Rules for the classification of naval ships

NR 483

AMENDMENTS

July 2020

These sheets contain amendments within the following Sections of June 2017 issue of the *Rules for the classification of naval ships.*

These amendments are cumulative with Amendments April 2020

These amendments are effective from July 1st, 2020.

Part	Volume	Chapter	Section
Part A	*NR483 A1 R02 E*	Ch 1	Sec 1, Sec 2
		Ch 2	Sec 3
		Ch 3	Sec 4
		Ch 5	Sec 1, Sec 9
Part B	*NR483 B1 R02 E*	Ch 3	Sec 2
		Ch 7	Sec 4
Part C	*NR483 C1 R02 E*	Ch 1	Sec 2, Sec 10, Sec 11
		Ch 2	Sec 3, Sec 8, Sec 12, Sec 13, Sec 14, Sec 15
Part D	*NR483 D1 R02 E*	Ch 4	Sec 1, Sec 3, Sec 4, Sec 5, Sec 6, Sec 7, Sec 8, Sec 9
		Ch 5	Sec 5
		Ch 7	Sec 1, Sec 2; Sec 3, Sec4
Part E	*NR483 E1 R02 E*	Ch 4	Sec 1
		Ch 9	Sec 9, Sec 10, Sec 11, Sec 12, Sec 13

BUREAU VERITAS MARINE & OFFSHORE

GENERAL CONDITIONS

1. INDEPENDENCE 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, designer, 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 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 entering into the relevant contract for the performance of the Services.

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 classification or statutory certificates, attestations and reports following the Society's intervention.

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 classification Certificate with reference to the Rules. Classification is an appraisement 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.

2.4 **"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 public electronic register of ships updated regularly by the Society.

2.11 **"Rules"** means the Society's classification rules and other documents. The Society's Rules 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, maritime labour certification, training activities, all activities and duties incidental thereto such as documentation on any supporting means, software, instrumentation, measurements, tests and trials on board. The Services are carried out by the Society according to the applicable referential and to the Bureau Veritas' Code of Ethics. 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.

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 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 Subject to the Services requested 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 enter the Unit's class in the Society's Register;
- survey the Unit periodically in service to note whether 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.

3.2 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 for surveys; and (iii) inform the Society in due time of any circumstances that may affect the given appraisement of the Unit or cause to modify the scope of the Services.

4.2 Certificates 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.

4.4 The Society may at times and at its sole discretion give an opinion on a design or any technical element that would 'in principle' be acceptable to the Society. This opinion shall not presume on the final issuance of any Certificate or on its content in the event of the actual issuance of a Certificate. This opinion shall only be an appraisal made by the Society which shall not be held liable for it.

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

7.2 Except in case of wilful misconduct of the Society, death or bodily injury caused by the Society's negligence and any other liability that could not be, by law, limited, 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 Services having caused the damage. This limit applies to any liability of whatsoever nature and howsoever arising, including fault by the Society, 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 completion of 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 shall defend, release, save, 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 (including for damages arising out of or in connection with opinions delivered according to clause 4.4 above) except for those claims caused solely and completely by the gross 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 Classification 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.

9.3 In the event where, in the reasonable opinion of the Society, the Client is in breach, or is suspected to be in breach of clause 16 of the Conditions, the Society shall have the right to terminate the Services (and the relevant contracts associated) with immediate effect.

10. FORCE MAJEURE

10.1 Neither Party shall be responsible or liable 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 properly and lawfully in the possession of the Society;
- is already in possession of the public or has entered the public domain, otherwise than through a breach of this obligation;
- is acquired or received 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 Parties 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 Without prejudice to sub-clause 11.1, 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 by the Society for the performance of the Services including, but not limited to drawings, calculations, and reports shall remain the exclusive property of the Society.

13. ASSIGNMENT

13.1 The contract resulting from to these Conditions cannot be assigned or transferred by any means by a Party to any 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 These Conditions shall be construed and governed by the laws of England and Wales.

15.2 The Parties 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 under the Rules of Arbitration of the Maritime Arbitration Chamber of Paris ("CAMP"), 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 Paris (France). The Parties agree to keep the arbitration proceedings confidential.

16. PROFESSIONAL ETHICS

16.1 Each Party shall conduct all activities in compliance with all laws, statutes, rules, economic and trade sanctions (including but not limited to US sanctions and EU sanctions) 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, copyright and trademark protection, personal data protection (https://personaldataprotection.bureauveritas.com/privacypolicy).

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 Bureau Veritas' Code of Ethics. https://group.bureauveritas.com/group/corporate-social-responsibility

Amendments to PART A

CHAPTER 1

Ch 1, Sec 1, [1.2] (Amendments April 2020)

Replace requirement [1.2.1] by:

1.2.1 The following general definitions are used in these Rules :

- Society means the Classification Society with which the ship is classed.
- Rules means these Rules for the Classification of Ships and documents issued by the Society serving the same purpose.
- Surveyor means technical staff acting on behalf of the Society to perform tasks in relation to classification and survey duties.
- Survey means an intervention by the Surveyor for assignment or maintenance of class as defined in Part A, Chapter 2, or interventions by the Surveyor within the limits of the tasks delegated by the Naval Authorities.
- Interested Party means a party, other than the Society, having responsibility for the classification of the ship, such as the Owner of the ship and his representatives, or the Shipbuilder, or the Engine Builder, or the Supplier of parts to be tested.
- Navy means the Governmental Body to whom the State or the Defence Department of the State has delegated responsibility for ownership of naval ships. The Navy is responsible for the requirement, procurement and through life support and maintenance of the naval ship.
- Naval Authority means the authority nominated by the Navy responsible for providing regulation associated with procurement and support of the ship. The Naval Authority may also be responsible for identifying appropriate standards, auditing and classification. The Naval Authority could be a Navy department, Statutory Authority or an independent organization with appropriate standing.
- Owner means the party having the responsibility to keep the ship seaworthy, having particular regard to the provisions relating to the maintenance of class laid down in Part A, Chapter 2.
- Shipbuilder means the party having the responsibility of the construction of the ship and of her classification at the assignment phase.
- Approval means the examination and acceptance by the Society of documents, procedures or other items related to classification, verifying solely their compliance with the relevant Rules requirements, or other referentials where requested.
- Type approval means an approval process for verifying compliance with the Rules of a product, a group of products or a system, and considered by the Society as representative of continuous production.
- Essential service is intended to mean a service necessary for a ship to proceed at sea, be steered or manoeuvred, or undertake activities connected with its operation, and for the safety of life, as far as class is concerned.

Ch 1, Sec 2, [4.7] (Amendments April 2020)

Replace (existing) requirement [4.7.1] by:

4.7.1 This notation is assigned to naval ships which, due to the peculiar characteristics of their activity, were grating a specific service notation as mentioned in Part D is not considered as relevant, though NR483 could be applied.

Specific Rules of the Society and in particular the Rules for the Classification of Steel Ships (NR467) may also be applied to these ships.

An additional service feature may be specified after the notation (e.g. **special service - hospital vessel**) to identify the particular service the ship is intended for. The scope and criteria of classification of such units are indicated in a memoranda.

Delete (existing) requirement [4.7.2].

Ch 1, Sec 2, [4] (Amendments April 2020)

Insert the following new sub-articles [4.5] and [4.8]:

4.5 Auxiliary naval vessel

4.5.1 The Service notation **auxiliary naval vessel** is assigned to ships designed for world wide operations and are intended for underway replenishment vessels and fleet support vessels which carry and may transfer at sea oil, and possibly other solid and liquid supplies, like freshwater, stores, spare parts and ammunitions.

Requirements of Part D, Chapter 4 are applicable to these ships.

4.8 Landing craft

4.8.1 The service notation **landing craft** is assigned to crafts designed for delivering troops and equipment ashore and restricted to vessels that can be docked in an amphibious mothership (length <60m).

They typically have versatile deck structure to accommodate wide spectrum of vehicles and loadings. They are usually equipped with loading / unloading ramps, have structure reinforced for beaching loads and have mooring and towing capability.

The notation **landing craft** is completed by **-MOTHERSHIP(name of mother ship class)** when the mothership is already known and the limits for overall dimensions of the landing craft are mentioned inside the request for classification.

Note : Navigation notations to be assigned to landing craft are restricted to **coastal area** or **sheltered area**.

The requirements of Part D, Chapter 7 are applicable to these ships.

Ch 1, Sec 2, [5.2] (Amendments April 2020)

Add the following new requirement [5.2.2]:

5.2.2 The navigation notations **coastal area** or **sheltered area** are only assigned to ships with the service notation **landing craft** as defined in [4.8].

The navigation notation **coastal area** is assigned to ships intended to operate only within 20 nautical miles from the shore and with a maximum sailing time of six hours from a place of refuge, including a mother ship, or a safe sheltered anchorage.

The navigation notation **sheltered area** is assigned to ships intended to operate in sheltered waters, i.e. harbours, estuaries, roadsteads, bays, lagoons and generally calm stretches of water and when the wind force does not exceed 6 Beaufort scale.

Ch 1, Sec 2, Table 1

Replace the row "ALP-ALM" by the following:

Insert the four rows "ARMOUR", "NSC", "RS-P" and "SHOCK".

Table 1 : List of additional class notations

Additional class notation	Reference for definition	Reference in Part E	Remarks
ALP **ALM**	[6.9.4]	NR526	**(1)**
ARMOUR	[6.9.11]	Pt E, Ch 9, Sec 9	
NSC **NSC()**	[6.9.10]	Pt E, Ch 9, Sec 10	When partial compliance with the Naval Ship Code, the list of the chapters complied with is indicated between brackets
RS-P	[6.9.13]	Pt E, Ch 9, Sec 13	
SHOCK **SHOCK STRENGTH** **SHOCK EQUIPMENT**	[6.9.12]	Pt E, Ch 9, Sec 11 and Pt E, Ch 9, Sec 12	

(1) A construction mark is added to this notation.

