Tasneef
هيئة الإمارات للتصنيف
Emirates Classification Society

Rules Classification of Offshore Units Operating in the Caspian Sea and Similar Areas

Effective from 1 January 2023

Part F

Additional Class Notations

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GENERAL CONDITIONS

Definitions:

"*Administration*" means the Government of the State whose flag the Ship is entitled to fly or under whose authority the Ship is authorised to operate in the specific case.

"IACS" means the International Association of Classification Societies.

"*Interested Party*" means the party, other than the Society, having an interest in or responsibility for the Ship, product, plant or system subject to classification or certification (such as the owner of the Ship and his representatives, the ship builder, the engine builder or the supplier of parts to be tested) who requests the Services or on whose behalf the Services are requested.

"*Owner*" means the registered owner, the ship owner, the manager or any other party with the responsibility, legally or contractually, to keep the ship seaworthy or in service, having particular regard to the provisions relating to the maintenance of class laid down in Part A, Chapter 2 of the Rules for the Classification of Ships or in the corresponding rules indicated in the specific Rules.

"Rules" in these General Conditions means the documents below issued by the Society:

(i) Rules for the Classification of Ships or other special units;
(ii) Complementary Rules containing the requirements for product, plant, system and other certification or containing the requirements for the assignment of additional class notations;
(iii) Rules for the application of statutory rules, containing the rules to perform the duties delegated by Administrations;
(iv) Guides to carry out particular activities connected with Services;
(v) Any other technical document, as for example rule variations or interpretations.

"*Services*" means the activities described in Article 1 below, rendered by the Society upon request made by or on behalf of the Interested Party.

"Ship" means ships, boats, craft and other special units, as for example offshore structures, floating units and underwater craft.

"*Society*" or *"TASNEEF"* means Tasneef and/or all the companies in the Tasneef Group which provide the Services.

"*Surveyor*" means technical staff acting on behalf of the Society in performing the Services.

Article 1

1.1. The purpose of the Society is, among others, the classification and certification of ships and the certification of their parts and components. In particular, the Society:
(i) sets forth and develops Rules;
(ii) publishes the Register of Ships;
(iii) issues certificates, statements and reports based on its survey activities.

1.2. The Society also takes part in the implementation of national and international rules and standards as delegated by various G overnments.

1.3. The Society carries out technical assistance activities on request and provides special services outside the scope of classification, which are regulated by these general conditions, unless expressly excluded in the particular contract.

Article 2

2.1. The Rules developed by the Society reflect the level of its technical knowledge at the time they are published. Therefore, the Society, although committed also through its research and development services to continuous updating of the Rules, does not guarantee the Rules meet state-of-the-art science and technology at the time of publication or that they meet the Society's or others' subsequent technical developments.

2.2. The Interested Party is required to know the Rules on the basis of which the Services are provided. With particular reference to Classification Services, special attention is to be given to the Rules concerning class suspension, withdrawal and reinstatemen t. In case of doubt or inaccuracy, the Interested Party is to promptly contact the Society for clarification.
The Rules for Classification of Ships are published on the Society's website: www.tasneef.ae.

2.3. The Society exercises due care and skill:
(i) in the selection of its Surveyors
(ii) in the performance of its Services, taking into account the level of its technical knowledge at the time the Services are performed.

2.4. Surveys conducted by the Society include, but are not limited to, visual inspection and non-destructive testing. Unless otherwise required, surveys are conducted through sampling techniques and do not consist of comprehensive verification or monitoring of the Ship or of the items subject to certification. The surveys and checks made by the Society on board ship do not necessarily require the constant and continuous presence of the Surveyor. The Society may also commission laboratory testing, underwater inspection and other checks carried out by and under the responsibility of qualified service suppliers. Survey practices and procedures are selected by the Society based on its experience and knowledge and according to generally accepted technical standards in the sector.

Article 3

3.1. The class assigned to a Ship, like the reports, statements, certificates or any other document or information issued by the Society, reflects the opinion of the Society concerning compliance, at the time the Service is provided, of the Ship or product subject to certification, with the applicable Rules (given the intended use and within the relevant time frame).
The Society is under no obligation to make statements or provide information about elements or facts which are not part of th e specific scope of the Service requested by the Interested Party or on its behalf.

3.2. No report, statement, notation on a plan, review, Certificate of Classification, document or information issued or given as p art of the Services provided by the Society shall have any legal effect or implication other than a representation that, on the basis of the checks made by the Society, the Ship, structure, materials, equipment, machinery or any other item covered by such document or information meet the Rules. Any such document is issued solely for the use of the Society, its committees and clients or other duly authorised bodies and for no other purpose. Therefore, the Society cannot be held liable for any act made or document issued by other parties on the basis of the statements or information given by the Society. The validity, application, meaning and interpretation of a Certificate of Classification, or any other document or information issued by the Society in connection with its Services, is governed by the Rules of the Society, which is the sole subject entitled to make such interpretation. Any disagreement on technical matters between the Interested Party and the Surveyor in the carrying out of his functions shall be raised in writing as soon as possible with the Society, which will settle any divergence of opinion or dispute.

3.3. The classification of a Ship, or the issuance of a certificate or other document connected with classification or certificati on and in general with the performance of Services by the Society shall have the validity conferred upon it by the Rules of the Society at the time of the assignment of class or issuance of the certificate; in no case shall it amount to a statement or warranty of seaw orthiness,

structural integrity, quality or fitness for a particular purpose or service of any Ship, structur e, material, equipment or machinery inspected or tested by the Society.

3.4. Any document issued by the Society in relation to its activities reflects the condition of the Ship or the subject of certifi cation or other activity at the time of the check.

3.5. The Rules, surveys and activities performed by the Society, reports, certificates and other documents issued by the Society are in no way intended to replace the duties and responsibilities of other parties such as Governments, designers, ship builders, manufacturers, repairers, suppliers, contractors or sub-contractors, Owners, operators, charterers, underwriters, sellers or intended buyers of a Ship or other product or system surveyed.

These documents and activities do not relieve such parties from any fulfilment, warranty, responsibility, duty or obligation (also of a contractual nature) expressed or implied or in any case incumbent on them, nor do they confer on such parties any right, claim or cause of action against the Society. With particular regard to the duties of the ship Owner, the Services undertaken by the Society do not relieve the Owner of his duty to ensure proper maintenance of the Ship and ensure seaworthiness at all times. Likewise, t he Rules, surveys performed, reports, certificates and other documents issued by the Society are intended neither to guarantee the buyers of the Ship, its components or any other surveyed or certified item, nor to relieve the seller of the duties arising out of the law or the contract, regarding the quality, commercial value or characteristics of the item which is the subject of transaction.

In no case, therefore, shall the Society assume the obligations incumbent upon the above-mentioned parties, even when it is consulted in connection with matters not covered by its Rules or other documents.

In consideration of the above, the Interested Party undertakes to relieve and hold harmless the Society from any third party claim, as well as from any liability in relation to the latter concerning the Services rendered.

Insofar as they are not expressly provided for in these General Conditions, the duties and responsibilities of the Owner and Interested Parties with respect to the services rendered by the Society are described in the Rules applicable to the specific Service rendered.

Article 4

4.1. Any request for the Society's Services shall be submitted in writing and signed by or on behalf of the Interested Party. Such a request will be considered irrevocable as soon as received by the Society and shall entail acceptance by the applicant of all relevant requirements of the Rules, including these General Conditions. Upon acceptance of the written request by the Society, a contract between the Society and the Interested Party is entered into, which is regulated by the present General Conditions.

4.2. In consideration of the Services rendered by the Society, the Interested Party and the person requesting the service shall be jointly liable for the payment of the relevant fees, even if the service is not concluded for any cause not pertaining to the Society. In the latter case, the Society shall not be held liable for non-fulfilment or partial fulfilment of the Services requested. In the event of late payment, interest at the legal current rate increased by 1.5% may be demanded.

4.3. The contract for the classification of a Ship or for other Services may be terminated and any certificates revoked at the request of one of the parties, subject to at least 30 days' notice to be given in writing. Failure to pay, even in part, the fees due for Services carried out by the Society will entitle the Society to immediately terminate the contract and suspend the Services.

For every termination of the contract, the fees for the activities performed until the time of the termination shall be owed to the Society as well as the expenses incurred in view of activities already programmed; this is without prejudice to the right to compensation due to the Society as a consequence of the termination.

With particular reference to Ship classification and certification, unless decided otherwise by the Society, termination of the contract implies that the assignment of class to a Ship is withheld or, if already assigned, that it is suspended or withdrawn; any st atutory certificates issued by the Society will be withdrawn in those cases where provided for by agreements between the Society and the flag State.

Article 5

5.1. In providing the Services, as well as other correlated information or advice, the Society, its Surveyors, servants or agents operate with due diligence for the proper execution of the activity. However, considering the nature of the activities performed (see art. 2.4), it is not possible to guarantee absolute accuracy, correctness and completeness of any information or advice supplied. Express and implied warranties are specifically disclaimed.

Therefore, except as provided for in paragraph 5.2 below, and also in the case of activities carried out by delegation of Governments, neither the Society nor any of its Surveyors will be liable for any loss, damage or expense of whatever nature sustained by any person, in tort or in contract, derived from carrying out the Services.

5.2. Notwithstanding the provisions in paragraph 5.1 above, should any user of the Society's Services prove that he has suffered a loss or damage due to any negligent act or omission of the Society, its Surveyors, servants or agents, then the Society will pay compensation to such person for his proved loss, up to, but not exceeding, five times the amount of the fees charged for the specific services, information or opinions from which the loss or damage derives or, if no fee has been charged, a maximum of AED5,000 (Arab Emirates Dirhams Five Thousand only). Where the fees charged are related to a number of Services, the amount of the fees will be apportioned for the purpose of the calculation of the maximum compensation, by reference to the estimated time involved in the performance of the Service from which the damage or loss derives. Any liability for indirect or consequential loss, damage or expense is specifically excluded. In any case, irrespective of the amount of the fees charged, the maximum damages payable by the Society will not be more than AED5,000,000 (Arab Emirates Dirhams Five Millions only). Payment of compensation under this paragraph will not entail any admission of responsibility and/or liability by the Society and will be made without prejudice to the disclaimer clause contained in paragraph 5.1 above.

