanical characteristics given in Tab 4 and Tab 5 correspond to general standard values. For more information, refer to the minimum values guaranted by the product supplier.

3.3.2 Material factor k for scantlings of structural members made of aluminium alloy

The value of the material factor k to be introduced into formulae for checking scantlings of structural members given in this Section is determined by the following equation:

$$k = \frac{100}{R'_{lim}}$$

where:

- R'_{lim} : Minimum guaranteed yield stress of the parent metal in welded condition $R'_{p0,2}$, in N/mm², but not to be taken greater than 70% of the minimum guaranteed tensile strength of the parent metal in welded condition R'_{m} , in N/mm² (see Tab 4).

For welded constructions in hardened aluminium alloys (series 5000 other than condition 0 or H111 and series 6000), greater characteristics than those in welded condition may be considered, provided that welded connections are located in areas where stress levels are acceptable for the alloy considered in annealed or welded condition.

In case of welding of two different aluminium alloys, the material factor k to be considered for the scantlings of welds is to be the greater material factor of the aluminium alloys of the assembly.

Table 4 : Mechanical properties for rolled products with 3 mm ≤ t ≤ 50 mm

Grade	Temper condition	Thickness t (mm)	Yield strength $R_{p0,2}$ min (N/mm ²)	Tensile strength R_m min or range (N/mm ²)	Elongation min (%) (1)	
					$A_{50\text{ mm}}$	A_{5d}
5083	O / H111	3 ≤ t ≤ 50	125	275 - 350	16	14
	H112	3 ≤ t ≤ 50	125	275	12	10
	H116	3 ≤ t ≤ 50	215	305	10	10
	H321	3 ≤ t ≤ 50	215 - 295	305 - 385	12	10
5383	O / H111	3 ≤ t ≤ 50	145	290		17
	H116	3 ≤ t ≤ 50	220	305	10	10
	H321	3 ≤ t ≤ 50	220	305	10	10
5059	O	3 ≤ t ≤ 50	160	330		24
	H111	3 ≤ t ≤ 50	160	330	24	24
		3 ≤ t ≤ 20	270	370	10	10
	H116	20 < t ≤ 50	260	360	10	10
	H321	3 ≤ t ≤ 20	270	370	10	10
		20 < t ≤ 50	260	360	10	10
5086	O / H111	3 ≤ t ≤ 50	95	240 - 305	16	14
	H112	3 ≤ t ≤ 12,5	125	250	8	
		12,5 < t ≤ 50	105	240		9
	H116	3 ≤ t ≤ 50	195	275	10 (2)	9
5754	O / H111	3 ≤ t ≤ 50	80	190 - 240	18	17
5456	O	3 ≤ t ≤ 6,3	130 - 205	290 - 365	16	
		6,3 < t ≤ 50	125 - 205	285 - 360	16	14
	H116	3 ≤ t ≤ 30	230	315	10	10
		30 < t ≤ 40	215	305		10
		40 < t ≤ 50	200	285		10
	H321	3 ≤ t ≤ 12,5	230 - 315	315 - 405	12	
		12,5 < t ≤ 40	215 - 305	305 - 385		10
		40 < t ≤ 50	200 - 295	285 - 370		10

(1) Elongation in 50 mm applies for thicknesses up to and including 12,5 mm and in 5d for thicknesses over 12,5 mm.

(2) 8% for thicknesses up to and including 6,3 mm.