(2) This notation may be completed by the suffix **-IMO**, **-MIL** (see Ch 1, Sec 2, [6.9.2])

Ch 1, Sec 2, [6.9.4] (Amendments April 2020)

Replace the first paragraph by:

Ships fitted with lifting appliances meeting the requirements of the Rules for the Certification of Lifting Appliances onboard Ships and Offshore Units (NR526) may be assigned the following additional class notations:

Ch 1, Sec 2, [6.9]

Add the following new requirements [6.9.10], [6.9.11], [6.9.12] and [6.9.13]:

6.9.10 Naval Ship Code (NSC)

The additional class notation **NSC** is assigned to ships complying with the Naval Ship Code published by NATO as ANEP 77 (Allied naval Engineering Publication).

When only partial compliance is required, the additional class notation **NSC()** is to be assigned, indicating between brackets the chapters of the Naval Ship Code where the compliance is looked after.

When the Society has been delegated by a Naval Authority, a Naval Ship Safety Certificate may be issued by the Society on behalf of the Naval Authority.

The requirements for the assignment of this notations are provided in Pt E, Ch 9, Sec 10.

6.9.11 ARMOUR

The additional class notation **ARMOUR** is assigned to ships fitted with a protection by armour, when the requirements of Pt E, Ch 9, Sec 9, Articles [2] to [4] are complied with.

The requirements for the assignment of this notations are provided in Pt E, Ch 9, Sec 9.

According to Pt A, Ch 1, Sec 1, [1.5.1], this additional class notation is mentioned in the Register only after the Owner has authorized the publication. When this notation is not mentioned in the Register, an attestation is issued by the Society.

6.9.12 SHOCK

The following additional class notations are assigned to ship for which shock-resistance capability measures are taken:

- The additional class notation **SHOCK STRENGTH** is granted to ship for which measures are taken to increase their survivability following threat damage to the structures from an assigned underwater non-contact explosion in compliance with the requirements of Pt E, Ch 9, Sec 11.
- The additional class notation **SHOCK EQUIPMENT** is granted to ship for which a list of specified pieces of equipment have been satisfactorily shock tested and subsequently fulfill the shock resilience criteria specified by the Naval Authority for the applicable design shock level in compliance with the requirements of Pt E, Ch 9, Sec 12.
- The additional class notation **SHOCK** is granted to ship for which hull strength and equipment are in compliance with both Pt E, Ch 9, Sec 11 and Pt E, Ch 9, Sec 12.

6.9.13 Residual strength (RS-P)

The additional class notation **RS-P** is assigned to ships for which the residual hull girder ultimate strength under damage condition is evaluated according to minimum hull damage scenarios and rule wave hull girder loads.

The requirements for the assignment of this notation are provided in Pt E, Ch 9, Sec 13.

CHAPTER 2

Ch 2, Sec 3, [1.2] (Amendments April 2020)

Replace the requirement [1.2.4] by:

1.2.4 In addition, the class is automatically suspended:

- when the class renewal survey has not been completed by its limit date or within the time granted for the completion of the survey, unless the ship is under attendance by the Society's Surveyors with a view to completion prior to resuming trading, and unless a specific action plan has been agreed for completion of the survey
- when the annual or intermediate surveys have not been completed by the end of the corresponding survey time window (see Ch 2, Sec 2, [3.1.3]) unless a specific action plan has been agreed for completion of the survey. Continuous survey item(s) due or overdue at the time of the annual surveys is(are) to be dealt with unless a postponement is granted by agreement with the Society, and unless a specific action plan has been agreed for completion of the survey.

Suspension of class with respect to the above cases will remain in effect until such time as the class is reinstated once the due items and/or surveys have been dealt with.

CHAPTER 3

Ch 3, Sec 4, [3.1] (Amendments April 2020)

Replace the requirement [3.1.4] by:

3.1.4 The in-water survey is to be carried out under the surveillance of a Surveyor by an in-water survey firm approved as a service supplier by the Society according to Ch 2, Sec 2, [3.4].

The Surveyor is to be satisfied with the methods of orientation of the diver(s) or remotely operated vehicle (ROV) on the plating, which should make use where necessary of permanent markings on the plating at selected points and with the method of pictorial representation. An efficient two-way communication between the Surveyor and the diver(s) is to be provided.

CHAPTER 5

Ch 5, Sec 1, Table 1 (Amendments April 2020)

Replace the last row in Table 1 by:

Table 1 : Additional class notations for which specific survey requirements are applicable

Additional class notation	Section applicable in this Chapter	Type of surveys affected by these specific requirements	Remarks
Other additional class notations: **ARMOUR** **HELICOPTER** **TOW**	Ch 5, Sec 9	See Remarks	As applicable in accordance with the related Articles in Ch 5, Sec 9

Ch 5, Sec 9

Replace Section 9 by:

SECTION 9 OTHER ADDITIONAL CLASS NOTATIONS

1 Generals

1.1 Application

1.1.1 The requirements of this Section apply to self-propelled ships granted with one or more of the following additional class notations:

- **HELICOPTER**
- **TOW**
- **ARMOUR**

1.1.2 These requirements apply in addition to the requirements given in Part A, Chapter 3 and Chapter 4 versus the type of surveys.

2 HELICOPTER

2.1 Annual survey

2.1.1 The additional items and equipment to be surveyed together with the scope of the survey shall be defined, on a case by case basis, by an agreement between the Surveyor and the Owner representative.

2.1.2 The type and number of additional tests to be performed shall be defined, on a case by case basis, by an agreement between the Surveyor and the Owner representative.

2.2 Class renewal survey

2.2.1 The additional items and equipment to be surveyed together with the scope of the survey shall be defined, on a case by case basis, by an agreement between the Surveyor and the Owner representative.

2.2.2 The type and number of additional tests to be performed shall be defined, on a case by case basis, by an agreement between the Surveyor and the Owner representative.

3 TOW

3.1 Annual survey

3.1.1 The additional items and equipment to be surveyed together with the scope of the survey shall be defined, on a case by case basis, by an agreement between the Surveyor and the Owner representative.

3.1.2 The type and number of additional tests to be performed shall be defined, on a case by case basis, by an agreement between the Surveyor and the Owner representative.

3.1.3 The survey shall include:

- an examination of the emergency towing installation
- the confirmation that the installation is instantaneously available including a pre-rigged aft towing arrangements and a forward chafing gear secured to the strong-point
- an examination of the pick-up gear, towing pennant and chafing gear over the full length for detection of possible deterioration. Where the pennant line is stored in a watertight condition and can be confirmed as being maintained, consideration may be given to waiving the requirement to examine the pennant line over the full length
- an examination of the strong-points, fairleads and pedestal roller together with their attachments to the hull structure.

3.2 Class renewal survey

3.2.1 The additional items and equipment to be surveyed together with the scope of the survey shall be defined, on a case by case basis, by an agreement between the Surveyor and the Owner representative.

3.2.2 The type and number of additional tests to be performed shall be defined, on a case by case basis, by an agreement between the Surveyor and the Owner representative.

4 ARMOUR

4.1 Class renewal survey

4.1.1 The survey shall include:

- an examination of the armour components as described in the armouring table
- the confirmation that the armour components are still in place, without external deficiency that can be detected by visual examination.

Amendments to PART B

Ch 3, Sec 2, [2.3.5]

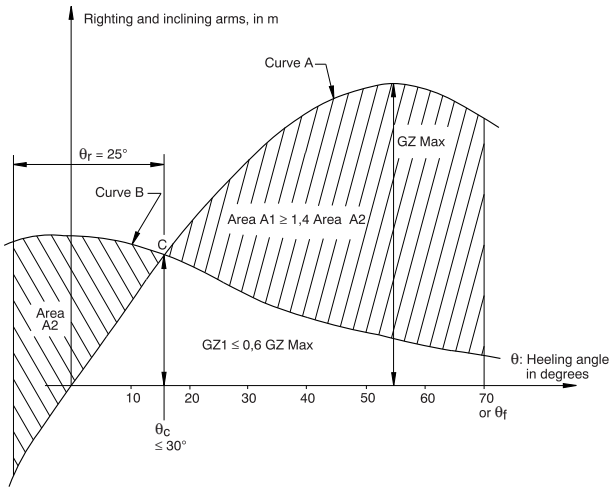
Replace the last paragraph by:

To ensure a sufficient level of safety, area "A1" is to be at least 40% greater than area "A2".

Ch 3, Sec 2

Replace Figure 8:

Figure 8: Icing criteria with wind



Ch 7, Sec 4, Symbols

Add the following definition of T_1

T_1 : Draught, in m, corresponding to the loading condition considered.

Ch 7, Sec 4

Replace Table 3:

Table 3: Wave pressure in inclined ship conditions (load cases "c" and "d")

Location		Wave pressure p_W, in kN/m² **(1)**	
		c-max / d-max	c-min / d-min
Bottom and sides below the waterline ($z \le T_1$)	$y \ge 0$	$C_{F2}\alpha^{1/4}\rho g h_2 \frac{\lvert y\rvert}{B_W}\left[\frac{T_1+z}{T_1}\right]$	$-C_{F2}\alpha^{1/4}\rho g h_2 \frac{\lvert y\rvert}{B_W}\left[\frac{T_1+z}{T_1}\right]$ without being taken less than $\frac{\gamma_S}{\gamma_W}\rho g(z-T_1)$
	$y < 0$	$-C_{F2}\alpha^{1/4}\rho g h_2 \frac{\lvert y\rvert}{B_W}\left[\frac{T_1+z}{T_1}\right]$ without being taken less than $\frac{\gamma_S}{\gamma_W}\rho g(z-T_1)$	$C_{F2}\alpha^{1/4}\rho g h_2 \frac{\lvert y\rvert}{B_W}\left[\frac{T_1+z}{T_1}\right]$
Sides above the waterline ($z > T_1$)	$y \ge 0$	$\rho g\left[T_1 + 2C_{F2}\alpha^{1/4}\frac{\lvert y\rvert}{B_W}h_2 - z\right]$	0,0
	$y < 0$	0,0	$\rho g\left[T_1 + 2C_{F2}\alpha^{1/4}\frac{\lvert y\rvert}{B_W}h_2 - z\right]$

(1) In the formulae giving the wave pressure p_W, the ratio $|y| / B_W$ is not to be taken greater than 0,5.