5.3. Any claim for loss or damage of whatever nature by virtue of the provisions set forth herein shall be made to the Society in writing, within the shorter of the following periods: (i) THREE (3) MONTHS from the date on which the Services were performed, or (ii) THREE (3) MONTHS from the date on which the damage was discovered. Failure to comply with the above deadline will constitute an absolute bar to the pursuit of such a claim against the Society.

Article 6

6.1. These General Conditions shall be governed by and construed in accordance with United Arab Emirates (UAE) law, and any dispute arising from or in connection with the Rules or with the Services of the Society, including any issues concerning responsibility, liability or limitations of liability of the Society, shall be determined in accordance with UAE law. The courts of the Dubai International Financial Centre (DIFC) shall have exclusive jurisdiction in relation to any claim or dispute which may arise out of or in connection with the Rules or with the Services of the Society.

6.2. However,

(i) In cases where neither the claim nor any counterclaim exceeds the sum of AED300,000 (Arab Emirates Dirhams Three Hundred Thousand) the dispute shall be referred to the jurisdiction of the DIFC Small Claims Tribunal; and

(ii) for disputes concerning non-payment of the fees and/or expenses due to the Society for services, the Society shall have the

right to submit any claim to the jurisdiction of the Courts of the place where the registered or operating office of the Interested Party or of the applicant who requested the Service is located.

In the case of actions taken against the Society by a third party before a public Court, the Society shall also have the right to summon the Interested Party or the subject who requested the Service before that Court, in order to be relieved and held harmless according to art. 3.5 above.

Article 7

7.1. All plans, specifications, documents and information provided by, issued by, or made known to the Society, in connection with the performance of its Services, will be treated as confidential and will not be made available to any other party other than the Owner without authorisation of the Interested Party, except as provided for or required by any applicable international, European or domestic legislation, Charter or other IACS resolutions, or order from a competent authority. Information about the status and validity of class and statutory certificates, including transfers, changes, suspensions, withdrawals of class, recommendations/conditions of class, operating conditions or restrictions issued against classed ships and other related information, as may be required, may be published on the website or released by other means, without the prior consent of the Interested Party.

Information about the status and validity of other certificates and statements may also be published on the website or released by other means, without the prior consent of the Interested Party.

7.2. Notwithstanding the general duty of confidentiality owed by the Society to its clients in clause 7.1 above, the Society's clients hereby accept that the Society may participate in the IACS Early Warning System which requires each Classification Society to provide other involved Classification Societies with relevant technical information on serious hull structural and engineering systems failures, as defined in the IACS Early Warning System (but not including any drawings relating to the ship which may be the specific property of another party), to enable such useful information to be shared and used to facilitate the proper working of the IACS Early Warning System. The Society will provide its clients with written details of such information sent to the involved Classification Societies.

7.3. In the event of transfer of class, addition of a second class or withdrawal from a double/dual class, the Interested Party undertakes to provide or to permit the Society to provide the other Classification Society with all building plans and drawings, certificates, documents and information relevant to the classed unit, including its history file, as the other Classification Society may require for the purpose of classification in compliance with the applicable legislation and relative IACS Procedure. It is the Owner's duty to ensure that, whenever required, the consent of the builder is obtained with regard to the provision of plans and drawings to the new Society, either by way of appropriate stipulation in the building contract or by other agreement.

In the event that the ownership of the ship, product or system subject to certification is transferred to a new subject, the latter shall have the right to access all pertinent drawings, specifications, documents or information issued by the Society or which has come to the knowledge of the Society while carrying out its Services, even if related to a period prior to transfer of ownership.

Article 8

8.1. Should any part of these General Conditions be declared invalid, this will not affect the validity of the remaining provisions.

RULES FOR THE CLASSIFICATION OF
OFFSHORE UNITS OPERATING IN THE CASPIAN SEA
AND SIMILAR AREAS

Part F
Additional Class Notations

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Part F
Additional Class Notations

Chapter 1
AVAILABILITY OF MACHINERY (AVM)

SECTION 1 INDEPENDENT ALTERNATIVE PROPULSION SYSTEM (AVM-IAPS)

1 General

1.1 Application

1.1.1 The additional class notation AVM-IAPS is assigned in accordance with Pt A, Ch 1, Sec 2, [6.2.2] to self-propelled ships arranged with means for independent alternative propulsion complying with the requirements of this Section.

1.1.2 This notation is granted, provided that:

a) the ship is arranged with at least two propellers and the associated independent shafting, each one independently driven by separate machinery, in such a way that the propulsion power needed to comply with [1.2] remains available whenever any of the propulsion machinery and the associated propeller and shafting are out of service.

It is also applicable to ships arranged with at least two independent azimuth thrusters and any other equivalent arrangement;

b) the propulsive installations are arranged in different compartments, in such a way that the propulsion power needed to comply with [1.2] remains available whenever propulsion and auxiliary machinery arranged in any one compartment is not operating.

1.2 Coverage of AVM-IAPS notation

1.2.1 Casualty

The loss (due to fire or flooding) of one compartment where propulsion, its auxiliary machinery, and the main source of electrical power are located is to be considered.

However, the collision in way of a bulkhead and the consequent loss of two adjacent compartments due to flooding is not to be considered a casualty for the purpose of this additional class notation.

The loss of the steering gear compartment is not considered within the scope of this additional class notation.

1.2.2 Targets

The following operating conditions are to be achieved by ships having an independent alternative propulsion system, in the case of a casualty, as specified in [1.2.1]:

- Full load speed not less than 7 knots (lower speeds may be considered acceptable when the ship is provided with azimuth thrusters or similar propulsion thrusters)
- Range of 1000 nautical miles or range corresponding to 1/2 of the range achievable with the full supply of fuel, whichever is the lesser
- Steering capability
- Availability of safety systems, including fire-fighting systems, bilge system, navigation lights, communication apparatus, life-saving appliances
- Habitability conditions, including minimum lighting, ventilation, galleys, refrigerated stores, drinking water or evaporator services
- Preservation of the cargo.

1.2.3 Services not required to be available

The following services need not be supplied after a casualty, during the emergency operation of the independent alternative propulsion system, when one of the propulsion systems is not available due to the casualty described in [1.2.1]:

- Cargo handling system
- Ballast system needed for cargo handling operation only
- Bow thrusters
- Air conditioning
- Other non essential services (for instance stabilisers, full lighting, amusement items).

1.2.4 Redundancy

If the independent alternative propulsion system is used in an emergency due to the loss of one compartment, it is accepted that some of the redundancies normally required by the Rules may no longer be available.

However, in the case of unavailability of one of the propulsion systems due to a single failure (excluding the loss of one compartment), all the redundancies of machinery and systems normally required by the Rules are to be kept available.

In the case of electric propulsion, cold standby propulsion control systems may be accepted in way of full redundancy provided that they are permanently installed, ready for use and easily put into operation.

1.3 Documentation to be submitted

1.3.1 The documents listed in Tab 1 are to be submitted.

2 Special arrangements

2.1 Systems for cooling, lubrication, fuel supply and starting

2.1.1 General The (main and alternative) propulsion systems, the propulsion auxiliaries and the main source of electrical power are to be designed and constructed such as to satisfy the conditions stipulated in [1.2.2].

In addition to the provisions in the relevant parts of the Rules and in [1.2.4], the following requirements apply.

2.1.2 Pumps

The systems concerned are to be provided with at least two pumps, one as a standby for the other, suitably located so that in the case of loss of one compartment at least one is still available.

One of the two pumps may be driven by the propulsion machinery, while the other is to be independently driven.

2.1.3 Cooling system

In general, separate cooling systems are to be provided for each main propulsion system, unless the FMEA demonstrates that one single cooling system serving all propulsion systems is arranged and located in such a way that any single failure of the system, including loss of one compartment, does not make all the propulsion systems inoperative at the same time.

2.1.4 Lubricating oil system

Each main propulsion system is to be fitted with a separate lubrication oil system.

2.1.5 Fuel oil system

In general, separate fuel oil systems are to be provided for each main propulsion system, unless the FMEA demonstrates that one single fuel oil system serving all propulsion systems is arranged and located in such a way that any single failure of the system, including loss of one compartment, does not make all the propulsion systems inoperative at the same time.

2.1.6 By-pass

Means are to be provided to bypass and shut off each of the components which may be subject to single failure or malfunction due to the casualty, as described in [1.2.1], without impairing the functioning of the system itself (including machinery and equipment) or of the other systems which are to be operated in connection with alternative propulsion.

2.1.7 Piping segregation

Piping systems common to the main and alternative propulsion systems or piping systems serving one propulsion system and passing through the spaces where another independent propulsion system is arranged are to be ducted in watertight trunks having a fire-retardant resistance at least equivalent to A60 standard and located outside B/5.

The trunks are to be accessible for inspection and maintenance.

2.2 Electrical installations

2.2.1 The electric generators are to be arranged in such a way that in the event of loss of one compartment, enough power still remains available to operate the ship under the conditions stated in [1.2.2] without any standby generating set. In general, this requirement is to be achieved arranging two main switchboards and the electric generators in two separate compartments.

2.2.2 Electrical cables and other electrical apparatus serving a machinery space and passing through the spaces where the other independent propulsion system is arranged are to be ducted in trunks having a fire-retardant resistance at least equivalent to A60 Standard and located outside B/5.

The trunks are to be accessible for inspection and maintenance.

The use of fire-resisting cables, as an alternative to the trunks having a fire-retardant resistance at least equivalent to A60 standard, will be considered on a case-by-case basis.

2.3 Automation

2.3.1 The automation system is to be arranged in such a way as to prevent the possibility that a single failure of the control system may lead to the loss of more than one propulsion system.

In the case of electric propulsion, cold standby propulsion control systems may be accepted in way of full redundancy provided that they are permanently installed, ready for use and easily put into operation.

3 Tests on board

3.1 Running tests

3.1.1 The independent alternative propulsion system is to be subjected to the running tests required by the Rules for similar systems.

3.2 Sea trials

3.2.1 In the course of sea trials, the casualty mentioned in [1.2.1] is to be simulated and the values of the power and speed developed in this condition are to be recorded.

Availability of the redundancies as per [1.2.4] is to be verified.

In the case of electric propulsion, when cold standby propulsion control systems are provided, it is to be checked that they are permanently installed, ready for use and easily put into operation.

