

Rules for the Classification of Naval Ships

NR 483 - June 2017



Part E - Additional Class Notations





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**BUREAU
VERITAS**

MARINE & OFFSHORE - GENERAL CONDITIONS

1. INDEPENDENCY OF THE SOCIETY AND APPLICABLE TERMS

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

2. DEFINITIONS

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

3. SCOPE AND PERFORMANCE

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

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

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

The Society will not:

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

4. RESERVATION CLAUSE

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

5. ACCESS AND SAFETY

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

6. PAYMENT OF INVOICES

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

7. LIABILITY

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

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

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

8. INDEMNITY CLAUSE

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

9. TERMINATION

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

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

10. FORCE MAJEURE

- 10.1. Neither Party shall be responsible for any failure to fulfil any term or provision of the Conditions if and to the extent that fulfilment has been delayed or temporarily prevented by a force majeure occurrence without the fault or negligence of the Party affected and which, by the exercise of reasonable diligence, the said Party is unable to provide against.
- 10.2. For the purpose of this clause, force majeure shall mean any circumstance not being within a Party's reasonable control including, but not limited to: acts of God, natural disasters, epidemics or pandemics, wars, terrorist attacks, riots, sabotages, impositions of sanctions, embargoes, nuclear, chemical or biological contaminations, laws or action taken by a government or public authority, quotas or prohibition, expropriations, destructions of the worksite, explosions, fires, accidents, any labour or trade disputes, strikes or lockouts

11. CONFIDENTIALITY

- 11.1. The documents and data provided to or prepared by the Society in performing the Services, and the information made available to the Society, are treated as confidential except where the information:
 - is already known by the receiving Party from another source and is properly and lawfully in the possession of the receiving Party prior to the date that it is disclosed;
 - is already in possession of the public or has entered the public domain, otherwise than through a breach of this obligation;
 - is acquired independently from a third party that has the right to disseminate such information;
 - is required to be disclosed under applicable law or by a governmental order, decree, regulation or rule or by a stock exchange authority (provided that the receiving Party shall make all reasonable efforts to give prompt written notice to the disclosing Party prior to such disclosure).
- 11.2. The Society and the Client shall use the confidential information exclusively within the framework of their activity underlying these Conditions.
- 11.3. Confidential information shall only be provided to third parties with the prior written consent of the other Party. However, such prior consent shall not be required when the Society provides the confidential information to a subsidiary.
- 11.4. The Society shall have the right to disclose the confidential information if required to do so under regulations of the International Association of Classifications Societies (IACS) or any statutory obligations.

12. INTELLECTUAL PROPERTY

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

13. ASSIGNMENT

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

14. SEVERABILITY

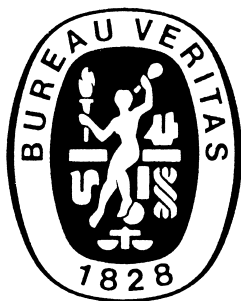
- 14.1. Invalidity of one or more provisions does not affect the remaining provisions.
- 14.2. Definitions herein take precedence over other definitions which may appear in other documents issued by the Society.
- 14.3. In case of doubt as to the interpretation of the Conditions, the English text shall prevail.

15. GOVERNING LAW AND DISPUTE RESOLUTION

- 15.1. The Conditions shall be construed and governed by the laws of England and Wales.
- 15.2. The Society and the Client shall make every effort to settle any dispute amicably and in good faith by way of negotiation within thirty (30) days from the date of receipt by either one of the Parties of a written notice of such a dispute.
- 15.3. Failing that, the dispute shall finally be settled by arbitration under the LCIA rules, which rules are deemed to be incorporated by reference into this clause. The number of arbitrators shall be three (3). The place of arbitration shall be London (UK).

16. PROFESSIONAL ETHICS

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



RULES FOR THE CLASSIFICATION OF NAVAL SHIPS

Part E Additional Class Notations

Chapters 1 2 3 4 5 6 7 8 9

Chapter 1	SEA KEEPING (SEA-KEEP)
Chapter 2	SYSTEM OF TRACE AND ANALYSIS OF RECORDS (STAR)
Chapter 3	AVAILABILITY OF MACHINERY (AVM)
Chapter 4	AUTOMATION SYSTEMS (AUT)
Chapter 5	MONITORING EQUIPMENT (MON)
Chapter 6	COMFORT ON BOARD (COMF)
Chapter 7	POLLUTION PREVENTION (CLEANSHIP)
Chapter 8	REFRIGERATING INSTALLATION (REF-STORE)
Chapter 9	OTHER ADDITIONAL CLASS NOTATIONS

The English wording of these rules take precedence over editions in other languages.

Unless otherwise specified, these rules apply to ships for which contracts are signed after June 1st, 2017. The Society may refer to the contents hereof before June 1st, 2017, as and when deemed necessary or appropriate.

CHAPTER 1

SEA KEEPING (SEA-KEEP)

Section 1 Sea-Keeping Assessment (SEA-KEEP)

1	General	23
1.1	Introduction	
1.2	Assessment procedure	
1.3	Environmental conditions	
2	Flight operations (FLY)	24
2.1	General	
2.2	Criteria	
3	Replenishment at sea (RAS)	25
3.1	General	
3.2	Parameters	
3.3	Criteria	
4	Weapons systems (WEAP)	26
4.1	General	
4.2	Criteria	
5	Personnel performance (CREW)	27
5.1	General	
5.2	Parameters	
5.3	Criteria	

Appendix 1 Sea-Keeping Calculations

1	Introduction	30
1.1	General	
1.2	Scope	
2	Short term assessment	30
2.1	General	
2.2	Loading conditions	
2.3	Ship speed	
2.4	Wave spectrum	
2.5	Hydrodynamic model	
2.6	Spectral moments	
2.7	RMS values	
3	Long term assessment	31
3.1	General	
3.2	Hydrodynamic model	
3.3	Sea state scatter diagram	

CHAPTER 2

SYSTEM OF TRACE AND ANALYSIS OF RECORDS (STAR)

Section 1 Star-Hull

1	General	35
1.1	Principles	
1.2	Conditions for the assignment and maintenance of the notation	
1.3	Ship database	
2	Documentation to be submitted	36
2.1	Plans and documents to be submitted	
2.2	Hot spot map	
2.3	Inspection and Maintenance Plan (IMP)	
3	Inspection and Maintenance Plan (IMP)	37
3.1	Minimum requirements	
3.2	General scope of IMP	
3.3	Periodicity of inspections	
3.4	Extent of inspections	
3.5	Inspection reports	
3.6	Changes to Inspection and Maintenance Plan	
4	Acceptance criteria	40
4.1	Coating assessment	
4.2	Sacrificial anode condition (as applicable)	
4.3	Thickness measurements (applicable only if required by the Society on case by case basis)	
4.4	Pitting	
4.5	Fractures	
5	Maintenance of the notation	41
5.1	Annual audit at the Naval Authority's offices	
5.2	Annual shipboard audit	
5.3	Class renewal survey	
5.4	Suspension and withdrawal of the notation	

Section 2 Star-Mach

1	General	45
1.1	Principles	
1.2	Conditions for the assignment and maintenance of the notation	
1.3	Ship database	
2	Documentation to be submitted	46
2.1	Plans, documents and specifications	
2.2	Inspection and Maintenance Plan (IMP)	
3	Risk analysis	47
3.1	Initial risk analysis	
3.2	Risk analysis review	

4	Inspection and Maintenance Plan	48
4.1	General	
4.2	Inspection and maintenance reports	
4.3	Changes to the Inspection and Maintenance Plan	
4.4	Responsible persons	
5	Maintenance of the notation	48
5.1	Annual audit at the Naval Authority's offices	
5.2	Annual shipboard audit	
5.3	Occasional onboard audits and/or surveys	
5.4	Suspension and withdrawal of the notation	

Appendix 1 Acceptance Criteria for Isolated Areas of Items

1	General	50
1.1	Application	

Appendix 2 Acceptance Criteria for Isolated Items

1	Partial safety factors	53
1.1	General	
1.2	Partial safety factors based on the increased knowledge of the structure	
2	Acceptance criteria for plating	53
2.1	Application	
2.2	Renewal thicknesses	
3	Acceptance criteria for ordinary stiffeners	55
3.1	Application	
3.2	Renewal scantlings	
4	Acceptance criteria for primary supporting members	56
4.1	Application	
4.2	Work ratios	
4.3	Renewal scantlings	

Appendix 3 Acceptance Criteria for Zones

1	General	59
1.1	Application	

Appendix 4 Pitting Intensity Diagrams

1	General	60
1.1	Diagrams	

Appendix 5 Naval Authority’s Hull Inspection Reports

1	General	61
	1.1	
2	Report for inspection of spaces	61
	2.1 General	
	2.2 Identification data	
	2.3 Summary of findings and repairs	
	2.4 Details of findings and repairs	
	2.5 Attached documentation	
3	Report for inspection of equipment	63
	3.1 General	
	3.2 Identification data	
	3.3 Detailed report	
	3.4 Attached documentation	

Appendix 6 Risk Analyses for Star-Mach

1	General	65
	1.1 Application	
	1.2 Carrying out of risk analysis	
	1.3 Procedure	
2	Overall process	65
	2.1 Selection of the ship’s critical systems	
	2.2 Functional analysis of the systems	
	2.3 Definition of top events	
	2.4 Collection of failure and maintenance data	
	2.5 Preparation of the logic-probabilistic model	
	2.6 Analysis of the results	
	2.7 Individuation of the critical components to be monitored	
	2.8 Collection of actual failure and maintenance data	
	2.9 Updating of failure and maintenance data	
	2.10 Analysis of the risk trend	

Appendix 7 Planned Maintenance Scheme

1	General	68
	1.1	
2	Conditions and procedures for the approval of the system	68
	2.1 General	
	2.2 Documentation	
	2.3 Information on board	
	2.4 Annual report	
3	Implementation of the system	69
	3.1	
4	Retention and withdrawal of the system	69
	4.1	

5	Surveys	69
5.1	Implementation survey	
5.2	Annual audit	
5.3	Damage and repairs	
6	Machinery items surveyed on the basis of condition monitoring	70
6.1		

CHAPTER 3

AVAILABILITY OF MACHINERY (AVM)

Section 1 Alternative Propulsion Mode (AVM-APM)

1	General	75
1.1	Application	
1.2	Principle	
1.3	Definitions	
1.4	Documentation to be submitted	
2	Design requirements	76
2.1	Availability of the alternative propulsion mode and other ship services	
2.2	Machinery systems	
2.3	Electrical systems	
3	Tests on board	76
3.1	Factory acceptance tests	
3.2	Sea trials	

Section 2 Duplicated Propulsion System (AVM-DPS)

1	General	78
1.1	Application	
1.2	Principle	
1.3	Definitions	
1.4	Documentation to be submitted	
2	Design requirements	79
2.1	Performance of the propulsion plant with one propulsion set inoperative	
2.2	Single failures to be considered for the propulsion set design	
2.3	Design of machinery systems	
2.4	Design of electrical installations	
2.5	Design of automation systems	
3	Tests on board	79
3.1	Running tests	
3.2	Sea trials	

Section 3 Independent Propulsion System (AVM-IPSt-(V))

1	General	80
1.1	Application	
1.2	Coverage of AVM-IPSt-(V) notation	
1.3	Documentation to be submitted	
2	Special arrangements	81
2.1	Systems for cooling, lubrication, fuel supply, air starting, monitoring and control	
2.2	Rudders and steering gears	
2.3	Electrical installations	
2.4	Automation	

3	Tests on board	82
3.1	Running tests	
3.2	Sea trials	

Appendix 1 Procedures for Failure Modes and Effect Analysis

1	General	83
1.1	Introduction	
1.2	Objectives	
1.3	Sister ships	
1.4	FMEA basics	
1.5	FMEA analysis	
2	FMEA performance	84
2.1	Procedures	
2.2	System definition	
2.3	Development of system block diagram	
2.4	Identification of failure modes, causes and effects	
2.5	Failure effects	
2.6	Failure detection	
2.7	Corrective measures	
2.8	Use of probability concept	
2.9	Documentation	
3	Tests and reporting	86
3.1	Reporting	
4	Probabilistic concept	87
4.1	General	
4.2	Occurrences	
4.3	Probability of occurrences	
4.4	Effects	
4.5	Safety level	
4.6	Numerical values	

CHAPTER 4

AUTOMATION SYSTEMS (AUT)

Section 1 Qualified Automation Systems (AUT-QAS)