Note 1:

α : Coefficient equal to T_1/T, but not to be taken greater than 1

C_{F2} : Combination factor, to be taken equal to:

- $C_{F2} = 1,0$ for load case "c"
- $C_{F2} = 0,5$ for load case "d"

B_W : Moulded breadth, in m, measured at the waterline at draught T_1, at the hull transverse section considered

h_2 : Reference value, in m, of the relative motion in the inclined ship condition, defined in Ch 5, Sec 3, [3.3.2] and not to be taken greater than the minimum of T_1 and $(D - 0,9\ T_1)$.

Amendments to PART C

CHAPTER 1

Ch 1, Sec 2, [4.5]

Replace the requirement [4.5.5] by:

4.5.5 Random checks of components to be presented for inspection after works trials are left to the discretion of the Surveyor.

Ch 1, Sec 10, [5.9.3]

Replace item g) in the alphanumeric list by:

g) Where they are likely to suffer external damage, flexible hoses and expansion joints are to be provided with adequate protection.

Ch 1, Sec 10, [19.4.6]

Replace item a) of the bullet list by:

a) Each flexible hose or expansion joint, together with its connections, is to undergo a hydrostatic test under a pressure at least equal to 1,5 times the maximum service pressure, subject to a minimum of 1 MPa.

Ch 1, Sec 11, [1.4.1]

Replace the last Symbol definition of R'_e by:

R'_e : Design yield strength, in N/mm^2, determined by the following formulae:

- where $R \geq 1,4\ R_e$: $R'_e = R_e$
- where $R < 1,4\ R_e$: $R'_e = 0,417\ (R_e + R)$

Ch 1, Sec 11, [2.3.3]

Replace “convertors” by “converters” in the second bullet ot item b).

CHAPTER 2

Replace “convertor” or “convertors” respectively by “converter” or “converters” in Section 3, Section 8 and Section 12 to Section 15.

Amendments to PART D

Ch 4, Sec 1, [1.1]

Replace the requirement [1.1.1] by:

1.1.1 Ships complying with the requirements of this Chapter are eligible for the assignment of the service notation **auxiliary naval vessel**, as defined in Pt A, Ch 1, Sec 2, [4.9].

Ch 4, Sec 2, [1.1.1]

Replace the term "special service - auxiliary naval vessel" by "auxiliary naval vessel" in requirement [1.1.1].

Ch 4, Sec 2, [5.1.2]

Replace the last paragraph in Note 1:

The Society will accept the methods of design and construction described in IMO Resolution MEPC.110(49) and its corrigenda.

Ch 4, Sec 3

Replace the term "special service - auxiliary naval vessel" by "auxiliary naval vessel" in requirement [1.1.1], [2.1.2], [2.2.8], [2.2.12] and [2.2.13].

Ch 4, Sec 4 and Sec 5

Replace the term "special service - auxiliary naval vessel" by "auxiliary naval vessel" in requirement [1.1.1].

Ch 4, Sec 6

Replace the term "special service - auxiliary naval vessel" by "auxiliary naval vessel" in requirement [1.1.1] and [6.1.1].

Ch 4, Sec 7

Replace the term "special service - auxiliary naval vessel" by "auxiliary naval vessel" in requirement [1.1.1].

Ch 4, Sec 8

Replace the term "special service - auxiliary naval vessel" by "auxiliary naval vessel" in requirement [2.1.2].

Ch 4, Sec 9

Replace the term "special service - auxiliary naval vessel" by "auxiliary naval vessel" in requirement [1.1.1].

Ch 5, Sec 5, [2.1]

Replace requirement [2.1.15] by the following one:

2.1.15 Where the emergency and/or transitional source of power is an uninterruptible power system (UPS), it is to comply with the requirements of Pt C, Ch 2, Sec 6, [2].

Chapter 7

Add the following new Chapter 7:

Part D
Service Notations

Chapter 7
LANDING CRAFTS

SECTION 1 GENERAL

1 General

1.1 Application

1.1.1 Ships complying with the requirements of this Chapter are eligible for the assignment of the service notation **landing craft** as defined in Pt A, Ch 1, Sec 2, [4].

1.1.2 The applicable set of requirements are governed by each of the following main characteristics:

- ship is able to be docked inside the well dock of a mother ship
- rule length
- high speed criteria
- hull material.

Ships not designed to be berthed aboard a mothership are not covered by the notation **landing craft**.

Ships with rule length equal or more than 60m are not covered by the notation **landing craft**.

1.2 Summary table

1.2.1 Ships dealt with in this Chapter are to comply with the requirements stipulated in:

- Part A of the present Rules
- the applicable requirements according to Tab 1
- NR216 Materials and Welding, as applicable.

Table 1 : Applicable requirements

Ship arrangement	• Article [2] • NR566 **(1)**
Hull	• Ch 7, Sec 2
Stability	• Ch 7, Sec 2
Machinery and systems	• Ch 7, Sec 3 • NR 566, Ch 2 **(1)**
Electrical installations and automation	• NR566, Ch 3 **(1)**
Fire protection, detection and extinction	• Ch 7, Sec 4
(1) Relevant requirements to be applied, except the specific requirements for passenger ships not to be taken into account. **Note 1:** NR566: Hull Arrangement, Stability and Systems for Ships less than 500 GT.	

2 Specific characteristics of landing crafts

2.1 Capacity to dock on the well deck of a mother ship

2.1.1 Overall dimensions of ship

Overall dimensions of ship shall be clearly mentioned in the drawings submitted. If the ship is fitted with retractable devices used when moving inside or outside a mothership, overall dimensions in these configurations shall also be clearly mentioned on drawings. When the mothership is already known and the limits for overall dimensions of the landing craft are mentioned inside the request for classification, these values can be compared to those mentioned on drawings and their validity assessed by the optional mention **-MOTHERSHIP(name of mother ship class)**.

2.1.2 Hull and appendices

Geometry of hull and appendices shall enable the docking of the ship on a plane surface without damaging any pieces of equipment or part of the ship structure. When docked, the ship shall be able to stay in a stable position without using any additional artefact.

2.1.3 Lashing

Securing points shall be arranged on the ship structure in order to keep the ship in a steady position thanks to securing devices when berthed inside the mother ship well deck.

2.2 Capacity to operate landing operations

2.2.1 Structure of ship adapted to landing operation

Bottom area is to be reinforced in beaching area according to Ch 7, Sec 2, [3.3].

In addition, the transom area might have to be reinforced against breaking waves in the surf zone, according to Ch 7, Sec 2, [3.3].

2.2.2 Ramp operation

In the present Chapter, it is considered that the bow ramp and the bow door are same equipment.

2.2.3 Capacity of ship to maintain herself in a steady position during landing operation

Means shall be available to keep ship on a steady position during landing operation. One or several of the following technical solutions shall be used:

- stern anchor(s)
- means of propulsion offering possibility to modify quickly direction of thrust when the speed of ship is equal to zero
- other solution with equivalent result.

2.2.4 Capacity to deliver on shore troops and equipment

Scantlings of external ramps are to comply with requirement of Ch 7, Sec 2, [3.2].

2.2.5 Capacity to maintain ship power production during landing operation

Specific requirements of Ch 7, Sec 3 are to be fulfilled.

2.2.6 Capacity to leave the beaching position after landing operation

Leaving beaching position, so-called de-beaching in the present Rules, could be achieved by several means (self-propulsion, push-out from the beach, pull-out from the craft, etc.), that must be formally defined and given as operating procedures, according to Ch 7, Sec 2, [3.1.2].

Specific requirements are to be complied with, according to Ch 7, Sec 2, [3.4].

2.3 Safe operation limits

2.3.1 Operation manual

Operation must be defined in an Operating Manual detailing the operating procedures and the limitations for safe operation.

This Operating Manual must be provided to Class Society for information.

This Operating Manual should be also made available on board.

SECTION 2 HULL AND STABILITY

1 General

1.1 Application

1.1.1 The provisions of this Section apply to the ships having the service notation **landing craft**.

2 Stability

2.1 General

2.1.1 Considered vessels may be assigned the service notation **landing craft** only after it has been demonstrated that their stability is adequate.

Adequate stability means compliance with standard laid down by the relevant Naval Authority or with the requirements specified in this Section.

In any case, the level of stability is not to be less than that provided by the Rules.

2.1.2 High speed criteria

Landing crafts are considered complying with the high speed criteria when the following condition is fulfilled:

$V \geq 7{,}16\ \Delta^{1/6}$

where

V : Maximum ahead service speed V, in knots, at displacement Δ defined below

Δ : Moulded displacement, in tons, in full load condition “end of life”.

Landing crafts complying with the above criteria are considered high speed.

Landing crafts not complying with the above high speed criteria are considered slow speed.

2.2 Intact stability

2.2.1 The intact stability is to comply with the provisions of NR467 Rules for Steel Ships, Part B, Chapter 3 for the loading conditions mentioned in [2.2.2], except when specified otherwise.

2.2.2 The following loading conditions have to be considered for the purpose of the stability calculations:

- ship in the fully loaded departure condition with the maximum weight of cargo and embarked troops homogeneously distributed on the dedicated spaces, with full fuel
- ship in the light arrival condition without cargo nor embarked troops, with 10% remaining fuel

2.2.3 Ice accretion

For the purpose of calculating the ice accretion, when applicable, the following values are to be used:

- 15 kg/m² on exposed weather decks and gangways
- 7,5 kg/m² for the projected lateral area on each side of the ship above the waterplane.

2.2.4 Cargo Space

For landing craft with open cargo space, the drainage system has to comply with the applicable requirements of regulation 24, paragraphs 1(b), 1(c), (4) to (6) of the International Load Line Convention, as modified by the Protocol. Alternatively, an additional amount of water equal to 0,10m above the cargo deck is to be considered for the intact stability calculations.

For landing craft with closed cargo space and fitted with a single bow door creating a possible entry of water, the stability of the ship has to be evaluated with an additional amount of seawater on the cargo deck, having a height equal to 0,30m. For this condition, the following stability criteria are to be complied with:

- the positive righting lever curve should have a minimum range of 7° beyond the angle of equilibrium
- the metacentric height (GM) should be positive
- the righting lever (GZ) is to be at least 0.05 m within the positive range.