Table 1 : Document to be submitted

No.	**(1)**	Document
1	A	Description of the independent alternative propulsion system including an analysis **(2)** demonstrating the availability of the operating conditions as per [1.2.2] and a description of the operations necessary to recover the propulsion and essential services

(1) A : to be submitted for approval, in four copies;

(2) This analysis may be in the form of a Failure Mode and Effect Analysis (FMEA), unless the actual arrangement of the machinery and equipment is quite simple and sufficient operating experience can be demonstrated such as to make unlikely the possibility of consequence failure in the case of a single failure. In such case the Society may consider accepting a functional description of the system in lieu of the requested analysis.

SECTION 2 DUPLICATED PROPULSION SYSTEM (AVM-DPS)

1 General

1.1 Application

1.1.1 The additional class notations AVM-DPS or AVM-DPS-NS are assigned in accordance with Pt A, Ch 1, Sec 2, [6.2.3] to self propelled ships arranged with means for duplicated propulsion system complying with the requirements of this Section.

1.1.2 This notation is granted to ships arranged with at least two propellers and the associated independent shafting, each one independently driven by separate machinery, in such a way that at least 50% of the power remains available whenever any of the propulsion machinery, the associated propeller and shafting are not available.

It is also applicable to ships arranged with at least two independent azimuth thrusters and any other equivalent arrangement.

1.1.3 When the duplicated propulsion system is designed for emergency use only (e.g. in case of loss of one of the ship's propulsion systems), the additional class notation AVM-DPS is assigned.

1.1.4 When the duplicated propulsion system is designed for use in conditions other than an emergency, additional class notation AVM-DPS-NS is assigned.

1.2 Coverage of AVM-DPS and AVM-DPS-NS notations

1.2.1 Single failure concept

The following single failures are to be considered: single failures of non-static components of the propulsion and steering systems and consequence failures, i.e. any failure of any component directly caused by a single failure of another component.

The loss of one compartment due to fire or flooding is not to be considered as a single failure. Accordingly, duplicated apparatus, such as for instance main propulsion machinery, electric power generators, different sections of the main switchboard, duplicated steering gears, etc. may be installed in the same compartment.

1.2.2 Targets

The following operating conditions are to be achieved by ships having a duplicated propulsion system, in the case of a single failure, as specified in [1.2.1]:

- At least 50% of the power still available (in the case of ships with two propellers, this condition may be achieved either considering one propeller running at full power, with the other propeller idle, or with the two propellers running at 50% of the respective power, depending on the type of failure considered)
- Full load speed not less than 7 knots (lower speeds may be considered acceptable when the ship is provided with azimuth thrusters or similar propulsion thrusters)
- Range of 1000 nautical miles or range corresponding to 1/2 of the range achievable with the full supply of fuel, whichever is the less
- Duplicated steering rudder and steering gear, or equivalent arrangement to ensure full steering capability in case of a single failure of one rudder or steering gear
- Availability of safety systems (including fire fighting systems, bilge system, navigating lights, communication apparatus, life-saving appliances)
- Habitability conditions (including minimum lighting, ventilation, galleys, refrigerated stores, drinking water or evaporator services)
- Preservation of the cargo.

1.2.3 Services not required to be available

The following services need not to be supplied during the operation of one (or more) of the propulsion systems, when any of the propulsion system is not available e.g. due to a single failure (as defined in [1.2.1]) of any component of the propulsion plant:

- Cargo handling system
- Ballast system needed for cargo handling operation only
- Bow thrusters
- Air conditioning
- Other non essential services (for instance stabilizers, full lighting, amusement items).

1.3 Redundancy

1.3.1 When the duplicated propulsion system is designed for emergency use only (e.g. in case of single failure of any one of the non-static components of the propulsion and steering systems), for the purpose of granting the AVM-DPS notation the following applies:

a) it is accepted that some of the redundancies of machinery and system normally required by the Rules may no longer be available

b) when exemptions are foreseen by the Rules for multiple propulsion systems, they are still applicable.

1.3.2 When the duplicated propulsion system is designed for use in conditions other than an emergency, for the pur-

pose of granting the AVM-DPS-NS notation the following applies:

a) all the redundancies of machinery and system normally required by the Rules are to be kept available

b) the exemptions mentioned in [1.3.1] b) are no longer applicable

c) in the case of electric propulsion, cold standby propulsion control systems may be accepted in way of full redundancy provided that they are permanently installed, ready for use and easily put into operation.

1.4 Documentation to be submitted

1.4.1 The documents listed in Tab 1 are to be submitted.

2 Special arrangements

2.1 Systems for cooling, lubrication, fuel supply and starting

2.1.1 General

The systems are to be constructed such as to satisfy the conditions stipulated in [1.2.2]. In addition to what stated in the relevant parts of the Rules, the following requirements apply.

2.1.2 Pumps

For the assignment of the **AVM-DPS** notation, the systems concerned are to be provided with at least two pumps, one as a stand-by of the other. One of the two pumps may be driven by the propulsion machinery, while the other pump is to be independently driven.

For the assignment of the **AVM-DPS-NS** notation, irrespective of which of the non-static components of the propulsion and steering systems is considered not available, the systems concerned are to be provided with at least two pumps, one as a standby for the other.

2.1.3 Cooling system

In general, separate cooling systems are to be provided for each main propulsion system, unless the FMEA demonstrates that one integrated cooling system serving all propulsion systems is arranged in such a way that any single failure of the system does not make inoperative all the propulsion systems at the same time.

In addition, the requirements under [1.3] apply depending on the notation required.

2.1.4 Lubricating oil system

Each main propulsion system is to be fitted with a separate lubrication oil systems.

In addition, the requirements under [1.3] apply depending on the notation required.

2.1.5 Fuel oil system

In general, separate fuel oil systems are to be provided for each main propulsion system, unless the FMEA demonstrates that one single fuel oil system serving all propulsion systems is arranged in such a way that any single failure of the system does not make all the propulsion systems inoperative at the same time.

In addition, the requirements under [1.3] apply depending on the notation required.

2.1.6 By-pass

Means are to be provided to by-pass and shut-off each of the components which may be subject to a single failure, described in [1.2.1], without impairing the functioning of the system itself (including machinery and equipment) or of the other systems which are to be operated in connection with navigation in emergency.

2.2 Rudders and steering gears

2.2.1

a) A duplicated rudder and steering gear are to be arranged, unless the arrangement of the main propulsion system allows the same manoeuvrability requested by the rules in case of single failure that may prevent the use of the normal steering system, such as ships with two independent controllable pitch propellers, ships with azimuth thrusters, ships with fore and aft side thrusters.

b) Where ships do not have traditional rudder and steering gears, being their steering capability supplied by azimuth thrusters or equivalent features, means are to be provided to allow at least the same redundancy as required in a) above.

2.3 Electrical installations

2.3.1 Where the electrical power is supplied to the auxiliaries necessary for propulsion through a single main switchboard, the switchboard is to be arranged in at least two sections with all circuits properly distributed between the sections. In case of short circuit in one of the sections, the faulty section is to be automatically disconnected and the other section(s) is (are) to be capable of supplying the auxiliaries necessary to operate the ship under the conditions stated in [1.2.1].

2.4 Automation

2.4.1 The automation system is to be arranged in such a way as to prevent the possibility that a single failure of the control system may lead to the loss of more than one propulsion system.

3 Tests on board

3.1 Running tests

3.1.1 The duplicated propulsion system is to be subjected to the running tests required by the Rules for similar systems.

3.2 Sea trials

3.2.1 In the course of sea trials the single failures mentioned in [1.2.1] are to be simulated and the values of the

power and speed developed in this condition are to be recorded.

Availability of the redundancies as per [1.3] is to be verified.

In the case of electric propulsion, when cold standby propulsion control systems are provided, it is to be checked that they are permanently installed, ready for use and easily put into operation.

Table 1 : Document to be submitted

Item No.	**(1)**	Document
1	A	Description of the duplicated propulsion system including an analysis **(2)** demonstrating the availability of the operating conditions as per [1.2.2] and a description of the operations necessary to recover the propulsion and essential services

(1) A : to be submitted for approval, in quadruplicate;

(2) This analysis may be in the form of a Failure Mode and Effect Analysis (FMEA). App 1 describes an acceptable procedure for carrying out the FMEA.

SECTION 3 INDEPENDENT PROPULSION SYSTEM (AVM-IPS)

1 General

1.1 Application

1.1.1 The additional class notation **AVM-IPS** is assigned in accordance with Pt A, Ch 1, Sec 2, [6.2.4] to self propelled ships arranged with means for independent propulsion systems complying with the requirements of this Section.

1.1.2 This notation is granted, provided that :

a) The ship is arranged with at least two propellers and the associated independent shafting, each one independently driven by separate machinery, in such a way that at least 50% of the power remains available whenever any of the propulsion machinery and the associated propeller and shafting are out of service.

It is also applicable to ships arranged with at least two independent azimuth thrusters and any other equivalent arrangement.

b) The propulsive installations are arranged in different compartments, in such a way that at least 50% of the power installed on board is still available whenever propulsion and auxiliary machinery arranged in any one compartment is not operating.

1.2 Coverage of AVM-IPS notation

1.2.1 Casualty

The loss (due to fire or flooding) of one compartment where propulsion, its auxiliary machinery, steering systems and the main source of electrical power are located, is to be considered. However, the collision in way of a bulkhead, and the consequent loss of two adjacent compartments due to flooding is not to be considered as a single failure for the purpose of this additional class notation.

1.2.2 Targets

The following operating conditions are to be achieved by ships having an independent propulsion system, in the case of a casualty, as specified in [1.2.1]:

- At least 50% of the power still available (in the case of ships with two propellers, this condition may be achieved either considering one propeller running at full power, with the other propeller idle, or with the two propellers running at 50% of the respective power, depending on the type of failure considered)
- Full load speed not less than 7 knots (lower speeds may be considered acceptable when the ship is provided with azimuth thrusters or similar propulsion thrusters)
- Range of 1000 nautical miles or range corresponding to 1/2 of the range achievable with the full supply of fuel, whichever is the less
- Duplicated steering rudder and steering gear, or equivalent arrangement to ensure steering capability in case of a major failure of the rudder or steering gear
- Availability of safety systems, including fire fighting systems, bilge system, navigating lights, communication apparatus, life-saving appliances
- Habitability conditions, including minimum lighting, ventilation, galleys, refrigerated stores, drinking water or evaporator services
- Preservation of the cargo.