Table 5 : Mechanical properties for extruded products with 3 mm ≤ t ≤ 50 mm

Grade	Temper condition	Thickness t (mm)	Yield strength R _{p0,2} min (N/mm ²)	Tensile strength R _m min or range (N/mm ²)	Elongation min (%) (1) (2)	
					A _{50mm}	A _{5d}
5083	O	3 ≤ t ≤ 50	110	270 - 350	14	12
	H111	3 ≤ t ≤ 50	165	275	12	10
	H112	3 ≤ t ≤ 50	110	270	12	10
5383	O	3 ≤ t ≤ 50	145	290	17	17
	H111	3 ≤ t ≤ 50	145	290	17	17
	H112	3 ≤ t ≤ 50	190	310		13
5059	H112	3 ≤ t ≤ 50	200	330		10
5086	O	3 ≤ t ≤ 50	95	240 - 315	14	12
	H111	3 ≤ t ≤ 50	145	250	12	10
	H112	3 ≤ t ≤ 50	95	240	12	10
6005A	T5	3 ≤ t ≤ 50	215	260	9	8
	T6	3 ≤ t ≤ 10	215	260	8	6
		10 < t ≤ 50	200	250	8	6
6060 (3)	T5	t ≤ 5	120	160	10	10
		5 < t ≤ 25	100	140	10	10
6061	T6	3 ≤ t ≤ 50	240	260	10	8
6106	T5	t ≤ 6	200	250	10	10
6082	T5	3 ≤ t ≤ 50	230	270	8	6
	T6	3 ≤ t ≤ 5	250	290	6	
		5 < t ≤ 50	260	310	10	8
(1) The values are applicable for longitudinal and transverse tensile test specimens as well.						
(2) Elongation in 50 mm applies for thicknesses up to and including 12,5 mm and in 5d for thicknesses over 12,5 mm.						
(3) 6060 alloy is not to be used for structural members sustaining dynamic loads (slamming and impact loads). The use of 6106 alloy is recommended in that case.						

3.3.3 Welding and riveting

The requirements for the scantling and joint design of welded and riveted connections of ships built in aluminium alloys are defined in NR561 Aluminium Ships, Section 3.

3.3.4 Corrosion protection - Heterogeneous steel/aluminium alloy assembly

Connections between aluminium alloy parts, and between aluminium alloy and steel parts, if any, are to be protected against corrosion by means of coatings applied by suitable procedures agreed by the Society.

In any case, any direct contact between steel and aluminium alloy is to be avoided (e.g. by means of zinc or cadmium plating of the steel parts and application of a suitable coating on the corresponding light alloy parts).

The conditions for heterogeneous assembly between structures made in aluminium alloys and steel are defined in NR561 Aluminium Ships, Section 3 (see Tab 6).

Table 6 : Aluminium alloys as welded mechanical characteristics

Aluminium alloy	Temper condition	R' _{p0,2}	R' _m
5000 series	0	R _{p0,2}	R _m
5000 series	other	values of 0 condition	
6005 A (closed sections)	T5 or T6	0,45 R _{p0,2}	0,6 R _m
6005 A (closed sections)	T5 or T6	0,50 R _{p0,2}	0,6 R _m
6060 (sections) (1)	T5	0,43 R _{p0,2}	0,5 R _m
6061 (sections)	T6	0,53 R _{p0,2}	0,6 R _m
6082 (sections)	T6	0,45 R _{p0,2}	0,6 R _m
6106 (sections)	T5	0,33 R _{p0,2}	0,54 R _m
(1) 6060 alloy is not to be used for structural members sustaining dynamic loads (slamming and impact loads). The use of 6106 alloy is recommended in that case.			

4 Composite materials

4.1 Application

4.1.1 The characteristics of composite materials and their testing and manufacturing process are to comply with the applicable requirements of NR546 Composite Ships, in particular for the:

- raw materials (see NR546, Section 4)
- individual layers and theoretical breaking stresses (see NR546, Section 5)
- laminate characteristics (see NR546, Section 6)
- mechanical tests and raw material homologation (see NR546, Section 11 and Appendix 1).

4.1.2 Attention is drawn to the use of composite materials from a structural fire protection point of view.

The Flag Administration may request that international convention be applied instead of the present requirements, entailing in some cases a use limitation of composite materials.