1	General	91
	1.1 Application	
	1.2 Communication system	
2	Documentation	91
	2.1 Documents to be submitted	
3	Fire and flooding precautions	91
	3.1 Fire prevention	
	3.2 Fire detection	
	3.3 Fire fighting	
	3.4 Protection against flooding	
4	Control of machinery	92
	4.1 General	
	4.2 Diesel propulsion plants	
	4.3 Gas turbine propulsion plants	
	4.4 Electrical propulsion plant	
	4.5 Shafting, clutches, CPP, gears	
	4.6 Auxiliary system	
	4.7 Control of electrical installation	
5	Alarm system	105
	5.1 General	
	5.2 Alarm system design	
	5.3 Machinery alarm system	
	5.4 Alarm system	
6	Safety systems	106
	6.1 General	
7	Testing	106
	7.1 General	

Section 2 Automated Operation in Port (AUT-PORT)

1	General	108
	1.1 Application	
	1.2 Communication system	
2	Documentation	108
	2.1 Documents to be submitted	
3	Fire and flooding precautions	108
	3.1 General	

4	Control of machinery	108
	4.1 Plant operation	
5	Alarm system	108
	5.1 General	
6	Location of the continuously manned control station	108
	6.1 General	
7	Testing	108
	7.1 Tests after completion	

Section 3 Integrated Automation Systems (AUT-IAS)

1	General	109
	1.1 Application	
2	Documentation	109
	2.1 Documents to be submitted	
3	Design requirements	109
	3.1 General	
	3.2 Integrated computer based systems	
4	Testing	110
	4.1 Additional testing	

CHAPTER 5

MONITORING EQUIPMENT (MON)

Section 1 Hull Stress and Motion Monitoring (MON-HULL)

1	General	113
1.1	Application	
1.2	Documentation	
1.3	Data limits, warning levels	
2	Hull monitoring system	113
2.1	Main functions	
2.2	Sensors	
2.3	Specifications	
2.4	Real time data processing	
2.5	Visual display	
2.6	Alarms	
2.7	Data storage (MON-HULL+S)	
2.8	Exploitation and checking of stored data (MON-HULL+S)	
2.9	Power supply unit	
2.10	Calibration	
2.11	Periodical inspections	

Section 2 Shaft Monitoring (MON-SHAFT)

1	General	116
1.1	Applicability of MON-SHAFT notation	
2	Requirements for the issuance of the notation	116
2.1	Arrangement	
2.2	Lubricating oil analysis	

CHAPTER 6

COMFORT ON BOARD (COMF)

Section 1	General Requirements	
1	General	119
	1.1 Application	
	1.2 Basic principles	
	1.3 Regulations - Standards	
	1.4 Documentation to be submitted	
2	Conditions of attribution	120
	2.1 Measurements	
	2.2 Acceptance criteria	
	2.3 Measuring locations	
3	Testing conditions	120
	3.1 General	
	3.2 Harbour test conditions	
	3.3 Sea trial conditions	
Section 2	Additional Requirements for Notation COMF-NOISE	
1	General	122
	1.1 Application	
2	Measurement procedure	122
	2.1 Instrumentation	
	2.2 Data processing - Analysis	
	2.3 Measuring condition	
	2.4 Measuring positions	
3	Noise levels and sound insulation measurement	122
	3.1 Noise level requirements	
	3.2 Sound insulation measurement	
Section 3	Additional Requirements for Notation COMF-VIB	
1	General	123
	1.1 Application	
2	Measurement procedure	123
	2.1 Instrumentation	
	2.2 Data processing, presentation of results and analysis	
	2.3 Measuring conditions	
	2.4 Measuring positions	
3	Vibration level requirements	123
	3.1 General	

CHAPTER 7

POLLUTION PREVENTION (CLEANSHIP)

Section 1 General Requirements

1	Scope and application	127
1.1	General	
1.2	Applicable rules and regulations	
2	Definitions and abbreviations	128
2.1	Definitions related to sea pollution	
2.2	Definitions related to air pollution	
2.3	Abbreviations	
3	Documents to be submitted and applicable standards	129
3.1	Documents to be submitted	
3.2	Modifications and additions	

Section 2 Design Requirements for the Notations CLEANSHIP and CLEANSHIP SUPER

1	General	134
1.1	Application	
1.2	Documents to be submitted	
2	Design requirements for the additional class notation CLEANSHIP	134
2.1	Waste management	
2.2	Oily wastes	
2.3	Wastewaters	
2.4	Garbage and hazardous wastes	
2.5	Hull antifouling systems	
2.6	Prevention of pollution by oil spillage and leakage	
2.7	Refrigeration systems	
2.8	Fire-fighting systems	
2.9	Emission of nitrogen oxides (NOx)	
2.10	Emission of sulphur oxides (SOx)	
3	Additional design requirements for the additional class notation CLEANSHIP SUPER	139
3.1	Waste minimization and recycling program	
3.2	Oily wastes	
3.3	Wastewaters	
3.4	Food wastes	
3.5	Prevention of pollution by oil spillage and leakage	
3.6	Protection against oil pollution in the event of collision or grounding	
3.7	Prevention of air pollution	
3.8	Monitoring and recording systems	

Section 3 Design Requirements for the Pollution Prevention Notations other than CLEANSHIP and CLEANSHIP SUPER

1	General	142
	1.1 Application	
	1.2 Documents to be submitted	
2	Additional class notation AWT	142
	2.1 Scope	
	2.2 Definitions and abbreviations	
	2.3 Design of the AWT plant	
3	Additional class notation BWE	143
	3.1 Scope	
	3.2 Design requirements	
4	Additional class notation BWT	143
	4.1 Scope	
	4.2 Design and installation requirements	
5	Additional class notation GWT	143
	5.1 Scope	
	5.2 Design of the grey water treatment plant	
6	Additional class notation NDO-x days	144
	6.1 Scope	
	6.2 Design requirements	
7	Additional class notation NOX-x%	144
	7.1 Scope	
	7.2 Design requirements	
8	Additional class notation OWS-x ppm	145
	8.1 Scope	
	8.2 Design requirements	
9	Additional class notation SOX-x%	145
	9.1 Scope	
	9.2 Design requirements	

Section 4 Onboard Surveys

1	Application	146
	1.1	
2	Periodical tests and measurements done by the shipowner	146
	2.1 General	
	2.2 Initial period	
	2.3 Periodical tests after first year of service	
3	Periodical surveys	147
	3.1 Initial survey	
	3.2 Periodical survey	

CHAPTER 8

REFRIGERATING INSTALLATION (REF-STORE)

Section 1 General Requirements

1	General	151
1.1	Application	
1.2	Definitions	
2	Design criteria	151
2.1	Reference conditions	
3	Documentation	151
3.1	Refrigerating installations	
4	General technical requirements	153
4.1	Refrigeration of chambers	
4.2	Refrigerating unit	
4.3	Defrosting	
4.4	Prime movers and sources of power	
4.5	Pumps	
4.6	Sea connections	
4.7	Refrigerating unit spaces	
5	Refrigerated chambers	154
5.1	Construction of refrigerated chambers	
5.2	Penetrations	
5.3	Access to refrigerated spaces	
5.4	Insulation of refrigerated chambers	
5.5	Protection of insulation	
5.6	Miscellaneous requirements	
5.7	Installation of the insulation	
5.8	Drainage of refrigerated spaces	
6	Refrigerants	155
6.1	General	
6.2	Rated working pressures	
7	Refrigerating machinery and equipment	156
7.1	Prime movers	
7.2	Common requirements for compressors	
7.3	Reciprocating compressors	
7.4	Pressure vessels	
7.5	General requirements for piping	
7.6	Accessories	
7.7	Refrigerating plant overpressure protection	
8	Specific requirements for direct refrigerating systems	157
8.1	Specific requirements for air cooling systems and distribution and renewal of air in refrigerated spaces	
9	Instrumentation, alarm, monitoring	158
9.1	General	
9.2	Instrumentation, alarm and monitoring arrangement	

10	Material tests, inspection and testing, certification	158
10.1	Material testing	
10.2	Shop tests	
10.3	Pressure tests at the workshop	
10.4	Thermometers and manometers	
10.5	Shipboard tests	
10.6	Defrosting system	

CHAPTER 9

OTHER ADDITIONAL CLASS NOTATIONS

Section 1 In-Water Survey Arrangements (INWATERSURVEY)

1	General	163
1.1	Application	
1.2	Documentation to be submitted	
2	Structure design principles	163
2.1		

Section 2 Manoeuvrability (MANOVR)

1	General	164
1.1	Introduction	
2	Manoeuvrability criteria	164
2.1	Standard manoeuvres	
2.2	Criteria	
3	Full scale trials	165
3.1	General	
3.2	Trials conditions	
3.3	Trials to be carried out	
3.4	Documentation to be submitted	

Section 3 Helicopter Deck (HELICOPTER)

1	General	167
1.1	Application	
2	Structure	167
2.1		
3	Fire protection, detection and extinction	167
3.1	General	
3.2	Additional fire safety measures for helideck	

Section 4 Towing (TOW)

1	Emergency towing arrangements	170
1.1	Definitions	
1.2	Application	
1.3	Documentation	
1.4	General	
1.5	Emergency towing arrangement approval	
1.6	Safe working load (SWL) of towing pennants, chafing gears, fairleads and strongpoints	

- 1.7 Towing pennant
- 1.8 Chafing gear
- 1.9 Fairleads
- 1.10 Strongpoint
- 1.11 Hull structures in way of fairleads or strongpoints
- 1.12 Rapid deployment of towing arrangement
- 1.13 Type approval

Section 5 Centralised Navigation Equipment (SYS-NEQ)

1	General	177
	1.1 Application	
	1.2 Operational assumptions	
	1.3 Regulations, guidelines, standards	
	1.4 Definitions	
2	Documentation	179
	2.1 Documents to be submitted	
3	Bridge layout	179
	3.1 General	
4	Bridge instrumentation and controls	179
	4.1 General	
	4.2 Safety of navigation: collision-grounding	
	4.3 Position fixing	
	4.4 Controls - Communication	
5	Design and reliability	181
	5.1 General	
	5.2 Power supply	
	5.3 Environmental conditions	
6	Prevention of accidents caused by operator's unfitness	182
	6.1 Bridge safety system	
	6.2 Field of vision	
	6.3 Alarm/warning transfer system - Communications	
	6.4 Bridge layout	
7	Ergonomical recommendations	183
	7.1 Lighting	
	7.2 Noise level	
	7.3 Vibration level	
	7.4 Wheelhouse space heating/cooling	
	7.5 Navigator's safety	
8	Testing	183
	8.1 Tests	

Section 6 Fire (FIRE)

1	Fire protection	184
	1.1 Accommodation spaces, service spaces and control stations	

Section 7 Flooding Fighting System (FFS)

1	Principle	185
	1.1	
2	Design of flooding fighting systems	185
	2.1 General	
	2.2 Pumps	
	2.3 Piping	

Section 8 VLS

1	General	187
	1.1 Application	
2	Hull arrangement and stability	187
	2.1 General arrangement design	
	2.2 Stability	

Part E
Additional Class Notations

Chapter 1
SEA KEEPING (SEA-KEEP)

SECTION 1 SEA-KEEPING ASSESSMENT (SEA-KEEP)

APPENDIX 1 SEA-KEEPING CALCULATIONS

SECTION 1

SEA-KEEPING ASSESSMENT (SEA-KEEP)

1 General

1.1 Introduction

1.1.1 Sea-keeping notations

The confidential additional class notations **SEA-KEEP-FLY**, **SEA-KEEP-RAS** and **SEA-KEEP-WEAP** are assigned to ships whose specific sea-keeping performance levels are assured up to a certain limiting sea state.

The above notations are assigned according to the specified performance assured:

- **FLY-X(L,M,H)**, for flight operations
- **RAS-X(L,M,H)**, replenishment at sea
- **WEAP-X(L,M,H)**, for weapons systems operations
- **CREW**, for crew capability.

where **X** specifies the sea state number, followed by a letter indicating whether it is High, Mid or Low sea state, up to which the required sea-keeping performance is maintained. E.g. the additional notation **SEA-KEEP-FLY-3(H)** is assigned to a ship that can satisfy the flight operation limits up to high sea state 3.

1.1.2 Operation limits

The operation limits depend on the specific operation the vessel must perform. For flight, replenishment at sea and weapons systems operations the limits ensure that:

- the aircraft/helicopters can be launched and recovered
- the replenishment at sea operations can be carried out safely and effectively
- the weapons systems can be operated and handled safely and effectively
- the crew is capable of performing the tasks connected to transit missions.

Operational limits for flight, replenishment at sea and weapons systems operations are taken according to the NATO standards STANAG 4154 Ed.3.