1.2.3 Services not required to be available

The following services need not to be supplied after casualty, during the emergency operation of one (or more) of the propulsion systems, when one of the propulsion systems is not available due to the casualty described in [1.2.1]:

- Cargo handling system
- Ballast system needed for cargo handling operation only
- Bow thrusters
- Air conditioning
- Other non essential services (for instance stabilizers, full lighting, amusement items).

1.2.4 Redundancy

In the case any of the independent propulsion system is used under an emergency due to the loss of one compartment, it is accepted that some of the redundancies required normally by the rules may not be anymore available.

However, in the case of unavailability of one of the propulsion systems due to a single failure (excluding the loss of one compartment), all the redundancies of machinery and systems normally required by the Rules are to be kept available.

In the case of electric propulsion, cold standby propulsion control systems may be accepted in way of full redundancy provided that they are permanently installed, ready for use and easily put into operation.

1.3 Documentation to be submitted

1.3.1 The documents listed in Tab 1 are to be submitted.

2 Special arrangements

2.1 Systems for cooling, lubrication, fuel supply and starting

2.1.1 General

The propulsion systems, the propulsion auxiliaries and the main source of electrical power are to be designed and

constructed such as to satisfy the conditions stipulated in [1.2.2]. In addition to what is stated in the relevant parts of the Rules and in [1.2.4], the following requirements apply.

2.1.2 Pumps

The systems concerned are to be provided with at least two pumps, one as a stand-by for the other, suitably located so that in case of loss of one compartment at least one is still available. One of the two pumps may be driven by the propulsion machinery, while the other pump is to be independently driven.

2.1.3 Cooling system

In general, separate cooling systems are to be provided for each main propulsion system, unless the FMEA demonstrates that one single cooling system, serving all propulsion systems is arranged and located in such a way that any single failure of the system, including loss of one compartment, does not make inoperative all the propulsion systems at the same time.

2.1.4 Lubricating oil system

Each main propulsion system is to be fitted with a separate lubrication oil system.

2.1.5 Fuel oil system

In general, separate fuel oil systems are to be provided for each main propulsion system, unless the FMEA demonstrates that one single fuel oil system serving all propulsion systems is arranged and located in such a way that any single failure of the system, including loss of one compartment, does not make inoperative all the propulsion systems inoperative at the same time.

2.1.6 By-pass

Means are to be provided to by-pass and shut-off each of the components which may be subject to a single failure, or malfunction due to the casualty as described in [1.2.1], without impairing the functioning of the system itself (including machinery and equipment) or of the other systems which are to be operated in connection with navigation in emergency.

2.1.7 Piping segregation

Piping systems common to the independent propulsion systems or piping systems serving one propulsion systems and passing through the spaces where another independent propulsion system is arranged are to be ducted in watertight trunks having a fire retardant resistance at least equivalent to A60 Standard and located outside B/5. The trunks are to be accessible for inspection and maintenance.

2.2 Rudders and steering gears

2.2.1

a) A duplicated rudder and steering gear are to be arranged in separate compartments, unless the arrangement of the main propulsion system allows the same manoeuvrability requested by the Rules in case of single failure that may prevent the use of the normal steering system, such as ships with two independent controllable pitch propellers, ships with azimuth thrusters, ships with fore and aft side thrusters.

b) Where ships do not have traditional rudder and steering gear, their steering capability being supplied by azimuth thrusters or equivalent features, means are to be provided to allow at least the same redundancy as required in a) above.

2.3 Electrical installations

2.3.1 The electrical generators are to be arranged in such a way that in case of loss of one compartment, enough power still remains available to operate the ship under the conditions stated in [1.2.1] without any stand-by generating set. In general this requirement is to be achieved arranging two main switchboards and the electric generators in two separate compartments.

2.3.2 Electrical cables and other electric apparatus serving a machinery space and passing through the spaces where other independent propulsion systems are arranged are to be ducted in trunks having a fire- retardant resistance at least equivalent to A60 Standard and located outside B/5. The trunks are to be accessible for inspection and maintenance.

The use of fire- resisting cables as an alternative to the trunks having a fire-retardant resistance at least equivalent to A60 standard will be considered on a case-by-case basis.

2.4 Automation

2.4.1 The automation system is to be arranged in such a way as to prevent the possibility that a single failure of the control system may lead to the loss of more than one propulsion system.

In the case of electric propulsion, cold standby propulsion control systems may be accepted in way of full redundancy provided that they are permanently installed, ready for use and easily put into operation.

3 Tests on board

3.1 Running tests

3.1.1 The independent propulsion system is to be subjected to the running tests required by the Rules for similar systems.

3.2 Sea trials

3.2.1 In the course of sea trials the casualty mentioned in [1.2.1] is to be simulated and the values of the power and speed developed in this condition are to be recorded.

Availability of the redundancies as per [1.2.4] is to be verified.

In the case of electric propulsion, when cold standby propulsion control systems are provided, it is to be checked that they are permanently installed, ready for use and easily put into operation.

Table 1 : Document to be submitted

Item No.	**(1)**	Document
1	A	Description of the independent propulsion system including an analysis **(2)** demonstrating the availability of the operating conditions as per [1.2.2] and a description of the operations necessary to recover the propulsion and essential services

(1) A : to be submitted for approval, in four copies.

(2) This analysis may be in the form of a Failure Mode and Effect Analysis (FMEA). App 1 describes an acceptable procedure for carrying out the FMEA.

APPENDIX 1 PROCEDURES FOR FAILURE MODE AND EFFECT ANALYSIS

1 General

1.1 Introduction

1.1.1 FMEA requirement

As specified in Sec 1, Sec 2 and Sec 3 in order to grant the **AVM** notations, an FMEA is to be carried out, with the exception indicated in Note (2) of Sec 1, Tab 1 to ascertain that in case of single failure to the propulsion, steering and power generating system, the ship is still capable to achieve the performances indicated in the applicable Sections as a condition for granting the notation.

1.1.2 Scope of the Appendix

This Appendix describes a failure mode and effects analysis (FMEA) and gives guidance as to how it may be applied by:

a) explaining basic principles

b) providing the procedural steps necessary to perform an analysis

c) identifying appropriate terms, assumptions, measures and failure modes, and

d) providing examples of the necessary worksheets.

1.1.3 Definition of FMEA

A practical, realistic and documented assessment of the failure characteristics of the ship and its component systems should be undertaken with the aim of defining and studying the important failure conditions that may exist.

1.1.4 FMEA principles

The FMEA is based on a single failure concept under which each considered system at various levels of a system's functional hierarchy is assumed to fail by one probable cause at a time. The effects of the postulated failure are analysed and classified according to their severity. Such effects may include secondary failures (or multiple failures) at other level(s). Any failure mode which may cause a catastrophic effect should be guarded against by system or equipment redundancy unless the probability of such failure is extremely improbable. For failure modes causing hazardous effects corrective measures may be accepted in lieu. A test programme should be drawn up to confirm the conclusions of FMEA.

1.1.5 Alternatives

While FMEA is suggested as one of the most flexible analysis techniques, it is accepted that there are other methods which may be used and which in certain circumstances may offer an equally comprehensive insight into particular failure characteristics.

1.2 Objectives

1.2.1 Primary objective

The primary objective of FMEA is to provide a comprehensive, systematic and documented investigation which establishes the important failure conditions of the ship propulsion, steering and power generation systems, as well as any other system requested by the Owner, and assesses their significance with regard to the safety of the ship and its occupants.

1.2.2 Aim of the analysis

The main aims of undertaking the analysis are to:

a) provide ship and system designers with data to audit their proposed designs

b) provide the Owner with the results of a study into ship's selected systems failure characteristics so as to assist in an assessment of the arrangements and measures to be taken to limit the damages consequent of the failure within acceptable limits

c) provide the Master and crew of the ship with data to generate comprehensive training, operational and maintenance programmes and documentation.

1.3 Sister ships

1.3.1 For ships of the same design and having the same equipment, one FMEA on any one of such ships may be sufficient, but each of the other ships are to be subject to the same FMEA conclusion trials.

1.4 FMEA basics

1.4.1 Before proceeding with a detailed FMEA into the effects of the failure of the system elements on the system functional output it is necessary to perform a functional failure analysis of the considered systems. In this way only systems which fail the functional failure analysis need to be investigated by a more detailed FMEA.

1.4.2 Operational modes

When conducting a system FMEA the following typical operational modes within the normal design environmental conditions of the ships are to be considered:

a) normal seagoing conditions at full speed

b) maximum permitted operating speed in congested waters

c) manoeuvring alongside

d) seagoing conditions in emergency, as defined in Sec 1, Sec 2, Sec 3 and Sec 4.

1.4.3 Functional interdependance

This functional interdependence of these systems is also to be described in either block diagrams or fault tree diagrams or in a narrative format to enable the failure effects to be understood. As far as applicable, each of the systems to be analysed is assumed to fail in the following failure modes:

a) complete loss of function

b) rapid change to maximum or minimum output

c) uncontrolled or varying output

d) premature operation

e) failure to operate at a prescribed time

f) failure to cease operation at a prescribed time.

Depending on the system under consideration other failure modes may have to be taken into account.

1.4.4 Systems which can fail without catastrophic effects

If a system can fail without any hazardous or catastrophic effect, there is no need to conduct a detailed FMEA into the system architecture. For systems whose individual failure can cause hazardous or catastrophic effects and where a redundant system is not provided, a detailed FMEA as described in the following paragraphs should be followed.

Results of the system functional failure analysis should be documented and confirmed by a practical test programme drawn up from the analysis.

1.4.5 Redundant systems

Where a system, the failure of which may cause a hazardous or catastrophic effect, is provided with a redundant system, a detailed FMEA may not be required provided that:

a) the redundant system can be put into operation or can take over the failed system within the time-limit dictated by the most onerous operational mode without hazarding the ship

b) the redundant system is completely independent of the system and does not share any common system element the failure of which would cause failure of both the system and the redundant system. Common system element may be acceptable if the probability of failure complies with [4].

c) the redundant system may share the same power source as the system. In such case an alternative power source should be readily available with regard to the requirement of a) above.

The probability and effects of operator error to bring in the redundant system are also to be considered.