The results of model tests may be used to determine the quantity of green water to be considered in the above calculations for open or closed cargo space, associated with a quantity of rainfall equal to 100 mm/hour.

2.3 Damage stability

2.3.1 Taking into account as initial conditions before flooding, the loading conditions defined in [2.2.2], the ship is to comply with the damage stability criteria as specified in [2.3.8], for the damage dimensions defined in [2.3.2].

2.3.2 The extent of damage is assumed to occur anywhere:

a) for side damage: on the ship’s length between watertight transverse bulkheads spaced at a distance of not less than the longitudinal extent of damage specified in Tab 1

b) for bottom damage: for 0,3L from the forward perpendicular of the ship, between watertight transverse bulkheads spaced at a distance of not less than the longitudinal extent of damage specified in Tab 1.

High speed landing craft (as defined in [2.1.2]) are to consider that the damage occur anywhere along the ship’s length.

Table 1 : Extent of damage

	Longitudinal extent	Transverse extent	Vertical extent
Side damage	3 + 3% L	B/5 **(1)**	Full depth **(2)**
Bottom damage (For 0,3 L from the forward perpendicular of the ship)	1/3 $L^{2/3}$	B/6	B/12
(1) Measured inboard from the side of the ship perpendicularly to the centerline at the level of the summer waterline. **(2)** From the moulded line of the bottom shell plating at centerline upwards without limit.			

Table 2 : Values of permeability

Spaces	Permeabilities
Appropriated to cargo	by calculation but not less than 0,60
Appropriated to stores	0,60
Occupied by accommodation	0,95
Occupied by machinery	0,85
Void spaces, empty tanks	0,95
Intended for liquids	0 to 0,95 **(1)**
(1) See [2.3.6].	

2.3.3 If pipes, ducts trunks or tunnels are situated within the assumed extent of damage, arrangements are to be made to ensure that progressive flooding cannot thereby extend to compartments other than those assumed to be floodable for each case of damage.

2.3.4 If damage of a lesser extent than that specified in [2.3.2] results in a more severe condition, such lesser extent is to be assumed.

2.3.5 The permeability of spaces assumed to be damaged is to be as indicated in Tab 2.

2.3.6 The permeability of partially filled compartments shall be consistent with the amount of liquid carried in the compartment. Whenever damage penetrates a tank containing liquids, it shall be assumed that the contents are completely lost from that compartment and replaced by salt water up to the level of the final plane of equilibrium.

2.3.7 Compliance with the requirements of [2.3.8] is to be confirmed by calculations which take into consideration the design characteristics of the ship, the arrangements, configuration and permeability of the damaged compartments and the distribution, specific gravities and free surface effect of liquids.

2.3.8 Ships are to be capable of surviving the assumed damage and the standard specified in [2.3.2], for the loading conditions defined in [2.2.2] in a condition of stable equilibrium and such as to satisfy the following criteria:

a) The final waterline, taking into account sinkage, heel and trim, is to be below the lower edge of any opening through which progressive flooding may take place. Such openings include air-pipes, ventilators and openings which are closed by means of weathertight doors or hatch covers but may exclude those openings closed by means of watertight manhole covers and flush scuttles, small watertight cargo tank hatch covers which maintain the high integrity of the deck, remotely operated watertight sliding doors and sidescuttles of the non-opening type.

b) In the final stage of flooding, the angle of heel due to unsymmetrical flooding should not exceed 7° when the cargo is not lashed with arrangements capable of preventing any shifting, and 15° otherwise.

c) The initial metacentric height of the ship in the final stage of flooding for the static equilibrium position in case of symmetrical flooding and for the upright position in case of unsymmetrical flooding as calculated by constant displacement method should not be less than 0,05 m before appropriate measures to increase the metacentric height have been taken.

d) The righting lever curve at the final stage of flooding should have a minimum range of 10° associated with a maximum righting equal or greater to the maximum between:

   - 0,05m
   - heeling moment / displacement, where heeling moment is the moment due to the crowding of the embarked troops after damage.

     For the purpose of calculating the heeling moment of crowding of embarked troops, the following assumptions shall be made:

     - 4 persons per square meter
     - a mass of 90kg for each person
     - the persons shall be distributed on the available spaces in such away that they produce the most adverse heeling moment.

   Unprotected openings may not become immersed at an angle of heel within the prescribed minimum range of residual stability unless the space in question has been included as a floodable space in calculations for damage stability. Within this range, immersion of any of the openings referred to in item a), and any other openings capable of being closed weathertight may be authorised.

e) The stability is to be sufficient during the intermediate stages of flooding. In this regard the Society applies the same criteria relevant to the final stage of flooding also during the intermediate stages of flooding.

3 Structure

3.1 General

3.1.1 Applicable Rules

Unless otherwise specified in this Section, the landing craft structure is to meet the relevant requirements of NR600, except NR600, Ch 2, Sec 2.

Note 1: NR600 Hull Structure and Arrangement for the Classification of Cargo Ships less than 65 m and Non Cargo Ships less than 90 m.

3.1.2 The navigation coefficient n which appears in the formulae of NR600 are defined in Tab 3 depending on the assigned navigation notation.

Table 3 : Navigation coefficient n

Navigation notation	Navigation coefficient n
unrestricted navigation	1,00
coastal area	0,80
sheltered area	0,65

3.2 Additional requirements for external ramps

3.2.1 General

It is assumed that the ramps are not lifted with vehicles on the ramp.

The external ramps are to be able to operate with a heel angle of 5° and a trim angle of 2°.

The thicknesses of plating and the scantlings of ordinary stiffeners and primary supporting members are to be determined:

- under vehicle loads in harbour condition, at rest, as defined in NR600, Ch 5, Sec 2, Tab 1
- under sea pressure, and slamming pressure if relevant, in lifted position and locked at sea.

The locking of external ramps in lifted position at sea is examined by the Society on a case by case basis.

The ship's structure under the reactions due to the ramp is examined by the Society on a case by case basis, under vehicle loads and under sea pressure.

Internal loads exerted on ramps in lifted position at sea are to specified by the designer.

3.2.2 Plating

The gross thickness of plate panels subjected to wheeled loads is to be not less than the value obtained from NR600, Ch 4, Sec 3.

However, minimum net thicknesses are to comply with Pt B, Ch 7, Sec 1, [2.2.1].

3.2.3 Ordinary stiffeners

The gross section modulus and the gross shear sectional area of ordinary stiffeners subjected to wheeled loads is to be not less than the value obtained from NR600, Ch 4, Sec 4.

3.2.4 Primary supporting members

The primary supporting structure of external ramps is to be verified through direct calculation, considering the following cases:.

- ramp in sloped position, supported by hinges at one end and by supporting ground or mother ship at the other, under loads defined in NR600, Ch 5, Sec 2, Tab 1, in harbour condition
- ramp in lifted position, loaded by relevant loads and locked, at sea.

It is to be checked that the stresses are in accordance with the criteria defined in NR600, Chapter 2, Section 3.

3.2.5 Locking devices

It is to be checked that the combined stresses σ_{VM} in rigid supports and locking devices are in accordance with the criteria defined in NR600, Chapter 2, Section 3.

3.2.6 Tests and trials

The watertightness / weathertightness is to be tested as per applicable requirements of NR600.

The weathertightness of the bow door is to be confirmed at each renewal survey by a hose test. In addition, for watertight bow door, a specific survey is requested at each annual survey, to confirm that the proper locking and tightness are maintained.

3.3 Additional requirements for landing operations - Beaching

3.3.1 A beaching reinforced area is to be considered at bottom level on a length to be defined by the Designer measured from fore end. In any case, this length should not be less than 0,3 L.

3.3.2 Bottom beaching pressure, in kN/m², is to be calculated as per following formula:

$$P_{beach} = (3,3 \cdot \Delta)/(L \cdot b)$$

with:

Δ : full load displacement, in t, at end of life

b : mean transversal dimension of horizontal bottom, in m, in 0,3L forward area.

3.3.3 Bottom plating t, in mm, in beaching reinforced area is to be calculated as follows:

$$t = \max(1,2 \cdot t_1, 8)$$

with:

t_1 : Thickness, in mm, calculated according NR600, Ch 4, Sec 3, with $p = P_{beach}$

3.3.4 Bottom secondary stiffeners in beaching reinforced area are calculated according to requirements of NR600, Ch 4, Sec 4, with $p = P_{beach}$

3.3.5 Bottom primary supporting members in beaching reinforced area are calculated according to requirements of NR600, Ch 4, Sec 5, with $p = P_{beach}$

3.3.6 All fillet welds of bottom structure in beaching area are to be double continuous.

3.3.7 If waves are likely to break on the transom, the structural design of the transom is to be reinforced adequately to support this breaking wave pressure. In such case, the design breaking wave pressure is to be specified by the Designer, without being taken less than 50 kN/m².

3.4 Additional requirements for landing operations - De-beaching

3.4.1 The maximum de-beaching force F_{DB}, in kN, is to be defined according to the Operating Manual mentioned in (Chap 7, Sec 1, [2.3]). In case F_{DB} is not mentioned in the Operating Manual, this force is to be taken equal to 5Δ, with Δ, in t, being the full load displacement at end of life.

3.4.2 When de-beaching is operated by pushing out the landing craft from the beach (e.g. by tractors or bulldozers), the craft structure must be suitably reinforced in way of push-out force application.

The maximum push-out force is to be according to the Operating Manual mentioned in (Ch 7, Sec 1, [2.3]). In case the maximum push-out force is not mentioned in the Operating Manual, this force, in kN, is to be taken as F_{DB}, defined in [3.4.1].

3.4.3 When de-beaching is operated by pulling out the landing craft from aboard (e.g. by pull-out anchors), the craft structure must be suitably reinforced in way of winch foundations and bollards sustaining the pull-out force and the winches must be designed to deliver the pull-out force.

The maximum pull-out force is to be according to the Operating Manual mentioned in (Ch 7, Sec 1, [2.3]). In case the maximum pull-out force is not mentioned in the Operating Manual, this force, in kN, is to be taken as F_{DB}, defined in [3.4.1].