1.1.3 Verification approach

The additional notations **SEA-KEEP-FLY-X(L,M,H)**, **SEA-KEEP-RAS-X(L,M,H)**, **SEA-KEEP-WEAP-X(L,M,H)** and **SEA-KEEP-CREW** are assigned to ships whenever the limiting sea state **X** for the specific operation has been determined by the use of sea-keeping computer calculations according to the indications in Ch 1, App 1.

1.1.4 Flight operations (FLY)

In terms of sea-keeping effects on performance, **FLY** involves a special and fairly consistent set of systems, tasks and criteria that must always be considered:

- aircraft take-off and landing

- helicopter and STOVL (Short Take-Off Vertical Landing) take-off and landing
- near-ship operations (e.g. Helicopter In-Flight Refuelling (HIFR))
- on-deck handling (e.g. fuelling, folding wings or rotors, transit into hangar).

1.1.5 Replenishment at sea (RAS)

Replenishment at sea represents a wide variety of resupply activities, including:

- connected replenishment (CONREP)
- fuelling at sea (FAS)
- vertical replenishment (VERTREP).

CONREP operations involve two (or more) ships that are connected by flexible umbilicals and/or constant tension wire rigging to exchange personnel and supplies such as munitions and general stores.

FAS operations involve two (or more) ships that are connected by flexible umbilicals to exchange fuel.

VERTREP operations cover operations where a helicopter is used to lower personnel and/or materials onto the ship.

1.1.6 Weapons systems operation (WEAP)

Weapons systems operations represent the missions where the crew must operate or handle the on-board weapons systems, including:

- operation of radars and sonars
- operation of guns
- launching/handling of missiles
- launching/handling of torpedoes.

1.2 Assessment procedure

1.2.1 Parameters

The parameters to be considered for the assessment of the sea-keeping are defined in [2], [3], [4] and [5].

1.2.2 Evaluation

The values of the ship sea-keeping parameters are to be assessed by means of computer calculations and/or small-scale model tests in a model basin.

The computer calculations have to be performed as described in Ch 1, App 1, and the following documentation must be provided:

- justification of the validity of the used software
- parameters to be calculated
- computation input data
- computation results
- model test results that verify and/or replace calculated results.

Concerning model tests the following documentation must be provided:

- parameters to be measured
- detailed test program
- analysis procedure of measured data
- sea- and ship loading-condition during the tests
- test results and their analysis.

1.3 Environmental conditions

1.3.1 Sea state

Sea state is an expression used to categorize wave conditions and normally a sea state comprises a significant wave height H_s and a wave period.

If not specified, the environmental conditions are to be taken from STANAG 4154.

Whenever computer calculations or model scale tests are used, i.e. when the environmental conditions are selectable, the sea states used for the verification of the criteria in [2.2] and [3.3] should be defined as described in [1.3.2] and [1.3.3].

1.3.2 Wave height

Generally, the references to the wave height are to be taken as the significant wave height H_s , i.e. the average of the 1/3 largest wave heights in a sea state.

The description of sea states found in STANAG 4154 defines the significant wave height as ranges, not absolute values. For this reason sea states must be referred to not just by their number, but also whether it is a low, mid or high sea state. Unless specified, a low sea state 6 has $H_s = 4,0$ m, mid sea state 6 has $H_s = 5,0$ m and high sea state 6 has $H_s = 6,0$ m.

The wave height to be considered for the verifications should be the largest significant wave height relative to the specified sea state; if a mid sea state 6 is specified, H_s should be taken as 5,0 m, if only sea state 6 is specified, H_s should be taken equal to 6,0 m.

1.3.3 Wave period

Generally, references to the wave period are to be taken as the modal wave period, as per STANAG 4154.

For TRAN mission, at least three periods should be considered, the values of which are to be taken from STANAG 4154. For other cases, one period value should be sufficient.

2 Flight operations (FLY)

2.1 General

2.1.1 Scope

The scope of verifying the sea-keeping performance is to determine in what sea state the ship motions and accelerations become so severe that they prevent or obstruct the flight operations.

2.1.2 Requirements

The requirements for verifying that the crew is able to carry out their tasks in FLIGHT operations is that the parameters evaluated do not exceed the criteria defined in [2.2].

The limiting sea state number **X** must be defined according to STANAG 4154, unless specified, and this number will be included in the following **FLY** notations:

- **FLY_CTOL**: criteria specific to “Conventional Take-Off and Landing”
- **FLY_FWAH**: criteria specific to “Fixed Wing Aircraft Handling”
- **FLY_HELOL**: criteria specific to “Helicopter and STOVL launch recovery”
- **FLY_HELOH**: criteria specific to “Helicopter and STOVL handling”.

2.2 Criteria

2.2.1 Fixed wing aircraft launch & recovery

Limits for Conventional Take-Off and Landing (CTOL) of fixed wing aircraft from aircraft carriers are listed in Tab 1, as RMS values of roll, pitch, vertical and lateral displacement and vertical velocity.

Table 1 : Fixed wing aircraft launch & recovery criteria limits

Governing factors	Performance limitations		
	Motion	Limit	Location
Aircraft handling	Roll	See roll criteria, Fig 1	
Sink off bow and OLS limits	Pitch	See pitch criteria, Fig 2	
Ramp clearance	Vertical displacement	0,8 m	Stern ramp at flight deck
Landing line-up	Lateral displacement	2,3 m	Stern ramp at flight deck
Landing gear	Vertical velocity	0,7 m/s	Touch down point

Note 1: All limits are given in terms of RMS amplitude

Figure 1 : Roll limits

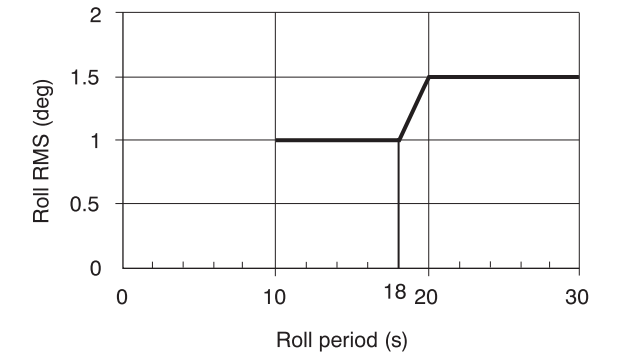
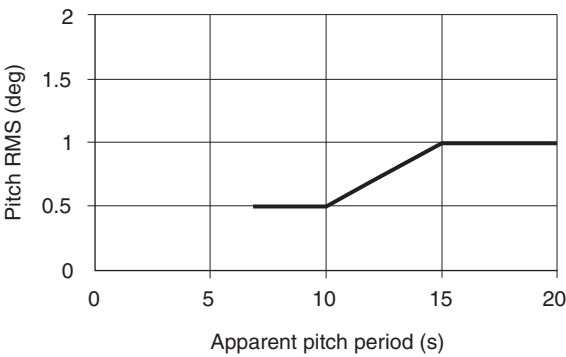


Figure 2 : Pitch limits



2.2.2 Fixed wing aircraft handling

Limits on support equipment for aircraft handling are given in Tab 2 as RMS values for pitch and roll motion. Support operations encompass a wide range of functions (e.g. ordnance handling, aircraft arming, fuelling, engine changing), hence the limits for support equipment are presented for the most restrictive of these.

Table 2 : Fixed wing aircraft handling criteria limits

Subsystem	Performance limitations		
	Motion	Limit	Location
Aircraft and handling equipment	Roll	See roll criteria, Fig 1	
	Pitch	See pitch criteria, Fig 2	
Elevators	Wetness	5/hr	Bottom inner leading elevator edge

2.2.3 Helicopter and STOVL launch & recovery

Limits for vertical and short takeoff and vertical landing (VTOL and STOVL) are given in Tab 3 as RMS values of roll and pitch motion and vertical velocity.

Table 3 : Helicopter and STOVL launch & recovery criteria limits

Operation	Performance limitations		
	Motion	Limit	Location
Generic helicopter launch	Roll	2,5°	
	Pitch	1,5°	
Generic short takeoff	Roll	2,5°	
	Pitch	1,5°	
Generic helicopter recovery	Roll	2,5°	
	Pitch	1,5°	
	Vertical velocity	1,0 m/s	Landing spot
Note 1: All limits are given in terms of RMS amplitude.			

2.2.4 Helicopter and STOVL handling

Limits for handling of helicopter and STOVL are given in Tab 4 as RMS values of roll and pitch motion.

Table 4 : Helicopter and STOVL handling criteria limits

Performance limitations	
Motion	Limit
Roll	1,8°
Pitch	1,8°
Note 1: All limits are given in terms of RMS amplitude.	

3 Replenishment at sea (RAS)

3.1 General

3.1.1 Scope

The scope of verifying the sea-keeping performance is to determine in what sea state the ship motions and accelerations become so severe that they prevent or obstruct the replenishment at sea operations.

3.1.2 Requirements

The requirements for certifying that the crew is able to carry out their tasks in RAS operations is that the parameters evaluated do not exceed the criteria defined in [3.3].

The limiting sea state number X must be defined according to STANAG 4154, unless specified, and this number will be included in the following RAS notations:

- **RAS_CONREP**: criteria specific to “Connected replenishment”
- **RAS_FAS**: criteria specific to “Fuelling at sea”
- **RAS_VERTREP**: criteria specific to “Vertical replenishment”.

3.2 Parameters

3.2.1 Motion Sickness Incidence (MSI)

The motion sickness incidence (MSI) is described in [5.2.1].

3.2.2 Motion Induced Interruption (MII)

The motion induced interruption (MII) is described in [5.2.2].

3.3 Criteria

3.3.1 Connected replenishment (CONREP)

Limits for connected replenishment (CONREP) between two ships are listed in Tab 5 as RMS values of roll and pitch motion, and as human factor limits expressed in MSI and MII.

3.3.2 Fuelling at sea (FAS)

Limits for (flexible connected) fuelling at sea (FAS) between two ships are listed in Tab 6 as human factor limits expressed in MSI, MII and wetness index.

3.3.3 Vertical replenishment (VERTREP)

Limits for vertical replenishment from helicopters (VERTREP) are listed in Tab 7 as RMS values of roll and pitch motion, vertical displacement and vertical velocity together with human factor limits expressed in MSI and MII.

Table 5 : Connected replenishment criteria limits

Limiting factor	Performance limitations		
	Motion	Limit	Location
Equipment: Pallet truck slip angle	Roll	2,2°	
	Pitch	2,2°	
Personnel	MI	0,5/min	CONREP station
	MSI	20% of crew, 4 hr	CONREP station
	Wetness index	0,5/hr	CONREP station
Note 1: Roll and pitch limits are given in terms of RMS amplitude.			

Table 6 : Fuelling at sea criteria limits

Limiting factor	Performance limitations		
	Motion	Limit	Location
Personnel	MI	0,5/min	FAS station
	MSI	20% of crew, 4 hr	FAS station
	Wetness index	0,5/hr	FAS station
Note 1: All limits are given in terms of RMS amplitude.			

Table 7 : Vertical replenishment criteria limits

Limiting factor	Performance limitations		
	Motion	Limit	Location
Helicopter-to-ship	Vertical displacement	0,7m	VERTREP station
	Vertical velocity	1,05m/s	VERTREP station
Equipment: Missile dolly slip angle	Roll	1,6°	
	Pitch	1,6°	
Personnel	MI	0,5/min	VERTREP station
	MSI	20% of crew, 4 hr	VERTREP station
	Wetness index	0,5/hr	VERTREP station
Note 1: Roll, pitch, vertical displacement and velocity limits are given in terms of RMS amplitude.			

4 Weapons systems (WEAP)

4.1 General

4.1.1 Scope

The scope of verifying the functionality of the on-board weapons systems is to ensure that the ship motions and accelerations, in weather conditions where the ship is expected to carry out her mission, do not become so severe that the weapons systems lose functionality.

4.1.2 Requirements

The requirement for verifying that the weapons systems are operable is that the parameters evaluated do not exceed the criteria defined in [4.2].

The limiting sea state for weapons systems operations is thus defined as the most severe sea state where the operations can be carried out safely and effectively. If not specified, the limiting sea state number X must be defined according to STANAG 4154, unless specified, and this number will be included in the following WEAP notations:

- WEAP_R-X : criteria specific to “radar”
- WEAP_S-X : criteria specific to “sonar”
- WEAP_TM-X : criteria specific to “trainable missile”
- WEAP_VM-X : criteria specific to “vertical launch system”
- WEAP_T-X : criteria specific to “torpedo system”
- WEAP_E-X : criteria specific to “support equipment”.

4.2 Criteria

4.2.1 Radars

For air search/surface surveillance radars with elevation-stabilised antennas, the maximum design roll angle is 25 degrees for 100% effective performance and 30 degrees for 0%. These values are rarely limiting. Mission performance will most likely depend upon motion limits on other subsystems.