1.5 FMEA analysis

1.5.1 The systems to be subject to a more detailed FMEA investigation at this stage are to include all those that have failed the system FMEA and may include those that have a very important influence on the safety of the ship and its occupants and which require an investigation at a deeper level than that undertaken in the system functional failure analysis. These systems are often those which have been specifically designed or adapted for the ship, such as the craft's electrical and hydraulic systems.

2 FMEA performance

2.1 Procedures

2.1.1 The following steps are necessary to perform an FMEA:

a) to define the system to be analysed

b) to illustrate the interrelationships of functional elements of the system, by means of block diagrams

c) to identify all potential failure modes and their causes

d) to evaluate the effects on the system of each failure mode

e) to identify failure detection methods

f) to identify corrective measures for failure modes

g) to assess the probability of failures causing hazardous or catastrophic effects, where applicable

h) to document the analysis

i) to develop a test programme

j) to prepare FMEA report.

2.2 System definition

2.2.1 The first step in an FMEA study is a detailed study of the system to be analysed, through the use of drawings and equipment manuals. A narrative description of the system and its functional requirements is to be drawn up including the following information:

a) general description of system operation and structure

b) functional relationship among the system elements

c) acceptable functional performance limits of the system and its constituent elements in each of the typical operational modes

d) system constraints.

2.3 Development of system block diagram

2.3.1 Block diagram

The next step is to develop block diagram(s) showing the functional flow sequence of the system, both for technical understanding of the functions and operation of the system, and for the subsequent analysis. As a minimum the block diagram is to contain:

a) breakdown of the system into major sub-systems or equipment

b) all appropriate labelled inputs and outputs and identification numbers by which each sub-system is consistently referenced

c) all redundancies, alternative signal paths and other engineering features which provide "fail-safe" measures.

2.3.2 Block diagrams and operational modes

It may be necessary to have a different set of block diagrams prepared for each different operational modes.

2.4 Identification of failure modes, causes and effects

2.4.1 Failure mode

Failure mode is the manner by which a failure is observed. It generally describes the way the failure occurs and its impact on the equipment or system. As an example, a list of failure modes is given in Tab 1. The failure modes listed in Tab 1 can describe the failure of any system element in sufficiently specific terms. When used in conjunction with performance specifications governing the inputs and outputs on the system block diagram, all potential failure modes can be thus identified and described. Thus, for example, a power supply may have a failure mode described as "loss of output" (29), and a failure cause "open (electrical)" (31).

Table 1 : Example of failure mode list

1	Structural failure (rupture)
2	Physical binding or jamming
3	Vibration
4	Fails to remain in position
5	Fails to open
6	Fails to close
7	Fails open
8	Fails closed
9	Internal leakage
10	External leakage
11	Fails out of tolerance (high)
12	Fails out of tolerance (low)
13	Inadvertent operation
14	Intermittent operation
15	Erratic operation
16	Erroneous indication
17	Restricted flow
18	False actuation
19	Fails to stop
20	Fails to start
21	Fails to switch
22	Premature operation
23	Delayed operation
24	Erroneous input (increased)
25	Erroneous input (decreased)
26	Erroneous output (increased)
27	Erroneous output (decrease)
28	Loss of input
29	Loss of output
30	Shorted (electrical)
31	Open (electrical)
32	Leakage (electrical)
33	Other unique failure conditions as applicable to the system characteristics, requirements and operational constraints

2.4.2 System failure

A failure mode in a system element could also be the failure cause of a system failure. For example, the hydraulic line of a steering gear system might have a failure mode of "external leakage" (10). This failure mode of the hydraulic line could become a failure cause of the steering gear system's failure mode "loss of output" (29).

2.4.3 Top-down approach

Each system should be considered in a top-down approach, starting from the system's functional output, and failure is to be assumed by one possible cause at a time. Since a failure mode may have more than one cause, all potential independent causes for each failure mode are to be identified.

2.4.4 Delay effect when operating back-up systems

If major systems can fail without any adverse effect there is no need to consider them further unless the failure can go undetected by an operator. To decide that there is no adverse effect does not mean just the identification of system redundancy. The redundancy is to be shown to be immediately effective or brought on line with negligible time lag. In addition, if the sequence is: "failure - alarm - operator action - start of back up- back up in service", the effects of delay should be considered.

2.5 Failure effects

2.5.1 Concept

The consequence of a failure mode on the operation, function, or status of an equipment or a system is called a "failure effect". Failure effects on a specific sub-system or equipment under consideration are called "local failure effects". The evaluation of local failure effects will help to determine the effectiveness of any redundant equipment or corrective action at that system level. In certain instances, there may not be a local effect beyond the failure mode itself.

2.5.2 End effect

The impact of an equipment or sub-system failure on the system output (system function) is called an "end effect". End effects should be evaluated and their severity classified in accordance with the following categories:

a) catastrophic

b) hazardous

c) major

d) minor.

The definition of these four categories of failure effects is in [4].

2.5.3 Catastrophic and hazardous effects

If the end effect of a failure is classified as hazardous or catastrophic, back-up equipment is usually required to prevent or minimize such effect. For hazardous failure effects corrective operational procedures may be generally accepted.

2.6 Failure detection

2.6.1 Detectable failures

The FMEA study in general only analyses failure effects based on a single failure in the system and therefore a failure detection means, such as visual or audible warning devices, automatic sensing devices, sensing instrumentation or other unique indications, is to be identified.

2.6.2 Non detectable failures

Where the system element failure is non-detectable (i.e. a hidden fault or any failure which does not give any visual or audible indication to the operator) and the system can continue with its specific operation, the analysis is to be extended to determine the effects of a second failure, which in combination with the first undetectable failure may result in a more severe failure effect e.g. hazardous or catastrophic effect.

2.7 Corrective measures

2.7.1 Back-up equipment response

The response of any back-up equipment, or any corrective action initiated at a given system level to prevent or reduce the effect of the failure mode of system element or equipment, is also to be identified and evaluated.

2.7.2 Corrective design provisions

Provisions which are features of the design at any system level to nullify the effects of a malfunction or failure, such as controlling or deactivating system elements to halt generation or propagation of failure effects, activating back-up or standby items or systems, are to be described. Corrective design provisions include:

a) redundancies that allow continued and safe operation

b) safety devices, monitoring or alarm provisions, which permit restricted operation or limit damage

c) alternative modes of operation.

2.7.3 Manual corrective actions

Provisions which require operator action to circumvent or mitigate the effects of the postulated failure are to be described. The possibility and effect of operator error is to be considered, if the corrective action or the initiation of the redundancy requires operator input, when evaluating the means to eliminate the local failure effects.

2.7.4 Acceptability of corrective action

It is to be noted that corrective responses acceptable in one operational mode may not be acceptable at another, e.g. a redundant system element with considerable time lag to be brought into line, while meeting the operational mode "normal seagoing conditions at full speed" may result in a catastrophic effect in another operational mode, e.g. "maximum permitted operating speed in congested water".

2.8 Use of probability concept

2.8.1 Acceptance criteria

If corrective measures or redundancy as described in preceding paragraphs are not provided for any failure, as an alternative the probability of occurrence of such failure is to meet the following criteria of acceptance:

a) a failure mode which results in a catastrophic effect is to be assessed to be extremely improbable

b) a failure mode assessed as extremely remote is to not result in worse than hazardous effects

c) a failure mode assessed as either frequent or reasonably probable is not to result in worse than minor effects.

2.8.2 Data

Numerical values for various levels of probabilities are laid down in [4]. In areas where there is no data from ships to determine the level of probabilities of failure other sources can be used such as:

a) workshop test

b) history of reliability used in other areas under similar operating conditions

c) mathematical model if applicable.

2.9 Documentation

2.9.1 Worksheet

It is helpful to perform FMEA on worksheets. Tab 2 shows an example of worksheet.

2.9.2 Worksheet organization

The worksheets are be organized to first display the highest system level and then proceed down through decreasing system levels.

Table 2 : FMEA worksheet

Name of system : Mode of operation : Sheet No : Date : Name of analyst :							References: System block diagram: Drawings:				
Equipment name or number	Function	Ident. No.	Failure mode	Failure cause	Failure effect		Failure detec-tion	Correc-tive action	Severity of faiure effect	Probability of failure (if applicable)	Remarks
					Local effect	End effect					

3 Tests and reporting

3.1 Test program

3.1.1 FMEA validation test

An FMEA test programme is to be drawn up to prove the conclusions of FMEA. It is recommended that the test programme is to include all systems or system elements whose failure would lead to:

a) major or more severe effects

b) restricted operations

c) any other corrective action.

For equipment where failure cannot be easily simulated on the ship, the results of other tests can be used to determine the effects and influences on the systems and ship

3.1.2 Further investigations

The trials are also to include investigations into:

a) the layout of control stations with particular regard to the relative positioning of switches and other control devices to ensure a low potential for inadvertent and incorrect crew action, particularly during emergencies and the provision of interlocks to prevent inadvertent operation for important system operation

b) the existence and quality of the craft's operational documentation with particular regard to the pre-voyage checklists. It is essential that these checks account for any unrevealed failure modes identified in the failure analysis

c) the effects of the main failure modes as prescribed in the theoretical analysis.

3.2 Reporting

3.2.1 The FMEA report is to be a self-contained document with a full description of the craft, its systems and their functions and the proposed operation and environmental conditions for the failure modes, causes and effects to be understood without any need to refer to other plans and documents not in the report. The analysis assumptions and system block diagrams are to be included, where appropriate.

The report is to contain a summary of conclusions and recommendations for each of the systems analysed in the system failure analysis and the equipment failure analysis. It is also to list all probable failures and their probability of failure where applicable, the corrective actions or operational restrictions for each system in each of the operational modes under analysis. The report is to contain the test programme, reference any other test reports and the FMEA trials.

4 Probabilistic concept

4.1 General

4.1.1 Different undesirable events may have different orders of acceptable probability. In connection with this, it is convenient to agree on standardized expressions to be used to convey the relatively acceptable probabilities of various occurrences, i.e. to perform a qualitative ranking process.

4.2 Occurences

4.2.1 Occurence

Occurence is a condition involving a potential lowering of the level of safety.

4.2.2 Failure

Failure is an occurrence in which a part, or parts, of the ship fail. A failure includes:

a) a single failure

b) independent failures in combinations within a system, and

c) independent failures in combinations involving more than one system, taking into account:

1) any undetected failure that is already present

2) such further failures as would be reasonably expected to follow the failure under consideration, and

d) common cause failure (failure of more than one component or system due to the same cause).