3.5 Anchoring, mooring and towing equipment

3.5.1 The anchoring capability, the mooring capability and the towing capability is left to the decision of the Naval Authority.

3.5.2 If anchors are used to pull-out the craft during de-beaching operation, the complete mooring line should be designed with a safety factor of 6 with respect to F_{DB} as defined in [3.4.1].

3.5.3 If anchoring capability is requested, equipment in anchors and chain cables is to be in compliance with NR600, Ch 5, Sec 5.

3.5.4 If mooring or towing capability is requested, corresponding equipment is to be in compliance with NR600, Ch 5, Sec 5.

3.6 Cargo lashing - securing points

3.6.1 Where cargo is secured by lashing devices, following requirements [3.6.2] to [3.6.6] are applicable.

3.6.2 Securing points are to be listed in the Operating Manual mentioned in Ch 7, Sec 1, [2.3], together with indications of Safe Working Load (SWL) and Maximum Securing Load (MSL).

3.6.3 Design of securing points, integration into craft structure and mini-maxi pulling angles are to be submitted for review.

3.6.4 Strength of lashings is outside scope of Classification.

3.6.5 checking criteria

It is to be checked that the equivalent stress σ_{VM}, in N/mm², induced by the pulling force SWL in the worse possible direction, is in compliance with the following formula:

$$\frac{R_y}{\gamma_R \gamma_m} \geq \sigma_{VM}$$

where:

R_y : Minimum yield stress, in N/mm², of the material to be taken equal to 235/k N/mm², unless otherwise specified

γ_R : to be taken equal to 1,2

γ_m : to be taken equal to 1,02

3.6.6 It is recommended to:

- avoid out of plane loading on stiffening members
- align welded attachments to decks and bulkheads with stiffeners by using a weld area suitable for load considered
- design eyeplates, lugs, etc. in accordance with recognized national or international standards suitable for considered MSL.

SECTION 3 MACHINERY AND SYSTEMS

1 General

1.1 Application

1.1.1 Unless otherwise specified, the provisions of this Section apply to the ships granted with the service notation **landing craft**.

2 Availability of energy and propulsion power means of production during landing operations

2.1

2.1.1 Protection of equipment against grounding

Equipment like propellers, thrusters involved shall be fitted with physical protection against grounding.

2.1.2 Protection and position of air inlets dedicated to means of propulsion and energy production and ventilation openings for machinery spaces

a) Air inlets and ventilation openings dedicated to machinery installations shall be protected against water ingress coming from waves impacting the aft part of the ship

b) Air inlets and ventilation openings dedicated to machinery installations should normally not be located on the aft part of the ship.

2.1.3 Availability of means of cooling

Sea inlets and outlets shall not be located on the fore part of the ship.

2.1.4 Availability of exhaust gas piping systems

Accumulation of water through water ingress coming from waves impacting the aft part of the ship should not be possible whenever the engines were in operation or not during landing operations.

SECTION 4 FIRE PROTECTION

1 General

1.1 Application

1.1.1 Unless otherwise specified, the provisions of this Section apply to the ships granted with the service notation **landing craft**.

1.1.2 Application of NR566, Chapter 4

NR566, Ch 4 is applicable as for ships other than passenger ships, and taking into account specific requirements and interpretation of this Section.

1.2 Definitions

1.2.1 Control stations

For the application of this Section, the definition given in NR566, Ch 4, Sec 1, [4.4.8] is to be completed by:

"Rooms containing naval systems, as detection, command or weapon control operating room, except technical spaces not normally manned, are to be categorized as control stations".

1.2.2 Open deck

For the application of this Section, the definition of category (10) given in NR566, Ch 4, Sec 4, [2.2.2], item b), 2) is to be completed by:

"Open deck spaces for the stowage of any embarkation such as tender or special force craft".

1.2.3 Evacuation stations

The evacuation stations are the areas from which the persons to be evacuated have access to the liferafts when launched at sea.

1.2.4 Machinery spaces

For the application of this Section, the definition given in NR566, Ch 4, Sec 1, [4.4.15] is to be completed by:

"The spaces containing naval systems, not normally manned, are to be considered as machinery spaces".

1.2.5 Ammunition spaces

Ammunition spaces are defined in Pt C, Ch 4, Sec 1, [2.4].

Note 1: The ready for use lockers located on open deck may be not considered as ammunition spaces.

2 Suppression of fire

2.1 Detection and alarm

2.1.1 Protection of ammunition spaces

Ammunition spaces are to be provided with a fixed fire detection and alarm system complying with the requirements of Pt C, Ch 4, Sec 3, [5].

When the required smoke detector cannot be contained into the ammunition lockers, this detector is to be installed into the space where the ammunition lockers are located.

2.2 Fire containment

2.2.1 Fire integrity of ammunition spaces

The bulkheads and decks of ammunition spaces are to be A-30 fire class standard.

Note 1: When an ammunition space is adjacent to the shell under the waterline, only "A-0" fire class standard is required.

2.2.2 Ventilation systems for ammunition spaces

Ventilation systems of ammunition spaces are to comply with the following provisions:

a) ventilation systems for ammunition spaces are to be independent of the systems serving other categories of spaces

b) no duct is to pass through any ammunition space, except the ducts provided for the ventilation of this ammunition space

c) capacity of the ventilation systems serving ammunition spaces are to comply with the requirement of Pt C, Ch 4, Sec 5, [6.6.1]

d) ducts provided for the ventilation of ammunition spaces, when passing through any other spaces, are to be constructed of steel and arranged to preserve the integrity of the division.

2.3 Fire fighting

2.3.1 Fixed fire-extinguishing systems in ammunition spaces

Ammunitions spaces are to be provided with a fixed fire-extinguishing system complying with the requirements of Pt C, Ch 4, Sec 6, [6.1.1].

2.3.2 Fire-fighter outfits

The ship is to be provided with at least four fire-fighter outfits with a minimum of two two-way portable radiotelephone apparatuses for communication between fire-fighters. Those two-way portable radiotelephone apparatuses are to be of an explosion proof type and intrinsically safe.

Fire-fighter outfits are to comply with Pt C, Ch 4, Sec 6, [8.1].

Fire-fighter outfits are to be stored so as to be easily accessible and ready for use, in at least two separated locations.

2.3.3 Fire pumps

The requirement of NR566, Ch 4, Sec 5, [2.2.1] and NR566, Ch 4, Sec 5, [2.2.3] are to be replaced by the following provisions:

a) the total capacity of the fire pumps is to be sufficient to supply simultaneously two hydrants and the most demanding fire-fighting system using the fire main

b) at least two independently powered fixed fire pumps are to be provided. The arrangement of sea connections, pumps and their sources of power is to be such as to ensure, in the event of a fire in any one compartment, that all the fire pumps will not be put out of actions.

2.3.4 International shore connection

At least one international shore connection complying with Pt C, Ch 4, Sec 6, [1.2.7] is to be provided.

3 Escape and circulation

3.1 Application

3.1.1 Limitation

The requirements of Ch 6, Sec 5, [3.2] are applicable for the ships with a maximum complement of less than 60 persons.

Special consideration is to be given by the Society to ships carrying more than 60 persons.

Amendments to PART E

CHAPTER 4

Ch 4, Sec 1, Table 25 (Amendments April 2020)

Replace "250 kW" by "2250 kW" in tablefoot note (2).

CHAPTER 9

Chapter 9

Add the following new Section 9, Section 10, Section 11, Section 12 and Section 13.

SECTION 9 ARMOUR

1 General

1.1 Introduction

1.1.1 During their operation, naval ships may be exposed to specific threats induced by weapons shoots. The threats may result from:

- bullets and other high performance projectiles
- splinters from external or internal blasts.

Naval ships are commonly protected from these threats by armour plate, armour compound or other adequate means.

The threats and corresponding levels of protection are defined by the Naval Authority.

1.2 Application

1.2.1 The additional class notation **ARMOUR** is assigned in accordance with Pt A, Ch 1, Sec 2, [6.9.11], to ships fitted with a protection by armour, when the requirements of Articles [2] to [4]of this Section are complied with.

2 Documentation

2.1 Document for information

2.1.1 Confidentiality

The documentation relating to the **ARMOUR** notation is treated as confidential, in accordance with the Society General Conditions (item 11), and any additional confidentiality level defined by Naval Authority, if any.

2.1.2 Armouring table

The following documentation is to be consolidated in an "armouring table" to be submittted to the Society for information:

- list of protected areas / compartments / structural modules. The concerned protected areas should be clearly described, in longitudinal - transverse - vertical location and in extend
- nature of armour components, for each protected area in the above list. In particular, the following information should be documented:
  - armour mechanical properties
  - thickness of different barriers or protective plates
  - armour configuration in simple / double plates, gaps, etc.

The armour components should be duly identified by a reference such as to allow management of information without ambiguity (see Article [3]).

- for each armour component of the above list:
  - description of the connection arrangement and the connection means to the ship structure (welding, bounding, bolting, etc)
  - load-carrying capability for normal loads exerted during navigation or operation in peace-time
  - possible welding restriction on the armour plate after installation on board, if any.

The above armouring table submitted to the Society should evidence formal acceptance by the Naval Authority.

3 Armour requirements

3.1 Strength

3.1.1 Special attention should be given to the connection of the armour components listed in the armouring table with the surrounding ship structural elements.

In particular, the following should be checked:

- the ship structure should be adequately reinforced to support the weight of the armour components
- the details of ship structure reinforcements should be shown on structure drawings submitted to the Society
- the external or internal loads during navigation or operation in peace-time should not be transferred to the armour component, if it is specified as non load-carrying in the armouring table.

3.2 Stability

3.2.1 The stability documentation submitted for the ship should adequately take into account the relevant datas of the amour components (weight, location on board, etc.).

3.3 Fire safety

3.3.1 Armour including combustible materials will be considered on a case by case basis.

4 Surveys

4.1 Construction Surveys

4.1.1 Welding

In case the armour component is welded to the ship structure, the relevant Welding Procedure Specification should be subject to Classification acceptance.

4.1.2 Compliance with armouring table

The presence on board of various armour components is checked during Surveyor's inspection, on basis of the armouring table specified in [2.1.2].