4.2.2 Sonars

Degradation of hull mounted sonar performance will occur due to the emergence of the sonar housing, modification of the signal caused by beam bearing fluctuation, and phase and frequency shift of the signal.

Full performance may be expected within the motion limits defined in Tab 8.

Table 8 : Sonar criteria limits

Hull mounted sonar	Performance limitations		
	Motion	Limit	Location
Active sonar	Emergence	24/hr	Leading edge of dome with hull
	Roll	7,5°	
	Pitch	2,5°	
Passive sonar	Emergence	90/hr	Leading edge of dome with hull
Note 1: Roll and pitch limits are given in terms of RMS amplitude.			

4.2.3 Missile systems

Maximum design limits for both trainable and vertical launch systems are given in Tab 9 and Tab 10.

It must be noted that these criteria apply only to the missile launch systems. For launch, the missiles themselves have limits on structural strength and controllability until their air speed is sufficient for aerodynamic control. Typically, the missile is held in the launcher until motions are within specified lockout limits, then they are launched. The missile lockout criteria are not available in an unclassified format.

The roll pitch and yaw limits listed in Tab 10 for vertical launch system operations are associated with minimum natural periods of 9 seconds, 9 seconds and 6 seconds, respectively. The limiting values will decrease below the minimum periods.

Table 9 : Trainable missile systems criteria limits

Subsystems limitations	Performance limitations	
	Motion	Limit
Launcher	Roll or pitch	3,8°
Missile handling - Automatic Operation	Roll or pitch	3,8°
Missile handling - Manual Operation	Roll or pitch	2,5°
Missile reloading	Roll or pitch	1,3°
Note 1: Limits are given in terms of RMS amplitude.		

Table 10 : Vertical launch systems criteria limits

Operation	Performance limitations		
	Motion	Limit	Location
Launch	Roll	8,8°	
	Pitch	1,5°	
	Yaw	0,8°	
	Longitudinal acceleration	0,15g	Launcher outboard corner
	Transverse acceleration	0,35g	Launcher outboard corner
	Vertical acceleration	0,30g	Launcher outboard corner
Note 1: Limits are given in terms of RMS amplitude.			

4.2.4 Torpedo systems

The criteria limits for torpedo system operation are defined in Tab 11. The torpedo itself is not limited by ship motion during launch. Typically heavier torpedoes and missiles must be loaded from dollies and thus the limits are somewhat more restrictive than for those that are loaded by hand.

4.2.5 Support equipment

Support operations encompass a wide range of functions (e.g. ordnance handling, arming maintenance), hence the limits to support equipment are defined for the most restrictive of these.

Table 11 : Torpedo systems criteria limits

Subsystems limitations	Performance limitations	
	Motion	Limit
Launcher	Roll or pitch	3,8°
Loading, torpedoes on dollies	Roll or pitch	1,3°
Loading by hand	Roll or pitch	1,5°
Automatic direct loading	Roll or pitch	3,8°
Note 1: Limits are given in terms of RMS amplitude.		

Table 12 : Support equipment criteria limits

Performance limitations		
Motion	Limit	Location
Roll	1,8°	
Pitch	1,8°	
Motion Induced Interruption (MII)	1/min	Task location
Note 1: Roll and pitch limits are given in terms of RMS amplitude.		

5 Personnel performance (CREW)

5.1 General

5.1.1 Scope

The scope of verifying the personnel behaviour is to ensure that the ship motions and accelerations do not become so severe that they prevent the crew from carrying out their tasks in weather conditions where the ship is expected to carry out its mission.

5.1.2 Requirements

The requirements for certifying that the crew is able to carry out their tasks in TRAN mission is that the parameters evaluated in the limiting sea state do not exceed the criteria defined in [5.3].

The Society can accept that the calculations do consider the effect of active motion damping systems (anti-roll fins, T-foils etc.) if the suitability and efficiency of such systems can be demonstrated.

If not specified, the limiting sea states are to be taken as mid sea state 5.

5.1.3 Motion induced interruption (MII)

A motion induced interruption (MII) is an incident where ship motions cause a person to slide or lose balance, resulting in stumble. Motion induced interruption does not only represent a danger to the crew, but also prevents the crew from carrying out their tasks.

In relation to TRAN mission, the MII limits are defined in Tab 13.

As an alternative to the MII limits, the root mean square (RMS) amplitude value of the ship motions can be used to specify limits. The ship motions that cause MII are roll and pitch.

In relation to TRAN mission, the motion RMS limits are defined in Tab 14.

Table 13 : Recommended personnel criteria limits

Parameter	Limit	Location
Motion Sickness Incidence (MSI)	35% of the crew in 2 hours	task location
Motion Induced Interruption (MII)	3/min	task location

Table 14 : Default personnel criteria limits

Parameter	Limit	Location
Roll	4°	
Pitch	1,5°	
Vertical acceleration	0,2 g	bridge
Lateral acceleration	0,1 g	bridge
Note 1: all limits given as RMS amplitude values.		

5.1.4 Seasickness

The seasickness corresponds to the man sickness induced by the ship motions.

On a perfectly rested man, the seasickness has a direct influence on his capacity to ensure the given tasks.

Seasickness is best measured in terms of motion sickness incidence (MSI), where MSI is the percentage of the crew who vomit after a given time of exposure to accelerations. MSI is therefore function of the ship accelerations (amplitude and frequency) and the exposure time.

In relation to TRAN mission, the MSI limits are defined in Tab 13.

As an alternative to the MSI, the root mean square (RMS) amplitude value of the acceleration can be applied to measure the seasickness. This approach does not take the frequency or the exposure time into account, and thus depends only on the acceleration amplitudes.

In relation to TRAN mission, the acceleration RMS limits are defined in Tab 14.

5.2 Parameters

5.2.1 Motion sickness incidence (MSI)

A simple and empirical model to relate motion sickness and vertical oscillations is given, in %, as:

$$MSI = 100 \left[0,5 + \operatorname{erf} \left(\frac{\log_{10}(a_v) - \mu_{MSI}}{0,4} \right) \right]$$

where:

$$\mu_{MSI} = -0,819 + 2,32 (\log_{10}(\omega_e))^2$$

a_v : Vertical acceleration, in units of g, averaged over half a motion cycle:

$$a_v = 0,7898 \text{RMS}_{AZ} \sqrt{\frac{T}{2}}$$

ω_e : (Encounter) frequency of the vertical oscillations, in units of rad/s:

$$\omega_e = 2 \pi / T_{z,e}$$

RMS_{AZ} : Root mean square value

T : Exposure time, in hrs

$T_{z,e}$: Average zero up-crossing period of the vertical accelerations experienced by the ship in irregular waves, defined as:

$$T_{z,e} = \frac{2\pi}{\sqrt{\frac{m_{2,AZ}}{m_{0,AZ}}}}$$

$m_{0,AZ}$: Zero order spectral moment of vertical acceleration

$m_{2,AZ}$: Second order spectral moment of vertical acceleration.

If agreed with the Society, other models for determining the MSI may be applied.

5.2.2 Motion induced interruption (MII)

In order to determine the MII index, the so-called Generalised Lateral Force Estimator for tipping port (GLFE_p) or starboard (GLFE_s) is to be evaluated according to the following definitions:

$$GLFE_p = \frac{1}{3} h a_R - a_T - g \phi - \frac{b}{h} a_v$$

$$GLFE_s = \frac{1}{3} h a_R - a_T - g \phi + \frac{b}{h} a_v$$

where b and h are defined in Fig 3.

The ratio b/h is called lateral tipping coefficient and a representative value of 0,25 with h taken equal to 1,20 m can be assumed based on typical human dimensions.

The formula above must be interpreted as a linear combination of the transfer functions (in-phase, pedex C, and out-of-phase, pedex S, components) of roll motion ϕ , roll acceleration a_R , transverse acceleration a_T and vertical acceleration a_v , which can be safely considered as a standard output from frequency-domain codes.

By definition of generalised lateral force estimator, a tipping event occurs whenever the estimator exceeds the threshold level (b/h)g. In order to evaluate this occurrence frequency one has to rely upon standard spectral theory, which is routinely incorporated into frequency-domain sea-keeping codes.

The first step is to determine the in/out-of-phase components of the estimator, GLFE_{p,sc} and GLFE_{p,ss}, and consequently its amplitude:

$$GLFE_{p,s_a} = \sqrt{(GLFE_{p,s_c})^2 + (GLFE_{p,s_s})^2}$$

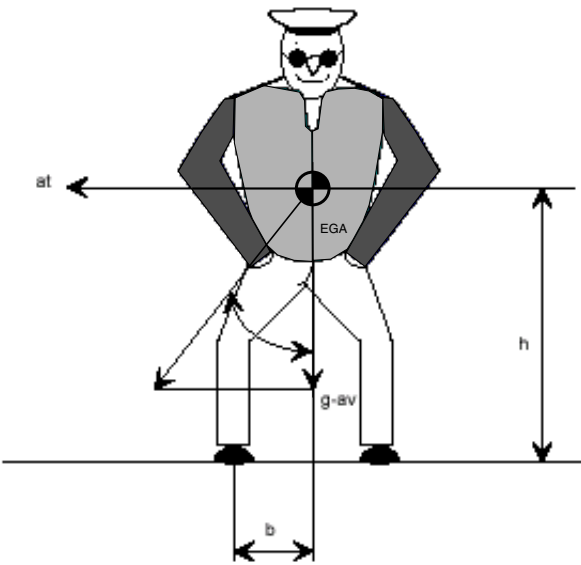
The second step is the evaluation of its zero'th and second order spectral moments:

$$m_{0;p,s} = \int_{\omega_{min}}^{\omega_{max}} GLFE_{p,s_a}^2 S(\omega) d\omega$$

$$m_{2;p,s} = \int_{\omega_{min}}^{\omega_{max}} \left| \omega - \frac{\omega^2 V}{g} \cos \psi \right|^2 GLFE_{p,s_a}^2 S(\omega) d\omega$$

where S(ω) is the wave spectrum of the sea state, ω is the wave frequency in rad/s, V is the ship speed in m/s, ψ is the heading angle and g is the gravity acceleration in m/s².

Figure 3 : Definitions for generalised lateral force estimator



The motion induced interruptions due to lateral tipping port/starboard $MII_{p,s}$ (in units of tipping events per minute) can then be calculated as:

$$MII_{p,s} = \frac{60}{2\pi} \sqrt{\frac{m_{2,p,s}}{m_{0,p,s}}} \exp\left(-\frac{a^2}{2m_{0,p,s}}\right)$$

having posed $a = (b/h)g$

Finally, the MII can be determined as:

$$MII = MII_p + MII_s$$

5.3 Criteria

5.3.1 Recommended criteria

The recommended criteria that ensure that the crew can carry out their tasks in a safe and sufficiently effective manner are given in Tab 13.

5.3.2 Default criteria

The default criteria that ensure that the crew can carry out their tasks in a safe and sufficiently effective manner are given in Tab 14.

APPENDIX 1

SEA-KEEPING CALCULATIONS

1 Introduction

1.1 General

1.1.1 This Appendix applies to ships with typical hull shape. Ships of unusual type or design are to be considered by the Society on a case by case basis.

The requirements are based on the assumption that a frequency domain strip theory sea-keeping code is being used for the calculations. The software to be used are to be documented and supported by validation documents.

1.2 Scope

1.2.1 The scope of the present Appendix is to supply details on how the sea-keeping calculations are to be performed. Requirements are given primarily on how to perform the short term assessments, but also some recommendations concerning long term assessments are given.

The short term assessments comprise all analyses of the ship behaviour in a single sea state, and thus short term assessments yield all necessary information for the determination of:

- wetness index
- slamming index
- propeller emergence
- Motion Sickness Incidence
- Motion Induced Interruption
- RMS values of all ship motions and accelerations.

Long term assessments of the sea-keeping yield estimates of, e.g., the long term distribution of the vertical bending moment.

2 Short term assessment

2.1 General

2.1.1 Short term assessments serve to analyse a ship sea-keeping behaviour in a given sea state. The sea states to be considered for the required rule checks are defined in Pt B, Ch 3, Sec 4.

2.2 Loading conditions

2.2.1 The sea-keeping verifications should be carried out for following loading conditions:

- auxiliary ships: full load and operational condition
- front and second line ships: operational condition.

2.3 Ship speed

2.3.1 Unless specified, the ship speed to be considered for the short term sea-keeping calculations should be taken as:

- the autonomy speed.