4.2 Principle of design review

4.2.1 The design review of composite structures is based on safety factors defined as the ratio between the theoretical capacity of the structure and the actual applied stresses, which are to be in compliance with the following criteria:

$$\frac{\sigma_{bri}}{\sigma_{iapp}} \geq SF$$

$$\frac{\sigma_c}{\sigma_A} \geq SF_B$$

where:

- σ_A : Compressive stress applied to the whole laminate considered
- σ_{bri} : In-plane theoretical individual layer breaking stresses defined in NR546 Composite Ships, Sec 5, [5]
- σ_c : Critical buckling stress of the composite element considered defined in NR546 Composite Ships, Sec 6, [4]
- σ_{iapp} : In-plane individual layer applied stresses as defined in NR546 Composite Ships, Section 6

SF, SF_B : Rules safety factors defined in [4.3].

In addition, the combined stress criteria in the individual layers defined in NR546 Composite Ships, Sec 2, [1.3.3] is to be greater than the Rules safety factor SF_{CS} defined in [4.3.3].

Note 1: Breaking stresses directly deduced from mechanical tests (as requested in NR546 Composite Ships), may be taken over from theoretical breaking stresses if mechanical test results are noticeably different from expected values.

4.2.2 Type of stresses considered

The following different type of stresses are considered, corresponding to the different loading mode of the fibres:

- Principal stresses in the individual layers:
 - Stress parallel to the fibre (longitudinal direction):
These stresses, σ_1 , may be tensile or compressive stresses, and are mostly located as follows:
 - in 0° direction of unidirectional tape or fabric reinforcement systems
 - in 0° and 90° directions of woven roving.
 - Stress perpendicular to the fibre (transverse direction):
These stresses, σ_2 , may be tensile or compressive stresses, and are mostly located as in 90° direction of unidirectional tape or combined fabrics when the set of fibres are stitched together without criss-crossing.
 - Shear stress (in the laminate plane) parallel to the fibre. These shear stresses, τ_{12} , may be found in all type of reinforcement systems
 - Shear stress (through the laminate thickness) parallel or perpendicular to the fibre. These shear stresses, τ_{13} and τ_{23} , are the same stresses than the interlaminar shear stresses τ_{IL2} and τ_{IL1}
 - Combined stress: Hoffman criteria
- Stresses in the whole laminate:
 - Compressive and shear stresses in the whole laminate inducing buckling.

4.2.3 Theoretical breaking criteria

Three theoretical breaking criteria are used in the present Rules:

- maximum stress criteria leading to the breaking of the component resin/fibre of one elementary layer of the full lay-up laminate
- hoffman combined stress criteria with the hypothesis of in-plane stresses in each layer
- critical buckling stress criteria applied to the laminate.

The theoretical breaking criteria defined in a) and b) are to be checked for each individual layer.

The theoretical breaking criteria defined in c) is to be checked for the global laminate.

4.2.4 First ply failure

It is considered that the full lay-up laminate breaking strength is reached as soon as the lowest breaking strength of any elementary layer is reached. This is referred to as "first ply failure".

4.3 Rules safety factors

4.3.1 General

- The Rules safety factors to be considered for the composite structure check are defined in [4.3.3], according to the type of hull structure calculation check and according to the partial safety factors defined in [4.3.2]
- Additional consideration on rule safety factors:
Rules safety factors other than those defined in [4.3.3] may be accepted for one elementary layer when the full lay-up laminate exhibits a sufficient safety margin between the theoretical breaking of this elementary layer and the theoretical breaking of the other elementary layers.

4.3.2 Partial safety factors

As a general rule, the minimum partial safety factors considered are to be as defined as follow:

a) Ageing effect factor C_V :

The factor C_V taking into account the ageing effect of the composites is generally taken equal to:

- for monolithic laminates (or face-skins laminates of sandwich):

$$C_V = 1,2$$

- for sandwich core materials:

$$C_V = 1,1$$

b) Fabrication process factor C_F :

The factor C_F taking into account the fabrication process and the reproducibility of the fabrication is generally taken equal to:

- in case of a prepreg process:

$$C_F = 1,1$$

- in case of infusion and vacuum process:

$$C_F = 1,15$$

- in case of a hand lay up process:

$$C_F = 1,25$$

- for the core materials of sandwich composite:

$$C_F = 1,0$$

c) Type of load factor C_i :