4.1.3 Installation on board

The fitting on board is checked based on the documents mentioned in [3.1].

SECTION 10 COMPLIANCE WITH NAVAL SHIP CODE (NSC)

1 General

1.1 Application

1.1.1 The Naval Ship Code is the Allied Naval Engineering Publication (ANEP) 77 published by NATO.

Ships whose design is in full compliance or in partial compliance with the requirements of the Naval Ship Code may be assigned one of the additional class notation **NSC** or **NSC()** defined in [1.1.2].

1.1.2 The additional notation **NSC** is granted to ships whose design complies with all chapters of the Naval Ship Code.

Ships whose design complies only with some chapters of the Naval Ship Code are granted the additional class notation **NSC()** with, indicated between brackets, the list of Chapters to comply with. Chapters regarding the definitions, the use and the certification process are deemed to apply automatically and are not needed to be indicated between brackets.

For example, **NSC(II, VI, VII)** means that Chapters II, VI and VII of the Naval Ship Code should be reviewed for assignment of the notation.

1.2 Documents to be submitted

1.2.1 The documents to be submitted for review for granting additional class notation **NSC** or **NSC()** are those required by the relevant chapters of the Naval Ship Code.

1.3 Naval Ship Safety Certificate (NSSC)

1.3.1 In compliance with the Naval Ship Code, when the ship is assigned with an additional class notation **NSC**, or **NSC()**, a Naval Ship Safety Certificate, indicating the applicable version of the Code, may be issued by the Society on behalf of the Naval Authority, when delegated.

SECTION 11 SHOCK STRENGTH

1 General

1.1 Assignement of the additional notation

1.1.1 Scope

The additional class notation **SHOCK STRENGTH** is assigned to a ship in order to certify that measures are taken to increase her survivability following threat damage to the structures from an assigned underwater non-contact explosion. This notation considers loads coming from underwater non-contact explosions of either submarine mines or torpedoes.

Note 1: When the ship comply with the requirement of Sec 11 and Sec 12, the notation **SHOCK STRENGTH** is replaced by the notation **SHOCK**.

1.1.2 Condition for the assignment

The assignment of the notation implies that a detailed structural analysis or a test have been carried out, for compliance with the requirements of this Section taking also into account the dynamic vertical bending and vibrations that can be induced by the assigned underwater non-contact explosion. Details of the calculations and testing methods and the structural performance achieved, based on the specified loads, will not be published and will be only disclosed to the Naval Authority.

1.1.3 Documentation to be submitted

The following confidential input data are to be submitted for information:

- the loading scenarios, as defined in [1.3]
- the description of the calculation procedures
- the assumptions made
- the details of the software used and its validation as appropriate
- the summary of the results obtained.

1.1.4 Assignment of the notation

If requested by the Naval Authority or by the Shipyard, the **SHOCK STRENGTH** notation is assigned by the Society if the acceptance criteria specified in this Section are fulfilled.

1.2 Underwater explosions

1.2.1 Non contact underwater explosions

A non contact underwater explosion is an explosion caused by the detonation of either a submarine mine or a torpedo warhead occurring at a distance such that the effects of the gas bubble impinging directly on the ship structures are negligible.

The plans are also to include the necessary instructions to facilitate the divers' work, especially for taking clearance measurements.

Moreover, a specific detailed plan showing the systems to be adopted in order to assess, when the ship is floating, the slack between pintles and gudgeons is to be submitted to the Society in triplicate for approval.

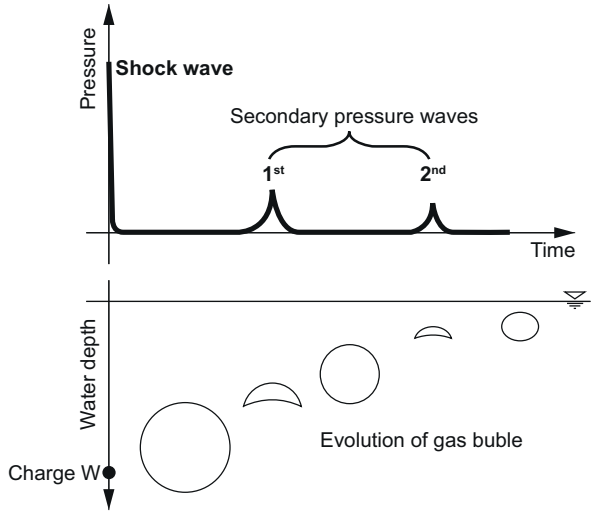
1.2.2 Bubble evolution and loading mechanisms

The evolution of the bubble and the corresponding field pressure, without any obstacle, is schematically shown in Fig 1. This implies two types of loading mechanisms:

- shock wave
- bubble pulsations.

Two types of loadings have fundamentally different physics and do not have the same consequences on the ship structure. The duration of the shock wave is extremely small (few milliseconds) and it affects the local hull structure as described in Article [2], while the duration of the pressure pulses are much longer and can induce the global hull girder vibrations (whipping) as described in Article [3].

Figure 1 : Evolution in time of the pressure field and the gas bubble migration process



1.2.3 Whipping

Whipping is defined as the transient beam-like, low frequency response of a ship caused by external transient loading.

1.3 Loading scenarios

1.3.1 Description of loading scenarios

A loading scenario is defined by a charge and its location with respect to the ship:

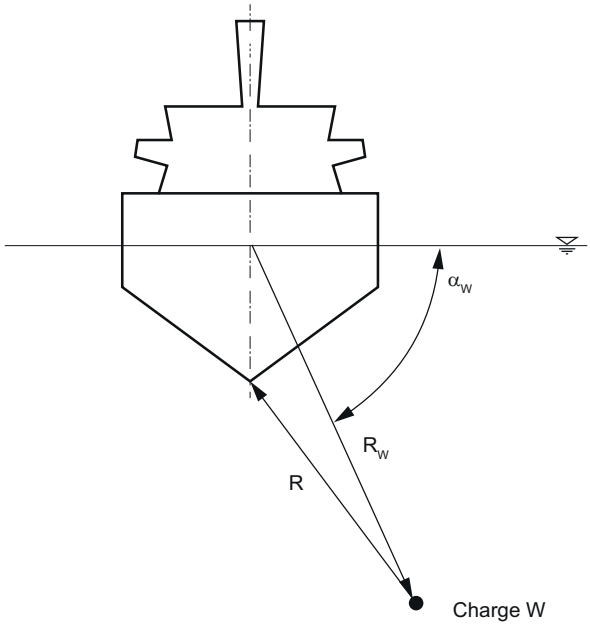
W : charge mass of TNT equivalent, in kg

R_W : distance, in m, between the center of the explosion and the point, in the plane of the explosion perpendicular to the longitudinal axis of the ship, defined as the intersection between the water line and the longitudinal plane of symmetry of the ship

α_W : relative angle of the charge location with respect to the free surface, as shown in Fig 2.

Longitudinal position of the center of the explosion with respect to the midship section.

Figure 2 : Definition of the charge position



1.3.2 Specification of loading scenarios

The loading scenarios to be used should be specified by the Naval Authority.

1.3.3 Shock factor

A quantity used to characterize the severity of the shock wave is called shock factor and is defined by the following expression:

$$SF = \frac{\sqrt{W}}{R}$$

R : standoff distance i.e. the distance from the charge to the closest hull point, m.

This quantity is often used to specify the loading scenarios. It should however be complemented by the value of the mass W and the depth of the charge (or its relative angle α_W).

1.3.4 Remarks

For a given charge W, the worst case for the local structural response to shock wave, is the one corresponding to the smallest distance from the center of explosion to the hull. However for the global whipping response, the worst loading scenario may not be the one with the smallest distance to the hull. Hence, as far as whipping analysis is considered, several distances, higher than the minimum distance specified in the loading scenarios should be considered in the computations.

2 Local structural response to shock wave

2.1 Shock wave modelling

2.1.1 Free field pressure

In the vicinity of the detonation point, the shock wave can be mathematically described as an acoustic pressure field travelling at speed of sound with the amplitude inversely proportional to the distance and exponentially decaying in time:

$$p_0 = p_{max}(-t/\theta)$$

$$p_0 = p_{max} \exp(-t/\theta)$$

p_{max} : maximum pressure at the distance R from the detonation point, MPa

t : time, ms

θ : decay constant depend on the type of charge and this dependency can be described by the following expressions:

$$P_{max} = K_1\left(\frac{\sqrt{W}}{R}\right)^{A_1}$$

$$\theta = K_2\sqrt{W}\left(\frac{\sqrt[3]{W}}{R}\right)^{A_2}$$

The different constants in the above expressions depend on the type of charge and their values should be agreed with the Society. In the absence of data the values for TNT can be used (see Tab 1).

Table 1 : Charge dependent constant

K1	A1	K2	A2
52,12	1,18	0,09	-0,185

Another important quantity is the energy per unit area (in MJ/m^2), and is given by:

$$E = \frac{\theta p_{max}^2}{2 \cdot \rho \cdot c}$$

where:

p sea water density: 1025 kg/m^3

c speed of sound in sea water: 1500 m/s

This energy per unit area is roughly proportional to the square of the Shock Factor.

2.1.2 Loading pressure

The maximum pressure p_{max} can be supposed to occur almost instantly (zero rise time) and the expression (see [2.1.1]) represents the pressure for the field without obstacle. In order to calculate the effective loading pressure p_L to be applied at the ship surface, the diffraction effects are to be taken into account. In the absence of more detailed diffraction analysis, the free field pressure p_0 could be multiplied by 2.

$$p_L = 2\,p_0$$

2.2 Structural response

2.2.1 General

The structural response to the shock pressure loading defined in [2.1.2], needs to be evaluated by the appropriate methods. The type of modelling depends on the complexity of the structural elements.

2.2.2 Plating

In the case of plating, a simplified approach may be accepted. These approaches might be based on the quasi static assumptions or the simplified dynamic analysis can be employed with the analytical definition of the mode shapes.

2.2.3 Stiffened panels

The structural response of the stiffened panels is to be evaluated using the appropriate nonlinear structural dynamic analysis applying the pressure loading time history defined in [2.1.2]. The strain rate effects should be accounted for in the analysis. Any other alternative numerical method may be accepted on a case-by-case basis.