2.4 Wave spectrum

2.4.1 General

The wave spectrum to be applied in the short term sea-keeping calculations is based on the characteristics of the sea area where the ship is going to operate:

- open ocean conditions: Bretschneider spectrum with both short and long crested seas
- limited fetch sea areas (e.g. North Sea): JONSWAP spectrum with short crested sea.

2.4.2 Bretschneider spectrum

The Bretschneider spectrum, or two parameter Pierson-Moskowitz spectrum, is defined as:

$$S(\omega) = \frac{H_s^2}{4\pi} \left(\frac{2\pi}{T_Z} \right)^4 \omega^{-5} \exp\left(-\frac{1}{\pi} \left(\frac{2\pi}{T_Z} \right)^4 \omega^{-4} \right)$$

where:

- HS : Significant wave height, in m
- ω : Angular wave frequency, in rad/s
- TZ : Zero up-crossing period, in s.

2.4.3 JONSWAP spectrum

The JONSWAP spectrum is defined as:

$$S(\omega) = 173 \frac{H_s^2 T_s (T_s \omega)^{-5}}{F_1 F_2^4} \exp(-692 (F_2 T_s \omega)^{-4}) \gamma^{\exp[-(0,206 F_2 T_s \omega - 1)^2 / 2 \sigma^2]}$$

where:

- HS : Significant wave height, in m
- ω : Angular wave frequency, in rad/s
- TS : Mean wave period, in s
- γ : JONSWAP peakedness parameter

$$\sigma = \begin{cases} 0,07 & \text{for } \omega \leq (0,206 F_2 T_s)^{-1} \\ 0,09 & \text{for } \omega > (0,206 F_2 T_s)^{-1} \end{cases}$$

The values of F1 and F2 are given in Tab 1.

Table 1 : F1 and F2 values as function of γ

γ	F ₁	F ₂
1	1,00	1,00
2	1,24	0,95
3	1,46	0,93
3,3 (1)	1,52	0,92
4	1,66	0,91
5	1,86	0,90
6	2,04	0,89
(1) Mean JONSWAP spectrum		

Unless otherwise agreed with the Society, the peakedness parameter γ should be taken to 3,3, corresponding to the mean JONSWAP spectrum.

2.4.4 Wave spreading

In case of short crested sea a spreading function is to be applied to the wave spectrum when calculating the spectral moments of the response processes. The spreading function is defined as:

$$D(\psi) = \frac{2}{\pi} \cos^2(\bar{\psi} - \psi)$$

where:

- ψ : Heading angle
- ψ : Angle ranging from (ψ - π/2) to (ψ + π/2).

2.5 Hydrodynamic model

2.5.1 Short term assessment of the sea-keeping behaviour is to imply that RAO's (Response Amplitude Operators) are to be calculated for:

- A suitable range of wave frequencies to cover the range of the sea spectrum (typically 0,2-2,0 rad/s, with not less than 20 frequencies). Most frequencies are to be placed in the range where most wave energy is present, and the calculation of RAO's at irregular frequencies, or for wave frequencies where the encounter frequency approaches zero, is to be avoided.
- At least 12 evenly distributed heading angles: 0°, 30°, 60°, ... , 330° (with 0° being the following sea).

2.6 Spectral moments

2.6.1 The n'th order response spectral moments are to be determined as follows:

- Short crested sea:

$$m_n = \int_0^\infty \int_{\bar{\psi}-\frac{\pi}{2}}^{\bar{\psi}+\frac{\pi}{2}} \left| \omega - \frac{\omega^2 V}{g} \cos \psi \right|^n |\phi(\omega)|^2 S(\omega) D(\psi) d\psi d\omega$$

- Long crested sea:

$$m_n = \int_0^\infty \left| \omega - \frac{\omega^2 V}{g} \cos \psi \right|^n |\phi(\omega)|^2 S(\omega) d\omega$$

where:

- V : Ship speed, in m/s
- g : Gravity acceleration (g = 9,81 m/s²)
- ψ : Heading angle
- D(ψ) : Spreading function
- φ(ω) : RAO
- S(ω) : Wave spectrum
- ω : Wave frequency, in rad/s.

2.7 RMS values

2.7.1 The Root Mean Square (RMS) value of a response is defined as:

$$RMS = \sqrt{m_0}$$

where m₀ is the zero'th order spectral moment of the response.

3 Long term assessment

3.1 General

3.1.1 Long term assessments serve to estimate long term distributions of the various ship responses, typically the wave induced amidships vertical bending moment.

Such a long term distribution can thence be used to obtain estimates of the extreme responses, e.g. the most probable largest response in 10⁸ wave cycles.

3.2 Hydrodynamic model

3.2.1 Unless otherwise agreed with the Society, the long term assessments should be carried out with the following hydrodynamic model:

- zero forward speed
- Bretschneider wave spectrum
- short crested sea
- a suitable range of wave frequencies to cover the range of the sea spectrum (typically 0,2-2,0 rad/s with not less than 20 frequencies). Most frequencies are to be placed in the range where most wave energy is present, and the calculation of RAO's at irregular frequencies is to be avoided
- at least 12 evenly distributed heading angles
- uniform distribution of heading angles, meaning that the same probability (e.g. 1/12 if 12 heading angles are considered) is assigned to each considered heading
- extreme responses are to be determined at 10⁻⁸ probability of exceeding.

3.3 Sea state scatter diagram

3.3.1 The scatter diagram to be applied in the spectral approach relates the probability of occurrence to a wide range of sea states, characterised by their significant wave height and zero up-crossing period.

When considering unrestricted service the scatter diagram shown in Tab 2 is to be applied. However, in case of ship with a restricted navigation notation, different scatter diagrams may be applied when agreed on with the Society.

Table 2 : Recommended sea state scatter diagram for unrestricted service

H _s	T _z																		
	1,5	2,5	3,5	4,5	5,5	6,5	7,5	8,5	9,5	10,5	11,5	12,5	13,5	14,5	15,5	16,5	17,5	18,5	SUM
0,5	0	0	1,3	133,7	865,6	1186	634,2	186,3	36,9	5,6	0,7	0,1	0	0	0	0	0	0	3050
1,5	0	0	0	29,3	986	4976	7738	5569,7	2375,7	703,5	160,7	30,5	5,1	0,8	0,1	0	0	0	22575
2,5	0	0	0	2,2	197,5	2158,8	6230	7449,5	4860,4	2066	644,5	160,2	33,7	6,3	1,1	0,2	0	0	23810
3,5	0	0	0	0,2	34,9	695,5	3226,5	5675	5099,1	2838	1114,1	337,7	84,3	18,2	3,5	0,6	0,1	0	19128
4,5	0	0	0	0	6	196,1	1354,3	3288,5	3857,5	2685,5	1275,2	455,1	130,9	31,9	6,9	1,3	0,2	0	13289
5,5	0	0	0	0	1	51	498,4	1602,9	2372,7	2008,3	1126	463,6	150,9	41	9,7	2,1	0,4	0,1	8328
6,5	0	0	0	0	0,2	12,6	167	690,3	1257,9	1268,6	825,9	386,8	140,8	42,2	10,9	2,5	0,5	0,1	4806
7,5	0	0	0	0	0	3	52,1	270,1	594,4	703,2	524,9	276,7	111,7	36,7	10,2	2,5	0,6	0	2586
8,5	0	0	0	0	0	0,7	15,4	97,9	255,9	350,6	296,9	174,6	77,6	27,7	8,4	2,2	0,5	0,1	1309
9,5	0	0	0	0	0	0,2	4,3	33,2	101,9	159,9	152,2	99,2	48,3	18,7	6,1	1,7	0,4	0,1	626
10,5	0	0	0	0	0	0	1,2	10,7	37,9	67,5	71,7	51,5	27,3	11,4	4	1,2	0,3	0,1	285
11,5	0	0	0	0	0	0	0,3	3,3	13,3	26,6	31,4	24,7	14,2	6,4	2,4	0,7	0,2	0,1	124
12,5	0	0	0	0	0	0	0,1	1	4,4	9,9	12,8	11	6,8	3,3	1,3	0,4	0,1	0	51
13,5	0	0	0	0	0	0	0	0,3	1,4	3,5	5	4,6	3,1	1,6	0,7	0,2	0,1	0	21
14,5	0	0	0	0	0	0	0	0,1	0,4	1,2	1,8	1,8	1,3	0,7	0,3	0,1	0	0	8
15,5	0	0	0	0	0	0	0	0	0,1	0,4	0,6	0,7	0,5	0,3	0,1	0,1	0	0	3
16,5	0	0	0	0	0	0	0	0	0	0,1	0,2	0,2	0,2	0,1	0,1	0	0	0	1
SUM	0	0	1	165	2091	9280	19922	24879	20870	12898	6245	2479	837	247	66	16	3	1	100.0000
Note 1: H _s is the significant wave height and T _z is the zero up-crossing period of the short term sea states. The probability of a sea state is given as fractions of 100.000.																			

SYSTEM OF TRACE AND ANALYSIS OF RECORDS (STAR)

SECTION 1	STAR-HULL
SECTION 2	STAR-MACH
APPENDIX 1	ACCEPTANCE CRITERIA FOR ISOLATED AREAS OF ITEMS
APPENDIX 2	ACCEPTANCE CRITERIA FOR ISOLATED ITEMS
APPENDIX 3	ACCEPTANCE CRITERIA FOR ZONES
APPENDIX 4	PITTING INTENSITY DIAGRAMS
APPENDIX 5	NAVAL AUTHORITY’S HULL INSPECTION REPORTS
APPENDIX 6	RISK ANALYSES FOR STAR-MACH
APPENDIX 7	PLANNED MAINTENANCE SCHEME

SECTION 1

STAR-HULL

1 General

1.1 Principles

1.1.1 Application

The additional class notation **STAR-HULL** is assigned, in accordance with Pt A, Ch 1, Sec 2, [6.2.2], to ships complying with the requirements of this Section.

1.1.2 Scope

The additional class notation **STAR-HULL** is assigned to a ship in order to reflect the fact that a procedure including periodical and corrective maintenance, as well as periodical and occasional inspections of hull structures and equipment, (hereafter referred to as the Inspection and Maintenance Plan) are dealt with on board by the crew and at the Naval Authority's offices according to approved procedures.

The assignment of the notation implies that a structural tridimensional analysis has been performed for the hull structures, as defined in Pt B, Ch 7, App 1 or Pt B, Ch 7, App 2 or Pt B, Ch 7, App 3, as applicable.

The implementation of the Inspection and Maintenance Plan is surveyed by the Society through:

- periodical audits carried out at the Naval Authority's offices and on board
- examination of the data recorded by the Naval Authority and made available to the Society through an electronic ship database suitable for consultation and analysis
- periodical check of the hull structure, normally at the class renewal survey, against defined acceptance criteria and based on:
 - the collected data from actual implementation of the Inspection and Maintenance Plan
 - the results of the inspections and other checks carried out during the class renewal survey (see [5]).

1.2 Conditions for the assignment and maintenance of the notation

1.2.1 Assignment of the notation

The procedure for the assignment of the **STAR-HULL** notation is the following:

- a request for the notation is to be sent to the Society:
 - signed by the Interested Party applying for the classification, in the case of new ships
 - signed by the Naval Authority, in the case of existing ships

- the following documents are to be submitted to the Society by the Interested Party:
 - plans and documents necessary to carry out the structural analysis, and information on coatings and on cathodic protection (see [2.1])
 - the hot spot map of the structure identified by the FEM analysis (see [2.2])
 - the Inspection and Maintenance Plan to be implemented by the Naval Authority (see [2.3])
 - information concerning the ship database and relevant electronic support to be implemented by the Naval Authority (see [1.3.1])
- the Society reviews and approves the initial Inspection and Maintenance Plan, taking into account the results of the structural analysis, as well as the information concerning the ship database
- the Society carries out an initial shipboard audit to verify the compliance of the procedures on board with respect to the submitted documentation.

1.2.2 Maintenance of the notation

The maintenance of the **STAR-HULL** notation is based on the following surveys and checks, whose scope and periodicity are specified in [5], to be carried out by the Society:

- annual audits at the Naval Authority's offices (see [5.1])
- annual shipboard audits (see [5.2])
- class renewal surveys (see [5.3]).

1.3 Ship database

1.3.1 The ship database, to be available on board and at the Naval Authority's offices, using an electronic support suitable for consultation and analysis, is to provide at least the following information:

- the hot spot map, as indicated in [2.2]
- the documents required for the Inspection and Maintenance Plan, as indicated in [2.3], and the corresponding reports during the ship operation, as indicated in [3.5].

The ship database is to include a backup system in order for the data to be readily restored, if needed.