Note 1: In assessing the further failures which follow, account should be taken of any resulting more severe operating conditions for items that have not up to that time failed.

4.2.3 Event

Event is an occurrence which has its origin outside the craft (e.g., waves).

4.2.4 Error

Error is an occurrence arising as a result of incorrect action by the operating crew or maintenance personnel.

4.3 Probability of occurences

4.3.1 Frequent

Frequent is one which is likely to occur often during the operational life of a particular ship.

4.3.2 Reasonably probable

Reasonably probable is one which is unlikely to occur often but which may occur several times during the total operational life of a particular ship.

4.3.3 Recurrent

Recurrent is a term embracing the total range of frequent and reasonably probable.

4.3.4 Remote

Remote is one which is unlikely to occur to every ship but may occur to a few ships of a type over the total operational life of a number of ship of the same type.

4.3.5 Extremely remote

Extremely remote is one which is unlikely to occur when considering the total operational life of a number of ships of the type, but nevertheless should be considered as being possible.

4.3.6 Extremely improbable

Extremely improbable is one which is so extremely remote that it should not be considered as possible to occur.

4.4 Effects

4.4.1 Effect

Effect is a situation arising as a result of an occurrence.

4.4.2 Minor effect

Minore effect is an effect which may arise from a failure, an event, or an error which can be readily compensated for by the operating crew; it may involve:

a) a small increase in the operational duties of the crew or in their difficulty in performing their duties, or

b) a moderate degradation in handling characteristics, or

c) slight modification of the permissible operating conditions.

4.4.3 Major effect

Major effect is an effect which produces:

a) a significant increase in the operational duties of the crew or in their difficulty in performing their duties which by itself should not be outside the capability of a competent crew provided that another major effect does not occur at the same time, or

b) significant degradation in handling characteristics, or

c) significant modification of the permissible operating conditions, but will not remove the capability to complete a safe journey without demanding more than normal skill on the part of the operating crew.

4.4.4 Hazardous effect

Hazardous effect is an effect which produces:

a) a dangerous increase in the operational duties of the crew or in their difficulty in performing their duties of such magnitude that they cannot reasonably be expected to cope with them and will probably require outside assistance, or

b) dangerous degradation of handling characteristics, or

c) dangerous degradation of the strength of the ship, or

d) marginal conditions for, or injury to, occupants, or

e) an essential need for outside rescue operations.

4.4.5 Catastrophic effect

Catastrophic effect is an effect which results in the loss of the craft and/or in fatalities.

4.5 Safety level

4.5.1 Safety level is a numerical value characterizing the relationship between ship performance represented as horizontal single amplitude acceleration (g) and rate of acceleration (g/s) and the severity of acceleration-load effects on standing and sitting humans. The safety levels and the corresponding severity of effects on passengers and safety criteria for ship performance are defined in Tab 3.

Table 3

Effect	Criteria not to be exceeded Type of load	Value **(2)**	Comment
LEVEL 1 MINOR EFFECT Moderate degradation of safety	Maximum acceleration measured horizontally **(1)**	0,20 g	0,08 g and 0,20 g/s **(3)** Elderly person will keep balance when holding 0,15 g and 0, 20 g/s Mean person will keep balance when holding 0,15 g and 0,80 g/s Sitting person will start holding
LEVEL 2 MAJOR EFFECT Significant degradation of safety	Maximum acceleration measured horizontally **(1)**	0,35 g	0,25 g and 2 g/s Maximum load for mean person keeping balance when holding 0,45 g and 10 g/s Mean person falls out of seat when nor wearing seat belts
LEVEL 3 HAZARDOUS EFFECT Major degradation of safety	Collision design condition calculated Maximum structural design load, based on vertical acceleration at centre of gravity	1 g	Risk of injury to persons, safe emergency operation after collision 1 g Degradation of person safety
LEVEL 4 CATASTROPHIC EFFECT		1 g	Loss of ship and/or fatalities

(1) The recording instruments used are to be such that the accelerationaccuracy is better than 5% of the real value and frequency response is to be minimum 20 Hz. Antialiasing filters with maximum passband attenuation 100 + 5% are to be used

(2) g = gravity acceleration (9,81 m/s^2)

(3) g-rate of jerk may be evaluated from acceleration/time curves

4.6 Numerical values

4.6.1 Where numerical probabilities are used in assessing compliance with requirements using the terms similar to those given above, the approximate values given in Tab 4 may be used as guidelines to assist in providing a common point of reference. The probabilities quoted should be on an hourly or per journey basis, depending on which is more appropriate to the assessment in question.

Note 1: Different occurrences may have different acceptable probabilities, according to the severity of their consequences (see Tab 5).

Table 4

Frequent	More than 10^{-3}
Reasonably probable	10^{-3} to 10^{-5}
Remote	10^{-5} to 10^{-7}
Extremely remote	10^{-7} to 10^{-9}
Extremely improbable	Whilst no approximate numerical probability is given for this, the figures used should be substantially less than 10^{-9}

Table 5

SAFETY LEVEL	**1**	**1**	**1**	**2**	**3**	**4**
EFFECT ON SHIP AND OCCUPANTS	Normal	Nuisance	Operating limitations	Emergency procedures; significant reduction in safety margins; difficult for crew to cope with adverse conditions; person injuries	Large reduction in safety margin; crew over-burden because of work-load or environmental conditions; serious injuries to small number of persons	Casualties and deaths, usually with loss of ship
F.A.R. PROBABILITY **(1)**	Probable			Improbable		Extremely improbable
JAR-25 PROBABILITY **(2)**	Probable			Improbable		Extremely improbable
	Frequent		Reasonably probable	Remote	Extremely remote	
	10^{-0}	10^{-2}	10^{-3}	10^{-5}	10^{-7}	10^{-9}
CATEGORY OF EFFECT	Minor			Major	Hazardous	Catastrophic

(1) The United States Federal Aviation Regulation

(2) European Joint Airworthiness Regulations

Part F
Additional Class Notations

Chapter 2
AUTOMATION SYSTEMS (AUT)

SECTION 1 UNATTENDED MACHINERY SPACES (AUT-UMS)

1 General

1.1 Application

1.1.1 The additional class notation **AUT-UMS** is assigned in accordance with Pt A, Ch 1, Sec 2, [6.3.2] to ships fitted with automated installations enabling periodically unattended operation of machinery spaces, and complying with the requirements of this Section.

Note 1: Machinery spaces are defined in Pt C, Ch 1, Sec 1, [1.4.2].

1.1.2 The arrangements provided shall be such as to ensure that the safety of the ship in all sailing conditions, including manoeuvring, is equivalent to that of a ship having the machinery spaces manned.

1.2 Exemptions

1.2.1 For ships whose gross tonnage is less than 500 and propulsive power less than 1 MW, the requirements laid down in [1.3] and [5.4.3] do not apply.

1.2.2 For ships whose gross tonnage is less than 500 and propulsive power less than 1 MW, the requirements laid down in [4] do not apply. An alarm signal is to be activated in the following circumstances:

a) for diesel engine propulsion plant

- lubricating oil system low pressure
- cylinder coolant high temperature
- cylinder coolant low pressure or low flow rate
- cylinder coolant make up tank low level
- sea water cooling low pressure or low flow rate

b) for auxiliary internal combustion engines intended for electricity production of a power higher than 37 kW, supplying essential services:

- cylinder coolant high temperature
- lubricating oil system low pressure.

1.2.3 For ships whose gross tonnage is less than 500 and propulsive power less than 1 MW, automatic stop is to be provided for lubricating oil failure of engines, reduction gears, clutches and reversing gears. A possible override of this automatic stop is to be available at the control stations, and an indication is to be provided at each control station, when override is activated.

1.2.4 The requirements laid down in [3.3.1] do not apply to cargo ships of less than 1 600 tons gross tonnage, insofar as the arrangements of the machinery space access make it unnecessary.

1.3 Communication system

1.3.1 A reliable means of vocal communication shall be provided between the main machinery control room or the propulsion machinery control position as appropriate, the navigation bridge and the engineer officers' accommodation.

This means of communication is to be foreseen in collective or individual accommodation of engineer officers.

1.3.2 Means of communication are to be capable of being operated even in the event of failure of supply from the main source of electrical power.

2 Documentation

2.1 Documents to be submitted

2.1.1 In addition to those mentioned in Pt C, Ch 3, Sec 1, Tab 1, the documents in Tab 1 are required.

Table 1 : Documents to be submitted

No.	(1)	Document
1	A	Means of communication diagram
2	A	Technical description of automatic engineer's alarm and connection of alarms to accommodation and bridge, when applicable
3	A	System of protection against flooding
4	A	Fire detection system: diagram, location and cabling
(1) A : to be submitted for approval		

3 Fire and flooding precautions

3.1 Fire prevention

3.1.1 The requirements regarding piping and arrangements of fuel oil and lubricating oil systems given in Pt C, Ch 1, Sec 8 are applicable.

3.1.2 Fuel oil and lubricating oil purifiers and the auxiliary equipment and its fittings containing hot fuel oil are to be grouped in a special room or in locations ventilated by extraction; nevertheless, transfer pumps may be located outside this room.

3.1.3 Where heating is necessary, it is to be arranged with automatic control. A high temperature alarm is to be fitted and the possibility of adjusting its threshold according to the fuel quality is to be provided. Such alarm may be omitted if it is demonstrated that the temperature in the tank cannot exceed the flashpoint under the following conditions: volume of liquid corresponding to the low level alarm and maximum continuous heating power during 24 hours.

3.2 Fire detection

3.2.1 For fire detection, the requirements given in Part C, Chapter 4 are applicable.

3.2.2 Means are to be provided to detect and give alarms at an early stage in case of fires:

- in boiler air supply casing and exhausts (uptakes); and
- in scavenging air belts of propulsion machinery

unless the Society considers this to be unnecessary in a particular case.

3.2.3 An automatic fire detection system is to be fitted in machinery spaces of Category A as defined in Pt C, Ch 1, Sec 1, [1.4.1] intended to be unattended.

3.2.4 The fire detection system is to be designed with self-monitoring properties. Power or system failures are to initiate an audible alarm distinguishable from the fire alarm.

3.2.5 The fire detection indicating panel is to be located on the navigating bridge, fire control station, or other accessible place where a fire in the machinery space will not render it inoperative.