The factor C_i taking into account the type of loads is generally taken equal to:

- for local external sea pressures and internal pressures or concentrated forces:

$$C_i = 1,0$$

- for local dynamic sea pressures (slamming loads on bottom and impact on flat bottom on forward area), and for test pressures and flooding loads:

$$C_i = 0,8$$

- for longitudinal strength analysis as defined in [10.3] and buckling check as defined in [10.7] where longitudinal stresses are obtained taking into account the total bending moment defined in Article [7]:

$$C_i = 0,8$$

d) Type of stress factor C_R :

The factor C_R taking into account the type of stress in the fibres of the reinforcement fabrics and the cores is generally taken equal to:

1) For fibres of the reinforcement fabrics:

- for tensile or compressive stress parallel to the continuous fibre of the reinforcement fabric:

- for unidirectional tape, bi-bias, three unidirectional fabric:

$$C_R = 2,1$$

- for woven roving:

$$C_R = 2,4$$

- for tensile or compressive stress perpendicular to the continuous fibre of the reinforcement fabric (unidirectional tape bi-bias, three unidirectional fabric):

$$C_R = 1,0$$

- for shear stress parallel to the fibre in the elementary layer and for interlaminar shear stress in the laminate:

- for unidirectional tape, bi-bias, three unidirectional fabric:

$$C_R = 1,6$$

- for woven roving:

$$C_R = 1,8$$

- for mat layer:

- for tensile or compressive stress in the layer:

$$C_R = 2,0$$

- for shear stress in the layer and for interlaminar shear stress:

$$C_R = 2,2$$

2) For core materials:

- for a tensile or compressive stress for cores:

general case:

- for a tensile or compressive stress:

$$C_R = 2,1$$

for balsa:

- for a tensile or compressive stress parallel to the wood grain:

$$C_R = 2,1$$

- for tensile or compressive stress perpendicular to the wood grain:

$$C_R = 1,2$$

- for a shear stress (whatever the type of core material)

$$C_R = 2,5$$

3) For wood materials for strip planking:

- for a tensile or compressive stress parallel to the continuous fibre of the strip planking:

$$C_R = 2,4$$

- for tensile or compressive stress perpendicular to the continuous fibre of the strip planking:

$$C_R = 1,2$$

- for a shear stress parallel to the fibre and for interlaminar shear stress in the strip planking:

$$C_R = 2,2$$

4.3.3 Rules safety factors

The Rules safety factors to be considered for the composite structure check are defined according to the type of hull structure calculation.

The Rules safety factors for structure checked under local loads or under global hull girder loads are defined as follows:

- Minimum stress criteria in layers:

$$SF = C_V C_F C_R C_i$$

with:

- C_V to be taken as defined in [4.3.2] a) for the check of the structure under local loads
- $C_V = 1,1$ for the check of the longitudinal strength as defined in [10.3] and for primary structure examined by direct calculation as defined in Article [9].

- Combined stress criteria in layers:

$$SF_{CS} = C_{CS} C_V C_F C_i$$

with:

- for unidirectional tape, bi-bias, three unidirectional fabric:

$$C_{CS} = 1,7$$

- for other type of layer:

$$C_{CS} = 2,1$$

where:

SF_{CS} : Safety factor calculated according to NR546 Composite Ships, Sec 2, [1.3.3]

- Critical buckling stress criteria:

$$SF_B = C_{Buck} C_V C_F C_i$$

with:

- for the check of the longitudinal strength as defined in [10.3] and for primary structure examined by direct calculation as defined in Article [9]:

$$C_{Buck} = 1,35 \text{ and } C_V = 1$$

- $C_{Buck} = 1,45$ and C_V as defined in [4.3.2] a) when the check of the structure under local loads is carried out.

4.3.4 Rules safety factor for structural adhesive joints

The structural adhesive characteristics are to be as defined in NR546 Composite Ships.