1.3.2 The ship database is to be:

- updated by the Naval Authority each time new inspection and maintenance data from the ship are available
- kept by the Naval Authority.

Access to the databases is to be logged, controlled and secured.

1.3.3 The ship database is to be made available to the Society. This ship database is to be transmitted to the Society at least every six months. It may be agreed between the Naval Authority and the Society that the required data are automatically downloaded into the Society's ship database after they are collected.

2 Documentation to be submitted

2.1 Plans and documents to be submitted

2.1.1 Structural analysis

The plans and documents necessary to support and/or perform the structural analysis covering hull structures are:

- those submitted for class as listed in Pt B, Ch 1, Sec 3, for new ships
- those listed in Tab 1, for existing ships or after major repair or renewal for these ships. However, depending on the service and specific features of the ship, the Society reserves the right to request to the Naval Authority additional or different plans and documents from those in Tab 1.

Table 1 : Existing ships - Plans and documents to be submitted to perform the structural analysis

Plans and documents
Midship section
Transverse sections
Shell expansion
Longitudinal sections and decks
Double bottom
Pillar arrangements
Framing plan
Deep tank and ballast tank bulkheads
Watertight subdivision decks and bulkheads
Watertight tunnels
Fore part structure
Aft part structure
Last thickness measurement report

2.1.2 Coatings

The following information on coatings is to be submitted:

- list of all structural items which are effectively coated
- characteristics of the coating system.

2.1.3 Cathodic protection

The following information on sacrificial anodes is to be submitted:

- localisation of anodes in spaces, on bottom plating and sea chests
- dimensions and weight of anodes in new condition.

When the protection against corrosion is achieved by means of impressed currents, the description of the system and the operating manual are to be provided to the Society.

2.2 Hot spot map

2.2.1 The items to be included in the hot spot map are, in general, the following:

- items (such as a plating panels, ordinary stiffeners or primary supporting members) for which the structural analysis carried out at the classification phase for new ships showed that the ratio between the applied loads and the allowable limits exceeded 0,975
- items identified as “hot spot item” during the structural reassessment according to Ch 2, App 2, or after repair or renewal for these ships under the Naval Authority responsibility
- structural details subjected to fatigue, based on the list defined in Pt B, Ch 11, App 1
- other items depending on the results of structural FEM analyses and/or on experience.

2.2.2 The updated hot spot map may indicate which items are to be inspected periodically under the Naval Authority's responsibility.

2.3 Inspection and Maintenance Plan (IMP)

2.3.1 The Inspection and Maintenance Plan is to be based on the Naval Authority's experience and on the results of the structural analyses including the hot spot map.

The Inspection and Maintenance Plan is to include:

- the list of areas, spaces and hull equipment to be subjected to inspection
- the periodicity of inspections
- the elements to be assessed during the visual examination for each area or space, as applicable:
 - coating
 - anodes (if any)
 - pitting
 - fractures
 - deformations
- the elements to be assessed during the inspection of hull equipment.

2.3.2 As regards the maintenance plan, the following information is to be given by the Naval Authority:

- maintenance scope
- maintenance type (inspection, reconditioning)
- maintenance frequency (periodicity value unit is to be clearly specified, i.e. hours, week, month, year)
- place of maintenance (port, sea, etc.)
- manufacturer's maintenance and repair specifications, as applicable
- procedures contemplated for repairs or renewal of structure or equipment.

3 Inspection and Maintenance Plan (IMP)

3.1 Minimum requirements

3.1.1 The minimum requirements on the scope of the Inspection and Maintenance Plan (IMP), the periodicity of inspections, the extent of inspection and maintenance to be scheduled for each area, space or equipment concerned, and the minimum content of the report to be submitted to the Society after the inspection are given hereafter.

3.1.2 At the Naval Authority's request, the scope and periodicity may be other than those specified below, provided that this is agreed with the Society.

3.1.3 The IMP performed at periodical intervals does not prevent the Naval Authority from carrying out occasional inspections and maintenance as a result of an unexpected failure or event which may affect the hull or hull equipment condition.

Interested parties are also reminded that any damage to the ship which may affect the class is to be reported to the Society.

3.2 General scope of IMP

3.2.1 The IMP is to cover at least the following areas/items:

- deck area structure
- access hatches
- deck fittings
- steering gear
- superstructures
- shell plating
- tanks, including peaks,
- rudders
- sea connections and overboard discharges
- sea chests
- propellers.

3.3 Periodicity of inspections

3.3.1 Inspections are to be carried out at least with the following periodicity:

- Type 1: two inspections every year, with the following principles:
 - one inspection is to be carried out outside the window provided for the execution of the annual class survey, in the vicinity of the halfway date of the anniversary date interval
 - the other inspection is to be carried out preferably not more than two months before the annual class survey is conducted
 - the minimum interval between any two consecutive inspections of the same item is to be not less than four months.
- Type 2: inspection at annual intervals, preferably not more than four months before the annual class survey is carried out.
- Type 3: inspection at bottom surveys.

3.3.2 The following areas/items are to be inspected with a periodicity of Type 1:

- deck area structure
- shell plating above waterline
- hatches
- deck equipment
- superstructures
- ballast tanks, including peaks
- dry holds and spaces
- other accessible spaces
- sea connections and overboard discharges.

For ships less than 6 years old, 25% in number of ballast tanks (with a minimum of one) are to be inspected annually, in rotation, so that all ballast tanks are inspected at least once during the 6-year class period.

For ships 6 years old or more, all ballast tanks are to be inspected annually.

3.3.3 The following areas are to be inspected with a periodicity of Type 2:

- bunker and double bottom fuel oil tanks
- fresh water tanks
- cargo tanks, if any.

3.3.4 Whenever the outside of the ship's bottom is examined in drydock or on a slipway, inspections are to be carried out on the following items:

- rudders
- propellers
- bottom plating
- sea chests and anodes.

In addition, the requirement under Pt A, Ch 2, Sec 2, [5.4.2] is to be complied with.

3.4 Extent of inspections

3.4.1 Deck area structure

The deck plating and structures over deck, as applicable, are to be visually examined for assessment of the coating, and detection of fractures, deformations and corrosion.

When structural defects affecting the class (such as fractures or deformations) are found, the Society is to be called by the Naval Authority for occasional survey attendance. If such structural defects are repetitive in similar areas of the deck, a program of additional close-up surveys may be planned at the Society's discretion for the next inspections.

In other cases, such as coating found in poor condition, repairs or renewal are to be dealt with, or a program of maintenance is to be set by the Naval Authority in agreement with the Society, at a suitable time, but at the latest at the next intermediate or class renewal survey, whichever comes first.

3.4.2 Hatches

Hatches are to be visually examined, in particular tightness devices, locking arrangements and coating condition, as well as signs of corrosion.

Any defective tightness device or securing/locking arrangement is to be dealt with. Operating devices of hatch covers are to be maintained according to the manufacturer's requirements and/or when found defective.

For structural defects or coating found in poor condition, refer to [3.4.1].

3.4.3 Deck fittings

The inspection of deck fittings is to cover at least the following items:

- Piping on deck

A visual examination of piping is to be carried out, with particular attention to coating, external corrosion, tightness of pipes and joints (examination under pressure), valves and piping supports. Operation of valves is to be checked.

Any defective tightness, supporting device or valve is to be dealt with.

- Vent system

A visual examination of the vent system is to be carried out. Dismantling is to be carried out as necessary for checking the condition of closure (flaps, balls) and clamping devices and of screens.

Any defective item is to be dealt with.

- Ladders, guard rails, bulwarks, walkways

A visual examination is to be carried out with attention to the coating condition (as applicable), corrosion, deformation or missing elements.

Any defective item is to be dealt with.

- Anchoring and mooring equipment

A visual examination of the windlass, winches, capstans, anchor and visible part of the anchor chain is to be carried out. A working test is to be effected by lowering a sufficient length of chain on each side and the chain lengths thus ranged out are to be examined (shackles, studs, wastage).

Any defective item is to be dealt with. For replacement of chains or anchors, the Society is to be requested for attendance.

The manufacturer's maintenance requirements, if any, are to be complied with.

- Other deck fittings

Other deck fittings are to be visually examined and dealt with under the same principles as those detailed in the items above according to the type of fitting.

3.4.4 Steering gear

The inspection of the installation is to cover:

- examination of the installation
- test with main and emergency systems
- changeover test of working rams.

3.4.5 Superstructures

The structural part of superstructures is to be visually examined and checked under the same scope as that required for deck structure.

The closing devices (doors, windows, ventilation system, skylights) are to be visually examined with attention to tightness devices and checked for their proper operation.

Any defective item is to be dealt with.

3.4.6 Shell plating

The shell plating, sides and bottom, are to be visually examined for assessment of the coating, and detection of fractures, deformations and corrosion.

When structural defects affecting the class (such as fractures or deformations) are found, the Society is to be called for occasional survey attendance. If such structural defects are repetitive in similar areas of the shell plating, a program of additional close-up surveys may be planned at the Society's discretion for the next inspections.

In other cases, such as coating found in poor condition, repairs or renewal are to be dealt with, or a program of maintenance is to be set by the Naval Authority in agreement with the Society, at a suitable time, but at the latest at the next intermediate or class renewal survey, whichever comes first.

3.4.7 Ballast tanks

Ballast tanks, including peaks, are to be overall surveyed with regards to:

- structural condition (fractures, deformations, corrosion)
- condition of coating and anodes, if any
- fittings such as piping, valves.

A program of close-up survey may also be required, depending on the results of the structural analyses and the hot spot map.

When structural defects affecting the class are found, the Society is to be called for occasional survey attendance. If such structural defects (such as fractures or deformations) are repetitive in similar structures in the same ballast tanks or in other ballast tanks, a program of additional close-up survey may be planned at the Society's discretion for the next inspections.

In other cases, such as coating found in poor condition or anodes depleted, repairs or renewal are to be dealt with, or a program of maintenance is to be set by the Naval Authority in agreement with the Society, at a suitable time, but at the latest at the next intermediate or class renewal survey, whichever comes first.

3.4.8 Dry holds and spaces

Dry holds and other spaces such as vehicle decks are to be subjected to overall examination and dealt with in the case of defects, under the same scope as that required for ballast tanks. Attention is also to be given to other fittings, such as bilge wells (cleanliness and working test) and ladders.

A program of close-up survey may also be required, depending on the results of the structural analyses and the hot spot map.

When structural defects affecting the class are found, the Society is to be called for occasional survey attendance. If such structural defects (such as fractures or deformations) are repetitive in similar structures, a program of additional close-up survey may be planned at the Society's discretion for the next inspections.

3.4.9 Other accessible spaces

Other spaces accessible during normal operation of the ship or port operations, such as cofferdams, void spaces, pipe tunnels and machinery spaces are to be examined and dealt with under the same scope as that required for dry holds and spaces.

Consideration is also to be given to the cleanliness of spaces where machinery and/or other equivalent equipment exist which may give rise to leakage of oil, fuel water or other leakage (such as main and auxiliary machinery spaces and steering gear space).

3.4.10 Rudder(s)

A visual examination of rudder blade(s) is to be carried out to detect fractures, deformations and corrosion. Plugs, if any, have to be removed for verification of tightness of the rudder blade(s). Thickness measurements of plating are to be carried out in case of doubt. Access doors to pintles (if any) have to be removed. Condition of pintle(s) has to be verified. Clearances have to be taken.

Condition of connection with rudder stock is to be verified.

Tightening of both pintles and connecting bolts is to be checked.

3.4.11 Sea connections and overboard discharges

A visual external examination of sea inlets, outlet corresponding valves and piping is to be carried out in order to check tightness. An operation test of the valves and manoeuvring devices is to be performed.

Any defective tightness and/or operability is to be dealt with.

3.4.12 Sea chests

Sea chests have to be examined with regards to:

- structural condition (fractures, deformations, corrosion)
- condition of cleanliness, coating and anodes
- visual examination of accessible part of piping or valve.

3.4.13 Propellers

A visual examination of propeller blades, propeller boss and propeller cap is to be carried out as regards fractures, deformations and corrosion. For variable pitch propellers, absence of leakage at the connection between the blades and the hub is to be also ascertained.

Absence of leakage of the aft tailshaft sealing arrangement is to be ascertained.

3.4.14 Cargo tanks, bunker and double bottom fuel oil tanks, fresh water tanks, as applicable

Bunker and double bottom fuel oil tanks are to be overall surveyed with regards to:

- structural condition (fractures, deformations, corrosion)
- condition of coating and anodes, if any
- fittings such as piping, valves.

Cargo tanks, if any, are to be overall surveyed with regards to:

- structural condition (fractures, deformations, corrosion)
- condition of coating and anodes, if any
- fittings such as piping, valves.