3.2.6 The fire detection indicating panel is to indicate the place of the detected fire in accordance with the arranged fire zones by means of a visual signal. Audible signals clearly distinguishable in characteristic from any other signals are to be audible throughout the navigating bridge and the accommodation area of the personnel responsible for the operation of the machinery space.

3.2.7 Fire detectors are to be of such type and so located that they will rapidly detect the onset of fire in conditions normally present in the machinery space. Consideration is to be given to avoiding false alarms. The type and location of detectors are to be approved by the Society and a combination of detector types is recommended in order to enable the system to react to more than one type of fire symptom.

3.2.8 Except in spaces of restricted height and where their use is specially appropriate, detection systems using thermal detectors only are not permitted. Flame detectors may be installed, although they are to be considered as complementary and are not to replace the main installation.

3.2.9 Fire detector zones are to be arranged in a manner that will enable the operating staff to locate the seat of the fire. The arrangement and the number of loops and the location of detector heads are to be approved in each case. Air currents created by the machinery are not to render the detection system ineffective.

3.2.10 When fire detectors are provided with the means to adjust their sensitivity, necessary arrangements are to be allowed to fix and identify the set point.

3.2.11 When it is intended that a particular loop or detector is to be temporarily switched off, this state is to be clearly indicated. Reactivation of the loop or detector is to be performed automatically after a preset time.

3.2.12 The fire detection indicating panel is to be provided with facilities for functional testing.

3.2.13 The fire detecting system is to be fed automatically from the emergency source of power by a separate feeder if the main source of power fails.

3.2.14 Facilities are to be provided in the fire detecting system to manually release the fire alarm from the following places:

- passageways having entrances to engine and boiler rooms
- the navigating bridge
- the control station in the engine room.

3.3 Fire fighting

3.3.1 Unless otherwise stated, pressurisation of the fire main at a suitable pressure by starting a main fire pump and carrying out the other necessary operations is to be possible from the navigation bridge. Alternatively, the fire main system may be permanently under pressure.

3.3.2 The arrangements for the ready availability of water supply are to be in cargo ships, to the satisfaction of the Society:

3.4 Protection against flooding

3.4.1 Bilge wells or machinery spaces bilge levels are to be monitored in such a way that the accumulation of liquid is detected in normal angles of trim and heel.

3.4.2 Where the bilge pumps are capable of being started automatically, means shall be provided to indicate when the influx of liquid is greater than the pump capacity or when the pump is operating more frequently than would normally be expected.

3.4.3 Where the bilge pumps are automatically controlled, they are not be started when the oil pollution level is higher than accepted in Pt C, Ch 1, Sec 8.

3.4.4 The location of controls of any valve serving a sea inlet, a discharge below the waterline or a bilge injection system shall be so sited as to allow adequate time for operation in case of influx of water to the space, having regard to the time likely to be required in order to reach and operate such controls. If the level to which the space could become flooded with the ship in the fully loaded condition so

requires, arrangements shall be made to operate the controls from a position above such level.

3.4.5 Bilge level alarms are to be given at the main control station, the engineers' accommodation area and the navigating bridge.

4 Control of machinery

4.1 General

4.1.1 Under all sailing conditions, including manoeuvring, the speed, direction of thrust and, if applicable, the pitch of the propeller shall be fully controllable from the navigation bridge.

4.1.2 All manual operations or services expected to be carried out with a periodicity of less than 24 h are to be eliminated or automated, particularly for: lubrication, topping up of make up tanks and filling tanks, filter cleaning, cleaning of centrifugal purifiers, drainage, load sharing on main engines and various adjustments. Nevertheless, the transfer of operation mode may be effected manually.

4.1.3 A centralised control position shall be arranged with the necessary alarm panels and instrumentation indicating any alarm.

4.1.4 Parameters for essential services which need to be adjusted to a preset value are to be automatically controlled.

4.1.5 The control system shall be such that the services needed for the operation of the main propulsion machinery and its auxiliaries are ensured through the necessary automatic arrangements.

4.1.6 It shall be possible for all machinery essential for the safe operation of the ship to be controlled from a local position, even in the case of failure in any part of the automatic or remote control systems.

4.1.7 The design of the remote automatic control system shall be such that in the case of its failure an alarm will be given. Unless impracticable, the preset speed and direction of thrust of the propeller shall be maintained until local control is in operation.

4.1.8 Critical speed ranges, if any, are to be rapidly passed over by means of an appropriate automatic device.

4.1.9 Propulsion machinery is to stop automatically only in exceptional circumstances which could cause quick critical damage, due to internal faults in the machinery. The design of automation systems whose failure could result in an unexpected propulsion stop is to be specially examined. An overriding device for cancelling the automatic shutdown is to be considered.

4.1.10 Where the propulsive plant includes several main engines, a device is to be provided to prevent any abnormal overload on each of them.

4.1.11 Where standby machines are required for other auxiliary machinery essential to propulsion, automatic changeover devices shall be provided.

4.2 Diesel propulsion plants

4.2.1 When a diesel engine is used for the propulsion plant, monitoring and control of equipment is to be performed according to Tab 2 for slow speed engines or Tab 3 for medium or high speed engines.

4.3 Electrical propulsion plant

4.3.1 Documents to be submitted

The following additional documents are to be submitted to the Society:

- A list of the alarms and shutdowns of the electrical propulsion system
- When the control and monitoring system of the propulsion plant is computer based, a functional diagram of the interface between the programmable logic controller and computer network.

4.3.2 Alarm system

The following requirements are applicable to the alarm system of electrical propulsion:

- Alarms circuits of electrical propulsion are to be connected to the main alarm system on board. As an alternative, the relevant circuit may be connected to a local alarm unit. In any case, a connection between the local alarm unit and the main alarm system is to be provided.
- The alarms can be arranged in groups, and shown in the control station. This is acceptable when a discrimination is possible locally.
- When the control system uses a computer based system, the requirements of Pt C, Ch 3, Sec 4 are applicable, in particular, for the data transmission link between the alarm system and the control system.
- Individual alarms are considered as critical and are to be individually activated at the control stations, and acknowledged individually.
- Shutdown activation is to be considered as an individual alarm.

4.3.3 Safety functions

The following requirements are applicable to the safety system of electrical propulsion:

- As a general rule, safety stop using external sensors such as temperature, pressure, overspeed, main cooling failure, stop of converter running by blocking impulse is to be confirmed by the automatic opening of the main circuit using a separate circuit.
- In order to avoid accidental stop of the propulsion line and limit the risk of blackout due to wire break, the tripping of the main circuit-breaker is to be activated by an emission coil with a monitoring of the line wire break.
- In the case of a single line propulsion system, the power limitation order is to be duplicated.
- As a general rule, when the safety stop is activated, it is to be maintained until local acknowledgement.

Table 2 : Monitored parameters for main propulsion low speed diesel engine

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote					
Identification of system parameter	Alarm activation	Remote indication	Slow-down with alarm	Shut-down with alarm	Automatic start of stand by pump with alarm
Fuel oil system					
• Fuel oil pressure after filter (engine inlet)	L	R			
					X
• Fuel oil viscosity before injection pumps or fuel oil temperature before injection pumps (for engine running on heavy fuel)	H + L				
• Leakage from high pressure pipes where required	H				
• Common rail fuel oil pressure	L				
Lubricating oil system					
• Lubricating oil to main bearing and thrust bearing pressure	L	R	X		
				X	
					X
• Lubricating oil to crosshead bearing pressure when separate	L	R	X		
				X	
					X
• Lubricating oil to camshaft pressure when separate	L				
	LL			X	
					X
• Lubricating oil to camshaft temperature when separate	H				
• Lubricating oil inlet temperature	H				
• Thrust bearing pads or bearing outlet temperature	H		X		
	HH			X	
• Main, crank, crosshead bearing, oil outlet temperature or oil mist concentration in crankcase **(5)**	H		X		
• Flow rate cylinder lubricator (each apparatus)	L		X		
• Level in lubricating oil tanks or oil sump, as appropriate **(4)**	L				
• Common rail servo oil pressure	L				
• Lubricating oil to turbocharger inlet pressure **(6)**	L				

(1) Not required, if the coolant is oil taken from the main cooling system of the engine.

(2) Where outlet flow cannot be monitored due to engine design, alternative arrangement may be accepted.

(3) Where one common cooling space without individual stop valves is employed for all cilynder jackets.

(4) Where separate lubrificating oil systems are installed (e.g. camshaft, rocker arms, etc.), individual level alarms are required for the tanks.

(5) When required by Pt C, Ch 1, Sec 2, [2.3.5] or by SOLAS Reg.II-1/47.2.

(6) Unless provided with a self-contained lubrificating oil system integrated with the turbocharger.

(7) Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design alternative arrangements may be accepted. Continuous monitoring of inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote					
Identification of system parameter	Alarm activation	Remote indication	Slow-down with alarm	Shut-down with alarm	Automatic start of stand by pump with alarm
• Turbocharger lubricating oil outlet temperature on each bearing **(7)**	H				
• Speed of turbocharger		R			
Piston cooling system					
• Piston coolant inlet pressure	L		X **(1)**		
					X
• Piston coolant outlet temperature on each cylinder	H		X		
• Piston coolant outlet flow on each cylinder **(2)**	L		X		
• Level of piston coolant in expansion tank	L				
Sea water cooling system					
• Sea water cooling pressure	L				
					X
Cylinder fresh cooling water system					
• Cylinder fresh cooling water system inlet pressure	L		X		
					X
• Cylinder fresh cooling water outlet temperature (from each cylinder) or cylinder water outlet temperature (general) **(3)**	H		X		
• Oily contamination of engine cooling water system (when main engine cooling water is used in fuel and lubricating oil heat exchangers)	H				
• Level of cylinder cooling water in expansion tank	L				
Fuel valve coolant system					
• Pressure of fuel valve coolant	L				
					X
• Temperature of fuel valve coolant	H				
• Level of fuel valve coolant in expansion tank	L				
Starting and control air system					
• Starting air pressure before main shut off valve	L	R			
• Control air pressure	L				
• Safety air pressure	L				
Scavenge air system					

(1) Not required, if the coolant is oil taken from the main cooling system of the engine.

(2) Where outlet flow cannot be monitored due to engine design, alternative arrangement may be accepted.