As a general rule, the rules safety factor SF applicable to maximum shear stress in adhesive joint considered in the present Rules is to be calculated as follows:

$$SF = 2,4 C_F$$

where:

C_F : Factor taking into account the gluing process, and generally taken equal to:

- in case of a vacuum process with rising curing temperature: $C_F = 1,4$
- in case of vacuum process: $C_F = 1,5$
- in the other cases: $C_F = 1,7$.

5 Construction and testing

5.1 General

5.1.1 Hull construction survey and testing procedures within the scope of classification of ships are defined in NR600, Ch 6, Section 3 and:

- NR600, Ch 6, Sec 4 for hull made of steel material
- NR561 Aluminium Ships, Section 9 for hull made of aluminium alloys
- NR546 Composite Ships, Section 11 for hull made of composite materials.

6 Design acceleration

6.1 Vertical acceleration at LCG

6.1.1 The design vertical acceleration at LCG, a_{CG} (expressed in g), is to be defined by the designer and is to correspond to the average of the 1per cent highest accelerations in the most severe sea conditions expected, in addition to the gravity acceleration.

As a rule, a_{CG} is to be taken not less than:

$$a_{CG} = foc \cdot Soc \cdot \frac{V}{\sqrt{L}}$$

where:

foc : To be taken equal to 0,85

Soc : Value given in Tab 7 in relation to sea area defined in [6.1.3].

Table 7 : Soc values

	Sea area 4	Sea area 3	Sea area 2	Sea area 1
Soc	C_F (1)	0,30	0,23	0,14
(1) $C_F = 0,2 + \frac{0,6}{V/\sqrt{L}} \geq 0,32$				

6.1.2 Lower a_{CG} values may be accepted at the Society's discretion, if justified, on the basis of model tests and/or full-scale measurements.

6.1.3 Navigation notation

The following navigation notation is assigned based on sea areas defined with reference to significant wave heights H_s which are exceeded for an average of not more than 10 per-cent of the year:

- **sea area 4** (open-sea service):
 $H_s \geq 4,0$ m
- **sea area 3** (restricted open-sea service):
 $2,5 \text{ m} \leq H_s < 4,0$ m
- **sea area 2** (moderate environment service):
 $0,5 \text{ m} < H_s < 2,5$ m
- **sea area 1** (smooth sea service):
 $H_s \leq 0,5$ m.

6.1.4 If the design acceleration cannot be defined by the designer, the a_{CG} value corresponding to the appropriate values of foc and Soc defined in [6.1.1] is to be assumed.

6.1.5 An acceleration greater than $a_{CG} = 1,5g$ may not be adopted for the purpose of defining limit operating conditions and scantlings.

6.1.6 The longitudinal distribution of vertical acceleration along the hull is given by:

$$a_v = k_v \cdot a_{CG}$$

where:

a_{CG} : Design acceleration at LCG defined in [6.1.1]

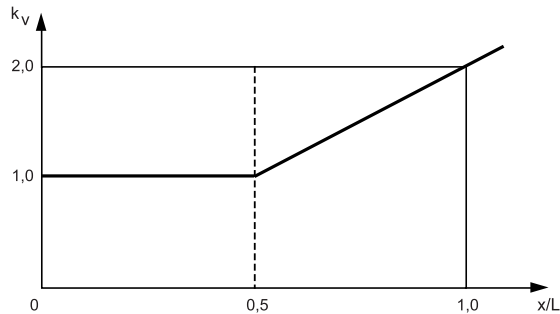
k_v : Longitudinal distribution factor, not to be less than (see Fig 1):

$k_v = 1$ for $x/L \leq 0,5$

$k_v = 2 \cdot x/L$ for $x/L > 0,5$

Higher values may be requested based on pitch consideration.

Figure 1 : k_v factor



6.1.7 Variation of a_v in the transverse direction may generally be disregarded.

6.2 Transverse acceleration

6.2.1 Transverse acceleration is defined on the basis of results of model tests and full-scale measurements, considering their characteristic value as specified in [6.3.1].