2.3 Acceptance criteria

2.3.1 Whatever the approach used for the evaluation of the structural response, the calculated strain should not exceed the strain corresponding to the maximum stress in the stress-strain $(\sigma, \in)$ curve of the corresponding material.

3 Global whipping response

3.1 Evaluation of the dynamic response

3.1.1 General

The mathematical model of the hull girder dynamics should combine the following steps:

- pressure bubble dynamics
- ship hull hydrodynamics
- ship structural dynamics
- coupled hydro-structure dynamics.

3.1.2 Gas bubble dynamics

The gas bubble is pulsating in the surrounding water with the migration tendency to approach the free surface (see Fig 2). As a first approximation the presence of the free surface can be ignored. The practical consequence of this assumption is that the gas bubble keeps the spherical shape during the pulsations, which significantly simplifies the analysis.

The basic assumptions of the mathematical model of the bubble dynamics are:

- the fluid is incompressible and inviscid
- the presence of ship does not affect the bubble evolution.

Based on the above assumptions, the differential equation for the instantaneous radius of the gas bubble, its first and second time derivatives, can be built and is to be solved in time domain using the recognized numerical techniques. The different parameters of the differential equation should be agreed with the Society. Among the acceptable methods the Double Asymptotic Approximation (DAA) is recommended.

When deemed necessary, the presence of the free surface should be accounted for using the appropriate mathematical model which has to be approved by the Society.

3.1.3 Ship hull hydrodynamics

While vibrating, the hull surface in contact with the water will induce the dynamic pressure which should be taken into account in the global interaction model. The final effect of the induced dynamic pressure can be modelled using the concept of the added mass. The pressure is to be calculated using the recognized 2D/3D potential flow numerical approach. The variation in time of the hydrostatic buoyancy forces should also be taken into account.

3.1.4 Ship structural dynamics

The modal approach is recommended to describe the global structural dynamics and the sufficient number of modes needs to be accounted for, typically more than 20.

3.1.5 Coupled hydro-structure dynamics

The coupled hydro-structure interaction motion equation is to be solved. The gas bubble excitation vector is obtained after projecting the gas bubble pressure [3.1.1] into the hull girder modes and integrating it over the wetted hull surface. The dynamic equation is to be integrated in time and the time history of the vertical bending moment along the ship is to be evaluated. The maximum value of the whipping bending moment at each section is denoted by $M_{Whip}(\chi)$ and this value is to be used to check the acceptance criteria.

3.2 Acceptance criteria

3.2.1 The maximum whipping bending moment $M_{Whip}(\chi)$ is to satisfy the following criteria:

$$M_{Whip}(\chi) \leq \frac{M_u(\chi)}{\gamma_R \gamma_M}$$

where:

$M_U(\chi)$: ultimate bending moment capacity, see Pt B, Ch 6, Sec 3, [3.3.1]

γ_R, γ_M : partial safety factors, see Pt B, Ch 6, Sec 3, [2.2.1].

3.3 Alternative method

3.3.1 Alternative methods may be used if duly justified and adequately documented to the satisfaction of the Society.

SECTION 12 SHOCK EQUIPMENT

1 General

1.1 Assignement of the additional notation

1.1.1 Scope

The requirements of this section apply to the pieces of equipment which are required to resist, to a certain extent, the shock loads due to an underwater explosion near the ship.

The notation **SHOCK EQUIPMENT** may be assigned to ships where a list of specified pieces of equipment have been satisfactorily shock tested and subsequently fulfill the shock resilience criteria specified by the Naval Authority for the applicable design shock level.

Note 1: When the ship comply with the requirement of Sec 11 and Sec 12, the notation **SHOCK EQUIPMENT** is replaced by the notation **SHOCK**.

1.1.2 Principles

The present section describes the process and methodology for assessment of the shock resilience capacity of the different critical pieces of equipment.

This process is composed of the following steps:

a) the critical pieces of equipment are specified by the naval authority

b) miscellaneous shock levels are defined by the Naval Authority

c) miscellaneous performance criteria are defined by the Naval Authority

d) each piece of equipment is associated to one or several shock levels and performance criteria

e) shock testing for the given shock level is performed for each equipment

f) performance criteria for equipment after shock testing is evaluated.

1.2 Documents to be submitted

1.2.1 For each piece of equipment required to be assessed under shock conditions, the following documents are to be

submitted for review:

a) equipment general arrangement drawing, showing actual possible orientation on board

b) detailed supporting arrangement, including mountings specifications and arrangement

c) design shock level applicable.

1.3 Definitions

1.3.1 Stanag 4549

Stanag 4549 refers to NATO standard Stanag 4549 Edition 1 - Testing of surface ship equipment on shock testing machines. The requirements of this section are in line with the principles identified in this standard, which is considered a recognized standard for shock testing.

1.3.2 Shock response spectra (SRS)

A shock response spectrum is the visualization of the maximum responses of an assembly of massless oscillators (fictitious single degree of freedom systems), having a range of natural frequencies (f), to a given shock motion of the base.

Each shock corresponds to a different time history of acceleration, and reproducing exactly such time series of acceleration is not possible with chock testing machines. This SRS is therefore a way of characterization of a given shock level, which can then be compared to actual shock testing machine motion measurement during the testing phase and ensure that the test is indeed representative of the shock level.

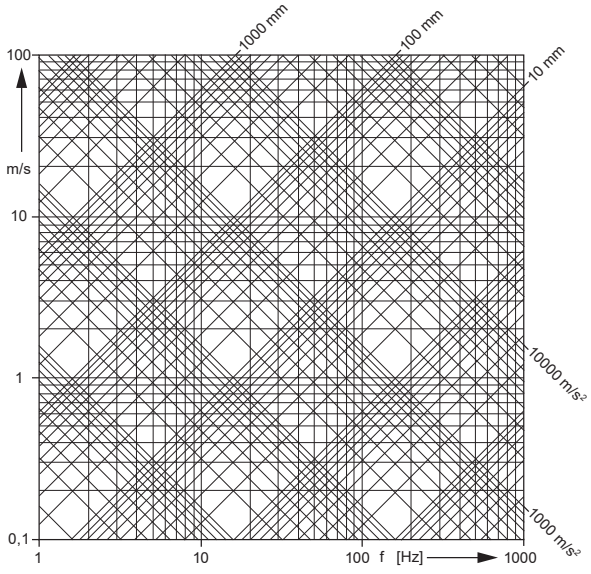
The SRS may be graphically represented on a specific grid shown in Fig 1, and defined as follows:

- horizontally, the natural frequency is plotted using logarithmic scale
- vertically, on a logarithmic scale, there the “pseudo velocity” ω, Z_{max}, where Z_{max} is the absolute value of the maximum relative displacement between the base and the mass of the single degree of freedom system, either occurring during the excitation or thereafter. That is a maximax shock spectrum. The angular natural frequency is:

  $$\omega = 2\pi f$$

- in the graph, a decade in frequency and a decade in pseudo velocity are to be represented by a same length, preferably 50 mm
- the graph must show lines rotated 45° anti-clockwise from the horizontal position. These being lines of constant relative displacement Z_{max}
- the graph must show lines rotated 45° clockwise from the horizontal position. These being lines of constant absolute acceleration, $\omega^2|Z_{max}|$, of the masses
- the grid as shown in Fig 1 must have 10 equidistant steps on a linear scale for each decade. This applies to f, $|Z_{max}|$, $\omega|Z_{max}|$ and $\omega^2|Z_{max}|$.

Figure 1 : Typical grid for representation of SRS



1.3.3 Design Shock Level

In order to define the design level of shock motion, a number of standardized shock levels may be defined using 3 parameters SRS parameters, each of these parameters corresponding to a straight line on the grid shown in Fig 1:

- the maximum relative displacement d_0, in meters
- the maximum pseudo velocity v_0, in m/s
- the maximum absolute acceleration a_0, in m/s²

It is generally defined in the frequency range from 4 to 400 Hz:

a) In the lower frequency range between 4 Hz and f_i a constant relative displacement.

b) In an intermediate frequency range between f_i and f_s, a constant pseudo velocity ω, in m/s:

$$\omega\ |d_0| = v_0$$

Occasionally f_i and f_s may coincide.

c) In the higher frequency range between fs and 400 Hz, a constant absolute acceleration ω^2, in m/s²:

$$\omega^2\ |d_0| = a_0$$

Note 1: f_i and f_s depend on the values for d_0, in m; v_0 in m/s and a_0 in m/s²:

$f_i = v/2\pi d_0$

$f_s = a_0/2\pi\ v_0$

In order that $f_s \geq f_i$, it is a requirement that $v_0 \leq (a_0 d_0)^{0,5}$. The SRS is then entirely defined by these three numerical values.

Note 2: Use of NATO Standardized Shock Levels: NATO Standardized Shock Levels based on such SRS are defined in Stanag 4549, and is identified in with the following term:

NS (relative displacement ; pseudo velocity ; absolute acceleration)

For instance, NS(0,035 ; 3,5 ; 1250) means a NATO standard level of:

- 35 mm relative displacement between 4,0 and 15,9 Hz
- 3,5 m/s pseudo velocity between 15,9 Hz and 56,8 Hz and
- ~125 g absolute acceleration between 56,8 Hz and 400 Hz.

Applications are foreseen within the following ranges:

- $0,025 \leq d_0 \leq 0,100$
- $2,5 \leq v_0 \leq 16$
- $250 \leq a_0 \leq 10,000$

The actual shock levels required for each project are to be specified by the Naval authority and in order to define the Design Shock Level for each equipment, in one the following formats:

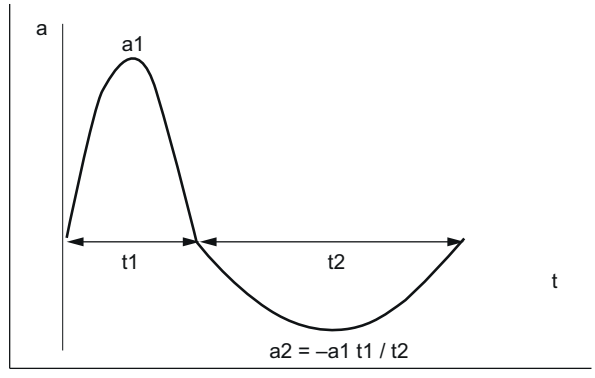
- a full SRS directly derived from a design shock level acceleration history
- a standard shock response spectrum NS(d_0, v_0, a_0).