A program of close-up survey may also be required, depending on the results of the structural analyses and the hot spot map.

When structural defects affecting the class are found, the Society is to be called for occasional survey attendance. If such structural defects (such as fractures or deformations) are repetitive in similar structures in the same tank or in other tank, a program of additional close-up survey may be planned at the Society's discretion for the next inspections.

In other cases, such as coating found in poor condition, repairs or renewal are to be dealt with, or a program of maintenance is to be set by the Naval Authority in agreement with the Society, at a suitable time, but at the latest at the next intermediate or class renewal survey, whichever comes first.

3.5 Inspection reports

3.5.1 Inspection reports are to be prepared by the person responsible after each survey. They are to be kept on board and made available to the Surveyor at his request. An electronic form is to be used for this purpose (see [1.3]).

A copy of these reports is to be transmitted to the Naval Authority's offices, for the records and updating of the ship database.

3.5.2 The inspection reports are to include the following.

- General information such as date of inspection/maintenance, identification of the person performing the inspection with his signature, identification of the area/space/equipment inspected.
- For inspection of structural elements (deck area, hatches, superstructures, ballast tanks, dry holds and spaces, other spaces), the report is to indicate:
 - coating condition of the different boundaries and internal structures and, if any, coating repairs
 - structural defects, such as fractures, corrosion (including pitting), deformations, with the identification of their location, recurrent defects
 - condition of fittings related to the space inspected, with description as necessary of checks, working tests, dismantling, overhaul
- For inspection of equipment (deck equipment, sea connections and overboard discharges), the report is to indicate the results of visual examination, working tests, dismantling, repairs, renewal or overhaul performed.

3.5.3 When deemed necessary or appropriate, the report is to be supplemented by documents, sketches or photographs, showing for example:

- location and dimension of fractures, pitting, deformations
- condition of equipment before repairs
- measurements taken if required by the Society.

3.5.4 Models of inspection reports for structural elements and equipment are given in Ch 2, App 5.

These models are to be used as a guide for entering the collected data into the ship database, in an electronic form.

3.6 Changes to Inspection and Maintenance Plan

3.6.1 Changes to ship operation, review of the inspection and maintenance reports, possible subsequent changes to the hot spot map and corrosion rates different than those expected may show that the extent of the maintenance performed needs to be adjusted if any by the Naval Authority to improve its efficiency.

Where more defects are found than would be expected, it may be necessary to increase the extent and/or the frequency of the maintenance program. Alternatively, the extent and/or the frequency of the maintenance may be reduced subject to documented justification.

4 Acceptance criteria

4.1 Coating assessment

4.1.1 Criteria

The acceptance criteria for the coating condition of each coated space is indicated in Tab 2.

Where acceptance criteria are not fulfilled, coating is to be repaired.

4.1.2 Repairs

The procedures for repairs of coatings are to follow the coating manufacturer's specification for repairs, under the Naval Authority's responsibility.

Table 2 : Acceptance criteria for coatings

Condition	Acceptance criteria
Ships less than 12 years old	Coatings in GOOD condition
Ships 12 years old or more	Coatings in GOOD or FAIR condition
Note 1: GOOD : only minor spot rusting FAIR : local breakdown at edges of stiffeners and weld connections and/or light rusting over 20% or more of areas under consideration, but less than as defined for POOR condition POOR : general breakdown of coating over 20% or more of areas or hard scale at 10% or more of areas under consideration.	

4.2 Sacrificial anode condition (as applicable)

4.2.1 Criteria

The acceptance criteria for sacrificial anodes in each coated space fitted with anodes is indicated in Tab 3 in terms of percentage of losses in weight.

Where acceptance criteria are not fulfilled, sacrificial anodes are to be renewed.

Table 3 : Acceptance criteria for sacrificial anodes

Condition	Percentage of loss in weight
Ships less than 12 years old	less than 25
Ships 12 years old or more	less than 50

4.3 Thickness measurements (applicable only if required by the Society on case by case basis)

4.3.1 General

The acceptance criteria for measured thicknesses are indicated in:

- Ch 2, App 1 for isolated areas of items (for example a localized area of a plate)
- Ch 2, App 2 for items (for example a plating panel or an ordinary stiffener)
- Ch 2, App 3 for zones (for example the bottom zone).

When the acceptance criteria are not fulfilled, actions according to [4.3.2] to [4.3.4] are to be taken.

4.3.2 Isolated area

The thickness diminution of an isolated area of an item is the localized diminution of the thickness of that item such as, for example, the grooving of a plate or a web or a local severe corrosion. It is expressed as a percentage of the relevant as built thickness.

It is not to be confused with pitting (see [4.4]).

If the criteria of acceptable diminution are not fulfilled for an isolated area, then this isolated area is to be repaired or replaced. In any case, the criteria of thickness diminution are to be considered for the corresponding item (see [4.3.3]).

4.3.3 Item

For each item, thicknesses are measured at several points and the average value of these thicknesses is to satisfy the acceptance criteria for the relevant item.

If the criteria of measured thicknesses are not fulfilled for an item, then this item is to be repaired or replaced. Where the criteria are fulfilled but substantial corrosion as defined in Pt A, Ch 2, Sec 2, [3.2.6] is found, the IMP is to be adjusted to increase the frequency and/or extent of the maintenance program. In any case, for the items which contribute to the hull girder longitudinal strength, the criteria in [4.3.4] are to be considered.

4.3.4 Zone

For consideration of the hull girder longitudinal strength, the transverse section of the ship is divided into three zones:

- deck zone
- neutral axis zone
- bottom zone.

The sectional area diminution of a zone, expressed as a percentage of the relevant as built sectional area, is to fulfil the criteria of acceptable diminution for that zone.

If the criteria of acceptable diminution are not fulfilled for a zone, then some items belonging to that zone are to be replaced (in principle, those which are most worn) in order to obtain after their replacement an increased sectional area of the zone fulfilling the relevant criteria.

4.4 Pitting

4.4.1 Pitting intensity

The pitting intensity is defined by the percentage of area affected by pitting.

The diagrams in Ch 2, App 4 are to be used to identify the percentage of area affected by pitting and thus the pitting intensity.

4.4.2 Acceptable wastage

The acceptable wastage for a localised pit (intensity ≤ 3%) is 23% of the average residual thickness.

For areas having a pitting density of 50% or more, the acceptable wastage in pits is 13% of the average residual thickness.

For intermediate values (between localised pit and 50% of affected area), the acceptable wastage in pits is to be obtained by interpolation between 23% and 13% of the average residual thicknesses (see Tab 4).

Table 4 : Pitting intensity and corresponding acceptable wastage in pits

Pitting intensity, in % (see Ch 2, App 4)	Acceptable wastage in pits, in percentage of the average residual thickness
≤ 3	23
5	22
10	21
15	20
20	19
25	18
30	17
40	15
50	13

4.4.3 Repairs

Application of filler material (plastic or epoxy compounds) is recommended as a mean for stopping/reducing the corrosion process but this is not an acceptable repair for pitting exceeding the maximum permissible wastage limits.

Welding repairs may be accepted when performed in accordance with agreed procedures.

4.5 Fractures

4.5.1 General

Fractures are found, in general, at locations where stress concentrations occur.

In particular, fractures occur at the following locations:

- beginning or end of a run of welding
- rounded corners at the end of a stiffener
- traces of lifting fittings used during the construction of the ship
- weld anomalies
- welding at toes of brackets
- welding at cut-outs
- intersections of welds
- intermittent welding at the ends of each length of weld.

The structure under examination is to be cleaned and provided with adequate lighting and means of access to facilitate the detection of fractures.

If the initiation points of the fractures are not apparent, the structure on the other side of the plating is to be examined.

4.5.2 Criteria

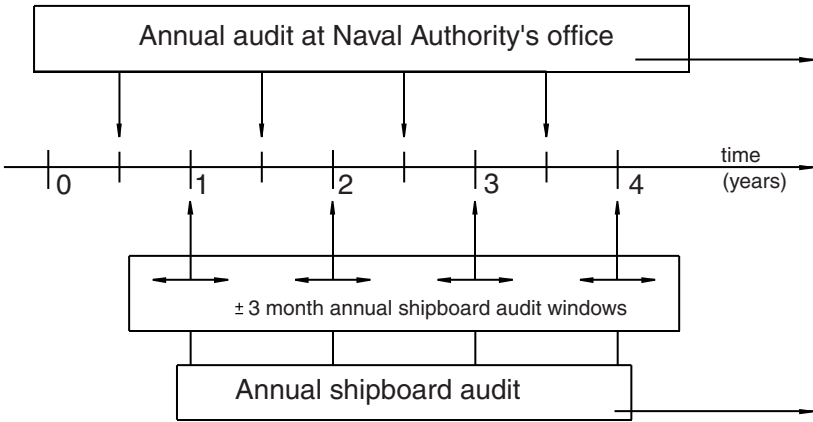
Where fractures are detected, the Society's Surveyor is always to be called by the Naval Authority for attendance.

5 Maintenance of the notation

5.1 Annual audit at the Naval Authority's offices

5.1.1 The audit is to be carried out annually preferably within the prescribed six-month window as shown in Fig 1.

Figure 1 : Audit periodicity



If two or more ships belonging to the same Naval Authority are assigned the **STAR-HULL** notation, this annual audit may be performed for all ships at the same time in a suitable period agreed between the Naval Authority and the Society.

5.1.2 The Surveyor checks that the ship database held at the Naval Authority's offices is kept updated, in particular with the inspection and maintenance reports of the IMP.

A preliminary evaluation on how the IMP is applied may be done on the basis of the data and information collected during this audit and the data received from the ship.

Depending on this evaluation, the Society may call for:

- an occasional survey on board the ship by a Surveyor of the Society to be carried out as soon as possible
- corrective actions to be taken by the Naval Authority in applying the IMP.

5.1.3 The annual audit at the Naval Authority's offices performed before the commencement of the class renewal survey is to include the planning required for this survey (see [5.2.2]).

5.2 Annual shipboard audit

5.2.1 The annual shipboard audit is to be carried out concurrently with the annual survey.

5.2.2 During this audit the Surveyor:

- verifies that the ship database is kept updated and transmitted to the Naval Authority's offices
- verifies the consistency and implementation of the IMP
- carries out additional inspections relevant to hull (structure and equipment), if required as a result of the audit at the Naval Authority's offices.

5.3 Class renewal survey

5.3.1 The survey for the renewal of the **STAR-HULL** notation is to be carried out concurrently with the class renewal survey.

The documentation to be prepared, the surveys to be carried out and the structural reassessment to be done in connection with the class renewal survey are summarised in the flowchart shown in Fig 2.

5.3.2 The planning of the class renewal survey is to be prepared in advance of the survey by the Naval Authority in cooperation with the Society. This planning is preferably to be agreed during the annual audit at the Naval Authority's offices performed approximately eighteen months before the due date of the class renewal survey (see [5.1.3]).

The planning is to include the following information:

- conditions for survey
- provisions and methods for access to structures
- equipment for survey
- indication of spaces and areas for internal examination, overall survey and close-up survey
- indication of tanks to be tested
- indication of areas to be checked for fatigue fracture detection (see [5.3.3]).

It is to take account of:

- the results of the IMP held by the Naval Authority during the current class period, as well as the class surveys carried out during the same period
- the scope of the class renewal survey as required in Pt A, Ch 3, Sec 3 and Part A, Chapter 4, as applicable to the ship concerned
- the additional requirements related to the **STAR-HULL** notation as indicated in [5.3.3].

5.3.3 In addition to the scope of the class renewal survey as required for the ship concerned, the following is to be carried out:

- an annual shipboard audit as detailed in [5.2]
- the assessment of the condition of coating and anodes if any
- the close-up survey as required in the survey planning as a result of the previous structural assessment required by the Society on case by case basis
- a specific survey for fatigue fracture detection in accordance with the planning as a result of the previous hot spot map.

5.3.4 On the basis of the results of the surveys, additional visual examination and fatigue fracture detection carried out as indicated in [5.3.3], the "as-inspected state" of the ship is established. A structural reassessment of the "as-inspected state" is performed according to the criteria in Ch 2, App 2. This state may be progressively updated based on the results of additional inspections and/or thickness measurements required on the basis of the first "running" of the analysis.

Once the final "as-inspected state" is established, a program of corrective actions is defined and planned, which may consist of:

- structural renewals
- repairs of structural defects (fractures, deformations, etc.)
- repairs/renewals of coating and/or anodes, if any.

in order to ensure that the ship continues to comply with the acceptance criteria given in [4]. In addition, the IMP may be modified if needed.