6.2.2 In the absence of such results, transverse acceleration, in g, at the calculation point of the craft may be obtained from:

$$a_t = 2,5 \cdot \frac{H_{sl}}{L} \cdot \left(1 + 5 \cdot \left(1 + \frac{V/(\sqrt{L})}{6}\right)^2 \cdot \frac{r}{L}\right)$$

where:

- H_{sl} : Permissible significant wave height at maximum service speed V (see [6.3.2], f))
- r : Distance from the point to 0,5 D.

6.3 Assessment of limit operating conditions

6.3.1 General

- a) “limit operating conditions” in this paragraph are to be taken to mean sea states (characterized only by their significant wave heights) compatible with the structural design parameters of the craft, i.e. the sea states in which the craft may operate depending on its actual speed
- b) limit operating conditions are derived from the restrictions defined in [6.3.2] and [6.3.3] below
- c) it is the designer’s responsibility to specify the format and the values of the limit operating conditions. Their format may be for example a relationship between speed and significant wave height which ascertains actual loads less than the one used for structural design
- d) the limit operating conditions must include the maximum allowed significant wave height H_{sm} consistent with the structural strength. When such design value is

not available, the formula given in h) may be used. The value of H_{sm} is to be consistent with the wave height upper limit corresponding to the sea area considered for structural design, according to [6.1.3]

- e) other specific design parameters influenced by sea state and speed could be also considered at the discretion of the Society
- f) the limit operating conditions are defined, at the discretion of the Society, on the basis of results of model tests and full-scale measurements or by numerical simulations
- g) the limit operating conditions, taken as a basis for classification, are indicated in the Classification Certificate.

These limit operating conditions must be put at the disposal of the crews operating the crew boat (display at the wheelhouse is recommended)
- h) it is assumed that, on the basis of weather forecast, the craft does not encounter, within the time interval required for the voyage, sea states with significant heights, in m, greater than H_{sm}

When H_{sm} is not available, following formula may be used:

$$H_{sm} = 5 \cdot \frac{a_{CG}}{V/(\sqrt{L})} \cdot \frac{L}{6 + 0,14 \cdot L}$$

where vertical acceleration a_{CG} is defined in [6.1]

- i) for craft with a particular shape or other characteristics, the Society reserves the right to require model tests or full-scale measurements to verify results obtained by the above formula.

6.3.2 Limitation imposed by bottom impact pressure and deck loads

- a) bottom impact pressure, given in [8.3], and deck loads, given in [8.8], are explicitly or implicitly depending on the vertical acceleration at LCG. Therefore, the design values of these loads, taken as the basis for the classification, directly impose limitation on vertical acceleration level at LCG
- b) it is the designer’s responsibility to provide for a relation between the speed and the significant wave height that provides a maximum vertical acceleration less than the design value
- c) model tests if any are to be carried out in irregular sea conditions with a significant wave height corresponding to the operating conditions of the craft and a clearly specified sea spectrum. The scale effect is to be accounted for with an appropriate margin of safety. The characteristic value of acceleration and global loads to be assumed corresponds to the average of the 1 per cent highest values obtained during tests. The duration of the test is, as far as practicable, to be sufficient to guarantee that results are stationary
- d) where model test results or full-scale measurements are not available, the formula given in e) may be used to define maximum speeds compatible with design acceleration, depending on sea states having a significant height H_s

- e) the significant wave height is related to the craft's geometric and motion characteristics and to the vertical acceleration a_{CG} by the following formula:

$$a_{CG} = \frac{(50 - \alpha_{dCG}) \left(\frac{\tau}{16} + 0,75 \right)}{3555 \cdot C_B} \cdot \left(\frac{H_s}{T} + 0,084 \frac{B_W}{T} \right) \cdot K_{FR} \cdot K_{HS}$$

for units for which:

- $V / L^{0,5} \geq 3$ and $\Delta / (0,01 \cdot L)^3 \geq 3500$

$$K_{FR} = \left(\frac{V_x}{\sqrt{L}} \right)^2$$

and

$$K_{HS} = 1$$

- $V / L^{0,5} < 3$ or $\Delta / (0,01 \cdot L)^3 < 3500$

$$K_{FR} = 0,8 + 1,6 \cdot \frac{V_x}{\sqrt{L}}$$

and

$$K_{HS} = \frac{H_s}{T}$$

where:

α_{dCG} : Deadrise angle, in degrees, at LCG, to be taken between 10° and 30°

H_s : Significant wave height, in m

τ : Trim angle during navigation, in degrees, to be taken not less than 4°

V : Maximum service speed, in knots

V_x : Actual craft speed, in knots.

if V_x is replaced by the maximum service speed V of the craft, the previous formula yields the significant height of the limit sea state, H_{sl} . This formula may also be used to specify the permissible speed in a sea state characterized by a significant wave height equal to or greater than H_{sl} .

- f) on the basis of the formula indicated in e), the limit sea state may be defined (characterized by its significant wave height H_{sl}), i.e. the sea state in which the craft may operate at its maximum service speed. During its voyage, whenever the craft encounters waves having a significant height greater than H_{sl} , it has to reduce its speed
- g) the reduction of vertical acceleration a_{CG} induced by stabilisation system if any is to be disregarded for the purpose of limit operating conditions imposed by bottom impact loads.

6.3.3 Limitation imposed by global loads

The longitudinal bending moment and shear forces as given in [7.2] are explicitly or implicitly depending on vertical acceleration along the ship. Therefore, the design values of these loads, taken as the basis for classification, directly impose limitation on vertical acceleration level at LCG. The requirements of [6.3.2] items b) to g) apply.

The reduction of vertical acceleration along the ship induced by stabilisation system if any is to be disregarded for the purpose of limit operating conditions imposed by global loads.

6.3.4 Hull monitoring

The Society may require a hull monitoring system to be fitted on board, allowing to monitor and display in real time the vertical acceleration and any other sensitive parameter with respect to the strength.

The information is to be available at the wheelhouse and displayed in a clear format allowing to compare with design values.

When a hull monitoring system is requested, its specification is to be submitted for review.

7 Overall loads

7.1 General

7.1.1 As a rule, only longitudinal vertical bending moment and shear force are to be considered for monohulls.

In addition, the torsional moment defined in [7.2.6] is to be considered for catamaran.

7.1.2 For large craft, values from model tests, or hydrodynamic calculations, may be taken into account, after agreement of the Society on the methodology, the sea conditions and the loading cases. In such cases, values given in [7.2] must be considered as short term $1/100^\circ$ values.

7.2 Bending moment and shear force

7.2.1 General

a) The values of the longitudinal bending moment and shear force are given, in first approximation, by the formula in [7.2.2], [7.2.3] and [7.2.4].

b) The total longitudinal bending moments M_{bIH} , in hogging conditions, and M_{bIS} , in sagging conditions, in kN.m, are to be taken as the greatest of those given by the formulae in [7.2.2] and [7.2.3].

The total shear forces T_{bl} , in kN, is given by the formula in [7.2.4].

c) The longitudinal distribution of the total bending moment M_{bIH} and M_{bIS} is given in [7.2.5].

7.2.2 Longitudinal bending moment due to still water loads, wave induced loads and impact loads

$$M_{bIH} = M_{bIS} = 0,55 \cdot \Delta \cdot L \cdot (C_B + 0,7) \cdot (1 + a_{CG})$$

where:

a_{CG} : Vertical acceleration at the LCG, defined in [6.1].

7.2.3 Longitudinal bending moment due to still water loads and wave induced loads

$$M_{bIH} = M_{sH} + 0,60 \cdot Soc \cdot C \cdot L^2 \cdot B \cdot C_B$$

$$M_{bIS} = M_{sS} + 0,35 \cdot Soc \cdot C \cdot L^2 \cdot B \cdot (C_B + 0,7)$$

where:

M_{sH} : Still water hogging bending moment, in kN.m

M_{sS} : Still water sagging bending moment, in kN.m