1.3.4 Acceleration time history

The shock level can also be specified as an acceleration time history, giving the acceleration (velocity, or displacement) as a function of time. This time history is generally given by the Naval Authority.

In case only a Design Shock Level or a SRS is given, a simple sinusoidal time history, as shown in Fig 2, may be used. The Shock Response Spectrum corresponding to this time history should be computed, and compared to the required Design Shock Level or SRS. The comparison of the spectra is done as specified in [2.1.5]. The various parameters of this simple time history should be tuned until the comparison with the required spectrum is satisfactory.

Figure 2 : Sinusoidal acceleration history



2 Assessment of Equipment

2.1 Assessment by testing

2.1.1 General

Each piece of equipment is to be shock tested in accordance with the requirements of this Section, or following another recognized standard. In particular, these requirements are in line with Stanag 4549.

Table 1 : Applicable test case depending on equipment orientation on board

	Case 1	Case 2	Case 3
	Only one single possible orientation on board for the equipment **(1)**	Only the vertical axis of the equipment is known, with one single face point upwards **(2)**	The equipment may be mounted in any orientation
Equipment local X axis	test (c) fore and aft direction (sense not specified)	test (b) athwartships (sense not specified)	test (a) vertically (sense upwards)
Equipment local Y axis	test (b) athwartships (sense not specified)	test (b) athwartships (sense not specified)	test (a) vertically (sense upwards)
Equipment local Z axis	test (a) vertically (sense upwards)	test (a) vertically (sense upwards)	test (a) vertically (sense upwards)

(1) In that case, Z is considered as the vertical axis, and X is considered oriented in the longitudinal direction of the ship

(2) In that case, Z is considered as the vertical axis, X and Y axis may be either in the longitudinal or transversal direction of the ship

2.1.2 Arrangement of mountings

The mountings are to be in the same configuration as on board installation during the testing.

When such an arrangement, that is, equipment on mountings, has passed the tests as specified herein, the equipment without mountings or on another type of mountings will not be considered to be in compliance with this Section.

If equipment is on mountings, then other links such as cables and piping may considerably enhance the total stiffness of equipment "suspension". Depending on the actual situation, these additional connections should also be simulated during testing.

The mounting arrangement plan on board and for testing is to be submitted for review.

2.1.3 Shock direction and attachment to the shock testing machine

Shock in three different shipboard directions are to be simulated by three separate tests:

a) vertically (sense upwards)

b) athwartships (sense not specified)

c) fore and aft direction (sense not specified).

During a test as mentioned under test (b) or test (c) it is allowed to apply at the same time an (unspecified) shock as mentioned under test (a). This is usual practice for some testing machines during so called inclined testing.

Depending on the foreseen orientation of each type of equipment on board, the relevant testing configurations are

required with reference to the equipment local axis (X, Y and Z).

The equipment including its mounting system (if any; see [2.1.2]) is attached through its normal attachment points to the shock testing machine, either directly or by means of fixtures. The attachment and the fixtures are to be such that the measured results are reproducible and that no plastic deformation occur other than in the mountings.

2.1.4 Required test verification

For a given design shock level, the actual shock testing is different according to the testing directions defined in [2.1.3] and applicable depending on the testing cases according to Tab 1.

The tests are to be carried out according to the following requirements:

a) for the test in the upward vertical direction the design shock level as defined in [1.3.3] is to be applied

b) for the test in the athwartships direction a similar spectrum should be used having as a minimum 50% of the d_0, v_0, a_0 values for the vertical test

c) for the test in the fore and aft direction a similar spectrum should be used having as a minimum 25% of the d_0, v_0, a_0 values for the vertical test.

A test for a given equipment comprises at a minimum 3 shocks.

The shock the equipment is subjected is to be measured in accordance with Stanag 4549 or another recognized standard.

2.1.5 Comparison of spectra

The acceleration measured during the test is to be converted in a Shock Response Spectrum. The required design shock

level is considered to have been met during testing if all measured SRS exceed the required spectra, with the exception of minor excursions.

A measured response spectrum is to exceed the required three-line spectrum, with the exception of frequency ranges where minor excursions occur below the required spectrum.

Further definitions of tolerances, with examples can be found in Appendix 3 to Annex A of Stanag 4549.

2.1.6 Shock testing report

A shock testing report is to be submitted to the Society for review for each equipment, detailing at least the following information:

a) Equipment description:

1) the name and address of the supplier or manufacturer

2) references to drawings and full description of equipment as accepted. If modifications during shock test-

ing were introduced and found appropriate during successive testing, such modifications are to be fully documented

3) the weight and general overall dimensions of the equipment as tested

4) description of any mounting system used to support the equipment during the test including the number of mountings fitted, their load range, their location, the type number and the name of the manufacturer of the mountings.

b) Description of actual shock testing:

1) reference to testing standard

2) reference to the project applicable design shock level

3) description of the testing machine

4) identification of testing authority

5) detailed installation of the equipment during the test, including mountings

6) description of each test

7) Description of the instrumentation

8) For each test, measured velocity signals and maximal shock response spectra

c) Description of the performance test:

1) definition of the acceptance criteria for equipment function after shock, according to specified shock resilience criteria

2) description of any damage

3) functional performance tests results

d) General conclusion with acceptable status from the testing authority.

2.2 Assessment by computations

2.2.1 General

As an alternative to the testing, the assessment of large and heavy mechanical components (such as shaft lines, reduction gears, main engines foundations, diesel generators foundations) may be performed based on computations for which the applied methodology is accepted by the Naval Authority.

2.2.2 Type of computations

Dynamic structural analysis should be used based on a structural model of the equipment.

2.2.3 Loading

The structural model is to be loaded by an imposed acceleration time history, as defined in [1.3.4].

2.3 Acceptance Criteria

2.3.1 An equipment is deemed to be qualified for a given design shock level after satisfactory review of an approved test report in accordance with Stanag 4549 and [2.1.6]. For components for which the assessment is based on dynamic structural analysis, the acceptance criteria is to be defined by the Naval Authority.

2.4 Alternative Methods

2.4.1 Any other alternative methods or reference standards that are used to assess the pieces of equipment to be covered by the additional class notation **SHOCK EQUIPMENT** may be considered on a case-by-case basis.

SECTION 13 RESIDUAL STRENGTH

1 General

1.1 Application

1.1.1 This Section applies to ships for which the residual hull girder ultimate strength under damage condition is evaluated according to minimum hull damage scenarios and rule wave hull girder loads defined in Article [2].

Ships complying with the requirements of this Section may be granted with the additional class notation **RS-P**.

2 Design requirements

2.1 Minimum damage scenarios

2.1.1 The two following damage scenarios are to be considered independently between 0,2 L and 0,8 L:

- in-air damages as defined in [2.1.2]
- under-water damages as defined in [2.1.3].

The damage extents defined in [2.1.2] and [2.1.3] are to be measured from the moulded lines of the ship.

Stiffeners are to be considered intact unless the connection of stiffener with attached plate is included in the damage extent.

2.1.2 Transverse extent for in-air damage

The damage extends from the point of intersection of the side shell and the uppermost continuous deck:

- Vertically downward for a distance D/4
- Transversally inboard for a distance B/2

where B and D are defined in Pt B, Ch 1, Sec 2.

2.1.3 Transverse extent for under-water damage

The damage extends from the point of intersection of the keel line and the side shell:

- Vertically upward for a distance D/5
- Transversally outboard for a distance B/3

where B and D are defined in Pt B, Ch 1, Sec 2.

2.2 Hull girder residual strength check

2.2.1 Hull girder loads

The vertical bending moment M_D, in kN.m, to be considered for the check of ultimate hull girder strength in damaged condition, is to be obtained from the following formula:

- in hogging condition:
  $M_{D,H} = M_{SW,H} + 0,825\ M_{WV,H}$
- in sagging condition:
  $M_{D,S} = M_{SW,S} + 0,825\ M_{WV,S}$

where:

$M_{SW,H}$: Maximum still water bending moments calculated in hogging condition, as defined, in Pt B, Ch 5, Sec 2, [2.2]

$M_{SW,S}$: Maximum still water bending moments calculated, in sagging condition, as defined, in Pt B, Ch 5, Sec 2, [2.2]

$M_{WV,H}$: Vertical wave bending moments calculated in hogging condition, as defined, in Pt B, Ch 5, Sec 2, [3.1]

$M_{WV,S}$: Vertical wave bending moments calculated in sagging condition, as defined, in Pt B, Ch 5, Sec 2, [3.1]

2.2.2 Hull girder ultimate bending capacity in the damaged condition

The hull girder ultimate bending capacity in damaged condition M_{UD}, in kN.m, is to be calculated in hogging and sagging conditions according to Pt B, Ch 6, App 1, with the damaged parts assumed not to contribute to the hull girder strength.

When assessing the ultimate bending capacity of the damaged hull transverse sections:

- damaged area as defined in [2.1] is to be removed from the capacity model
- the hull girder longitudinal members are to be considered with their net scantlings according to Pt B, Ch 6, Sec 1, [2].

2.2.3 Checking criteria

The vertical hull girder ultimate bending capacity in the damaged condition at any hull transverse section located between 0,2 L and 0,8 L is to satisfy the following criteria:

$$\frac{M_{UD}}{\gamma_R \gamma_m} \geq M_D$$

where:

M_{UD} : Ultimate bending moment capacity of the hull transverse section considered, in kN.m:

- In hogging condition:
  $M_{UD} = M_{UD,H}$
- In sagging condition:
  $M_{UD} = M_{UD,S}$

M_D : Vertical bending moment, in kN.m, defined in [2.2.1]

γ_m : Partial safety factor for material defined in Pt B, Ch 6, Sec 3

γ_R : Partial safety factor for resistance defined in Pt B, Ch 6, Sec 3.

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