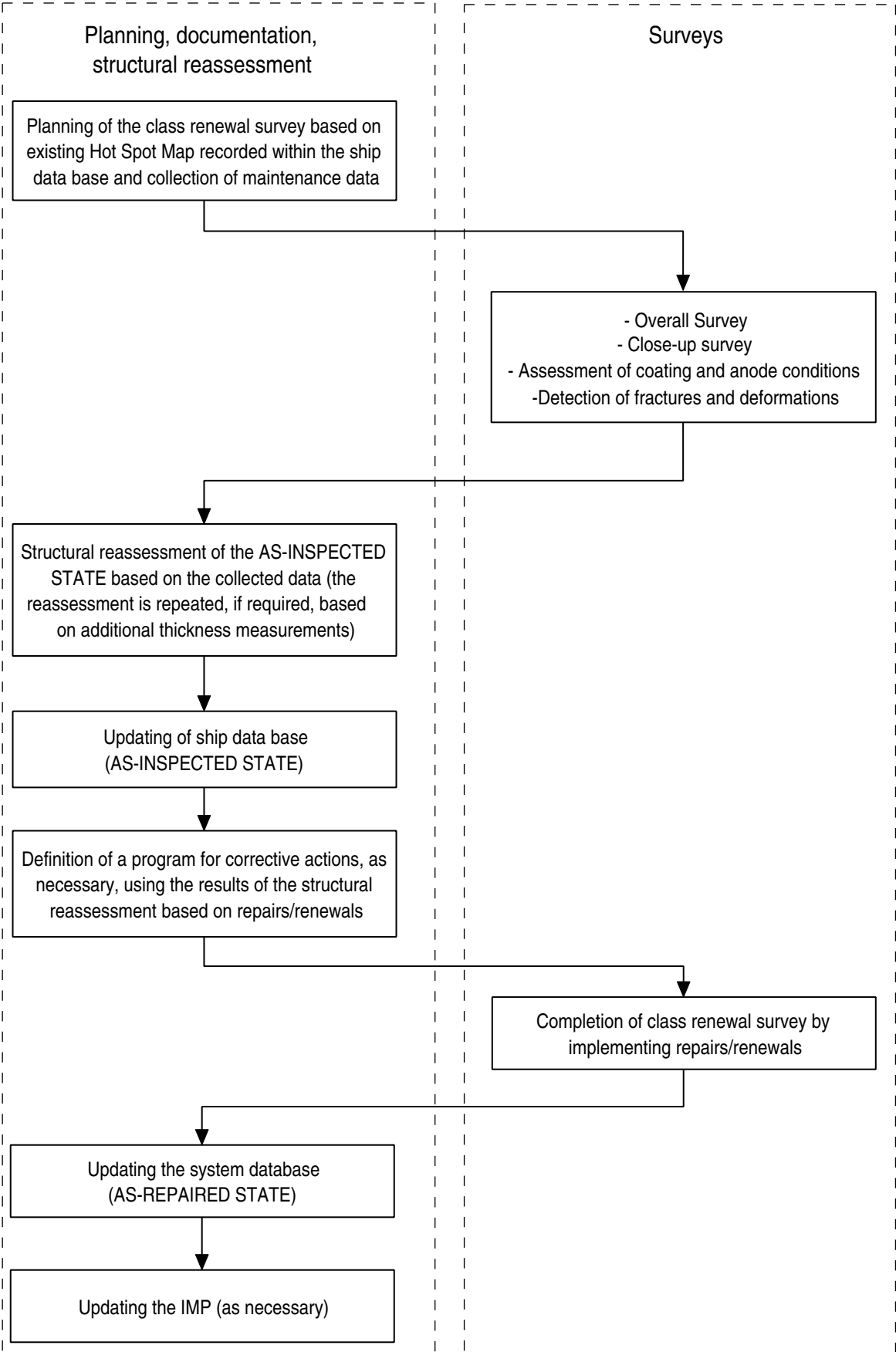
5.3.5 The corrective actions are to be surveyed by a Surveyor of the Society. Subsequently a new "as-repaired state" of the ship is obtained, including an updated hot spot map.

5.4 Suspension and withdrawal of the notation

5.4.1 The maintenance of the **STAR-HULL** notation is subject to the same principles as those for the maintenance of class: surveys are to be carried out by their limit dates and possible recommendations (related to the notation) are to be dealt with by their limit dates.

The suspension of class automatically causes the suspension of the **STAR-HULL** notation.

Figure 2 : Actions to be taken in connection with the Class Renewal Survey



5.4.2 Various events may lead either to imposition of a recommendation related to the **STAR-HULL** notation or to suspension of the notation itself. Some cases are given below.

- The condition of the ship is below the minimum level required for class (e.g. scantling of a hull structure below the corrosion margin acceptable for the class around hot spot areas). The action to be taken is either the immediate repair or the imposition of a recommendation for the class (if acceptable) and suspension of the **STAR-HULL** notation. However, in cases where the recommendation is of a minor nature, the notation may not be suspended.
- The Inspection and Maintenance Plan is not complied with (e.g. delays in performing the operations programmed according to the plan or the scope of inspection and/or maintenance not completely fulfilled), and/or the maintenance of the database is not fulfilled.

The action to be taken is:

- either the immediate compliance with the requirements or the imposition of a recommendation if the non-conformity is of a minor nature or is an exceptional occurrence

- or the suspension of the **STAR-HULL** notation if the non-conformity is of a major nature or a recurrence.

- A defect or a deficiency is found in applying the IMP. The actions to be taken are the same as stated both for repair of structure/coating/equipment (first two cases above) and for the application of the IMP (third case above).
- An unexpected defect or deficiency is found or an accident occurs, i.e. not as a result of lack of maintenance or failure in the application of the IMP. The actions to be taken are the same as stated for repair of structure/coating/equipment (first two cases above).

5.4.3 The withdrawal of the **STAR-HULL** notation may be decided in different cases, such as:

- recurrent suspension of the **STAR-HULL** notation
- suspension of the **STAR-HULL** notation for more than a given period (i.e. 3 months)
- expiry or withdrawal of class.

SECTION 2

STAR-MACH

1 General

1.1 Principles

1.1.1 Application

The additional class notations **STAR-MACH** and **STAR-MACH-PMS** are assigned, in accordance with Pt A, Ch 1, Sec 2, [6.2.3] to ships complying with the requirements of this Section.

1.1.2 Inspection and Maintenance Plan

The **STAR-MACH** notation reflects the fact that a procedure including periodic and corrective maintenance, condition-monitoring as well as periodic and occasional inspections of machinery installations and equipment (hereinafter referred to as the Inspection and Maintenance Plan) is operated on board and at the Naval Authority's offices.

The implementation of the Inspection and Maintenance Plan is verified by the Society through:

- a risk analysis, initially performed by the Society in order to identify tentatively critical machinery and equipment items covered in the Inspection and Maintenance Plan, and periodically updated to analyse the performance of these items on the basis of the information stored in the ship database, requiring suitable modifications of the inspection and maintenance intervals, if needed
- periodic examination of the data recorded by the Naval Authority and made available to the Society through an electronic ship database suitable for consultation and analysis; and
- periodic audits carried out by the Society at Naval Authority's offices and on board.

1.1.3 Risk analysis

The purpose of the risk analysis is to assess the inspection and maintenance process taking into account the consequences if a system fails.

The risk analysis is to include at least the machinery and equipment which are identified in [2.1]. The Society, in consultation with the Naval Authority, may extend the scope of the risk analysis to other equipment or systems which are considered critical, depending on the ship's characteristics.

For the purpose of the risk analysis, instruction manuals, spare parts and tools are assumed to be available, when needed.

1.1.4 Class renewal survey

The assignment of the **STAR-MACH** and **STAR-MACH-PMS** notations imply that the class renewal surveys of machinery are carried out by applying the planned maintenance scheme (PMS) described in Part A, Ch 2, Sec 2. The procedure of recognizing surveys carried out by the Chief Engineer, as indicated in Part A, Ch 2, Sec 2 when CMS or PMS schemes are adopted, is also applied.

The combination of the Inspection and Maintenance Plan implemented by the Naval Authority and the risk analysis carried out by the Society enables to improve the planned maintenance scheme (PMS), as described in Part A, Ch 2, Sec 2. For instance, it is possible to allow the inspection of a machinery item based on running hours to be performed at intervals exceeding five years, based on its actual conditions and performances on board.

1.1.5 Manufacturer's recommendations

The **STAR-MACH** notation has by no means to be considered a relapsation or a variation of the type and timing of maintenance recommended by the Manufacturer.

Any possible change or optimization of the original maintenance scheme may be considered only after the expiry of the Manufacturers' warranty period, once that all involved machinery and equipment are set in service and the information relative to the maintenance and performance of various machinery and equipment are collected and elaborated, as necessary, in consultation with the Manufacturer, at Naval Authority's request.

1.2 Conditions for the assignment and maintenance of the notation

1.2.1 Assignment of the notation

The procedure for the assignment of the **STAR-MACH** notation is the following:

- a request for the notation is to be sent to the Society
- the following documentation is to be submitted to the Society by the Interested Party:
 - plans and documents of machinery and equipment (see [2.1])
 - the Inspection and Maintenance Plan to be implemented by the Naval Authority during the ship life (see [2.2]), and
 - information concerning the ship database and relevant electronic support to be implemented by the Naval Authority during the ship life (see [1.3.1])
- the Society performs the risk analysis for the ship and its plants, based on the documentation submitted

- the Society reviews and approves the Inspection and Maintenance Plan, taking into account the results of the above-mentioned risk analysis as well as the information concerning the ship database
- the Society carries out an initial shipboard audit to verify the compliance of the procedures on board with respect to the submitted documentation.

1.2.2 Maintenance of the notation

The maintenance of the **STAR-MACH** notation is based on a risk analysis review (see [3.2]) and the following surveys to be carried out by the Society, according to the scope and periodicity given in [5]:

- annual audit at the Naval Authority's offices (see [5.1])
- annual shipboard audit (see [5.2])
- occasional shipboard audits/surveys (see [5.3]) triggered by:
 - risk analysis results
 - changes to ship operations
 - non-conformities.

1.3 Ship database

1.3.1 The ship database, to be available on board and at the Naval Authority's offices, using an electronic support suitable for consultation and analysis, is to include at least the following information:

- the documents required for the Inspection and Maintenance Plan, as indicated in [2.2], and the corresponding reports during the ship operation, as indicated in [4.2]
- the results of the risk analysis.

1.3.2 The ship database is to be:

- updated by the Naval Authority each time new inspection and maintenance data from the ship are available
- kept by the Naval Authority.

Access to the database is to be logged, controlled and secured.

The ship database is to include a back up system in order that the data can be readily restored, if needed.

1.3.3 The ship database is to be made available to the Society.

The ship database is to be transmitted to the Society at least every six months. When agreed between the Naval Authority and the Society, the required data may be automatically discharged into a Society's database.

1.3.4 The data provided in accordance with [1.3.3] will be used to carry out the risk analysis.

1.3.5 As the risk analysis is subject to be reviewed and updated by the Society during the ship's life, the software used by the Naval Authority is to be compatible with the one used by the Society, in order to make possible the review and updating of the risk analysis results.

2 Documentation to be submitted

2.1 Plans, documents and specifications

2.1.1

- The plans and documents necessary to assign the **STAR-MACH** notation are to include at least the machinery and equipment listed in Tab 1.
- For a new ship, the plans and documents listed in Tab 1 do not need to be duplicated with respect to the documents requested for the purpose of classification in Part C.
- The plans are to be supplemented by Manufacturer's specifications, including the list of relevant equipment and accessories and instructions for their use.
- The Society may request additional documents or information, when needed.

2.2 Inspection and Maintenance Plan (IMP)

2.2.1 The Inspection and Maintenance Plan is to include at least the following information:

- the list of machinery and equipment covered, including at least the ones listed in Tab 1
- for each item of machinery and equipment:
 - Manufacturer's maintenance instruction book, taking into consideration the scheme recommended by the Manufacturer (see [1.1.5])
 - details relevant to the type of maintenance (e.g. inspection, reconditioning, overhauls, spare parts)
 - maintenance frequency (i.e. running hours, calendar days, weeks, months, years)
 - condition monitoring scheme, where applied
 - place of maintenance execution (e.g. in port, at sea)
 - utilisation rate, running hours and type of service (e.g. heavy, light)
 - procedures foreseen for repairs, overhauling or substitution
- names and qualification of personnel authorized to carry out the duties foreseen by the Inspection and Maintenance Plan (see [4.4])
- procedures for the storage and backup of records and any other relevant information (see [1.3])
- procedure for modification and approval of the plan based on feedback experience and Manufacturer's consultation, as necessary.