(3) Where one common cooling space without individual stop valves is employed for all cilynder jackets.

(4) Where separate lubrificating oil systems are installed (e.g. camshaft, rocker arms, etc.), individual level alarms are required for the tanks.

(5) When required by Pt C, Ch 1, Sec 2, [2.3.5] or by SOLAS Reg.II-1/47.2.

(6) Unless provided with a self-contained lubrificating oil system integrated with the turbocharger.

(7) Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design alternative arrangements may be accepted. Continuous monitoring of inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote					
Identification of system parameter	Alarm activation	Remote indication	Slow-down with alarm	Shut-down with alarm	Automatic start of stand by pump with alarm
• Scavenging air receiver pressure		R			
• Scavenging air box temperature (detection of fire in receiver, see [3.2.2])	H		X		
• Scavenging air receiver water level	H				
Exhaust gas system					
• Exhaust gas temperature after each cylinder	H	R	X		
• Exhaust gas temperature after each cylinder, deviation from average	H				
• Exhaust gas temperature before each turbocharger	H	R			
• Exhaust gas temperature after each turbocharger	H	R			
Miscellaneous					
• Engine speed (and direction of speed when reversible)		R			
• Engine overspeed	H			X	
• Wrong way	X				
• Control, safety, alarm system power supply failure	X				

(1) Not required, if the coolant is oil taken from the main cooling system of the engine.

(2) Where outlet flow cannot be monitored due to engine design, alternative arrangement may be accepted.

(3) Where one common cooling space without individual stop valves is employed for all cilynder jackets.

(4) Where separate lubrificating oil systems are installed (e.g. camshaft, rocker arms, etc.), individual level alarms are required for the tanks.

(5) When required by Pt C, Ch 1, Sec 2, [2.3.5] or by SOLAS Reg.II-1/47.2.

(6) Unless provided with a self-contained lubrificating oil system integrated with the turbocharger.

(7) Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design alternative arrangements may be accepted. Continuous monitoring of inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.

Table 3 : Monitored parameter for main propulsion medium or high speed diesel engine

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote					
Identification of system parameter	Alarm activation	Remote indication	Slow-down with alarm	Shut-down with alarm	Automatic start of stand by pump with alarm
Fuel oil system					
• Fuel oil pressure after filter (engine inlet)	L	R			
					X
• Fuel oil viscosity before injection pumps or fuel oil temperature before injection pumps (for engine running on heavy fuel)	H + L				
• Leakage from high pressure pipes where required	H				
• Common rail fuel oil pressure	L				
Lubricating oil system					
• Lubricating oil to main bearing and thrust bearing pressure	L	R			
				X	
					X
• Lubricating oil filter differential pressure	H	R			
• Lubricating oil inlet temperature	H	R			
• Oil mist concentration in crankcase **(1)**	H			X	
• Flow rate cylinder lubricator (each apparatus)	L		X		
• Common rail servo oil pressure	L				
• Lubricating oil to turbocharger inlet pressure **(2)**	L	R			
• Turbochanger lub oil temp. each bearing **(4)**	H	R			
Sea water cooling system					
• Sea water cooling pressure	L	R			
					X
Cylinder fresh cooling water system					
• Cylinder water inlet pressure or flow	L	R	X		
					X
• Cylinder water outlet temperature (general)	H	R			
			X		
• Level of cylinder cooling water in expansion tank	L				
Starting and control air system					
Starting air pressure before main shut-off valve	L	R			
Control air pressure	L	R			
Scavenge air system					

(1) When required by Pt C, Ch 1, Sec 2, [2.3.5] or by SOLAS Reg.II-1/47.2.
One oil mist detector for each engine having two independent outputs for initiating the alarm and shut-down would satisfy the requirement for independence between alarm and shut-down system.

(2) Unless provided with a self-contained lubrificating oil system integrated with the turbocharger.

(3) For engine power > 500 kW/cyl.

(4) Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design alternative arrangements may be accepted. Continuous monitoring of inlet pressure and inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote					
Identification of system parameter	Alarm activation	Remote indication	Slow-down with alarm	Shut-down with alarm	Automatic start of stand by pump with alarm
• Scavenging air receiver temperature	H				
Exhaust gas system					
• Exhaust gas temperature after each cylinder **(3)**	H	R	X		
• Exhaust gas temperature after each cylinder **(3)**, deviation from average	H				
Miscellaneous					
• Engine speed		R			
• Engine overspeed	H			X	
• Control, safety, alarm system power supply failure	X				

(1) When required by Pt C, Ch 1, Sec 2, [2.3.5] or by SOLAS Reg.II-1/47.2.
One oil mist detector for each engine having two independent outputs for initiating the alarm and shut-down would satisfy the requirement for independence between alarm and shut-down system.

(2) Unless provided with a self-contained lubrificating oil system integrated with the turbocharger.

(3) For engine power > 500 kW/cyl.

(4) Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design alternative arrangements may be accepted. Continuous monitoring of inlet pressure and inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.

4.3.4 Transformers

For transformers, parameters according to Tab 4 are to be controlled or monitored.

4.3.5 Converters

For converters, parameters according to Tab 5, Tab 6 and Tab 7 are to be monitored or controlled.

4.3.6 Smoothing coil

For the converter reactor, parameters according to Tab 8 are to be monitored or controlled.

4.3.7 Propulsion electric motor

For propulsion electric motors, parameters according to Tab 9 are to be monitored or controlled.

4.3.8 All parameters listed in the tables of this item are considered as a minimum requirement for unattended machinery spaces.

Some group alarms may be locally detailed on the corresponding unit (for instance loss of electronic supply, failure of electronic control unit, etc.)

4.4 Shafting, clutches, CPP, gears

4.4.1 For shafting and clutches, parameters according to Tab 10 are to be monitored or controlled.

4.4.2 For controllable pitch propellers, parameters according to Tab 11 are to be monitored or controlled.

4.4.3 For reduction gears and reversing gears, parameters according to Tab 12 are to be monitored or controlled.

Table 4 : Transformers

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Motor			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Earth failure on main propulsion circuits	I						
Circuit-breaker, short-circuit	I **(2)**			X			
Circuit-breaker, overload	I **(2)**			X			
Circuit-breaker, undervoltage	I **(2)**			X			
Temperature of winding on phase 1, 2, 3 **(1)**	G						
	I, H		X **(3)**				
	I, HH			X			
Temperature sensor failure (short-circuit, open circuit, supply failure)	G						
Cooling pump pressure or flow	G, L						
			X				
						X	
Cooling medium temperature	G, H			X			
Leak of cooling medium	G						
			X				

(1) A minimum of 6 temperature sensors are to be provided :
- 3 temperature sensors to be connected to the alarm system (can also be used for the redundant tripping of the main circuit-breaker)
- 3 temperature sensors connected to the control unit.

(2) To be kept in the memory until local acknowledgement.

(3) Possible override of slowdown by the operator.

Table 5 : Network converter

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Motor			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Short-circuit current I max	I			X			
Overvoltage	G			X			
Undervoltage	G						
Phase unbalanced	I			(X) **(1)**			
Power limitation failure	I						
Protection of filter circuit trip	I						
Circuit-breaker opening operation failure	I						
Communication circuit, control circuits, power supplies, watchdog of control system according to supplier's design	G			X			

(1) This parameter, when indicated in brackets, is only advisable according to the supplier's requirements.

Table 6 : Motor converter

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Motor			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Short-circuit current I max	I			X			
Overvoltage	G			X			
Undervoltage	G			X			
Phase unbalanced	I						
Protection of filter circuit trip	I						
Communication circuit, control circuits, power supplies, watchdog of control system according to supplier's design	G			X			
Speed sensor system failure	G					X **(1)**	
Overspeed	I			X			
(1) Automatic switch-over to the redundant speed sensor system.							

Table 7 : Converter cooling circuit

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Motor			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Air cooling temperature high	I	R					
Ventilation, fan failure	G						
			X				
Cooling pump pressure or flow low	G	R					
						X	
Cooling fluid temperature high	G						
Leak of cooling medium	G						
			X				
Temperature sensor failure (short-circuit, open circuit, supply failure)	G						

Table 8 : Smoothing coil

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Motor			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Temperature of coil	I, H	R					
	I, HH						
Cooling air temperature	I, H						
Ventilation fan failure	G						
			X				
Cooling pump pressure or flow low	G	R					
						X	
Cooling fluid temperature high	G						
Leak of cooling medium	G						
			X				
Temperature sensor failure (short-circuit, open circuit, supply failure)	G						

Table 9 : Propulsion electric motor

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Motor			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Automatic tripping of overload and short-circuit protection on excitation circuit	G, H			H			
Loss of excitation	G			X			
Winding current unbalanced	G						
Harmonic filter supply failure	I						
Interface failure with power management system	I		X				
Earthing failure on stator winding and stator supply	I	R					
Temperature of winding on phase 1, 2, 3	G	R					
	I, H		X				
	I, HH			X			
Motor cooling air temperature	I, H	R					
Cooling pump pressure or flow	G ,L	R					
			X				
						X	
Cooling fluid temperature	G, H						
Leak of cooling medium	G						
			X				
Temperature sensor failure (short-circuit, open circuit, supply failure)	G						
Motor bearing temperature	G, H	R					
Bearing lubrication oil pressure (for self-lubricated motor, when the speed is under the minimum RPM specified by the manufacturer, shutdown is to be activated)	I, L	R					
			X				
						X	
Bearing lubrication oil pressure	G, L						
Turning gear engaged	I						
Brake and key engaged	I						
Shaft reduction gear bearing temperature	I, H						
Shaft reduction gear lubricating oil temperature	I, H						
Shaft reduction gear bearing pressure	I, L						
				X			

Table 10 : Shafting and clutches of propulsion machinery

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Main Engine			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Temperature of each shaft thrust bearing (not applicable for ball or roller bearings)	H		X				
Sterntube bush oil gravity tank level	L						
Clutch lubricating oil temperature	H						
Clutch oil tank level	L						
Clutch control oil pressure	L						
	LL					X	

Table 11 : Controllable pitch propeller

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Main Engine			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Control oil temperature	H						
Oil tank level	L						
Control oil pressure	L						
	LL					X	

Table 12 : Reduction gears/reversing gears of propulsion machinery

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Main Engine			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Lubricating oil temperature	H	R **(1)**					
Lubricating oil pressure	L **(1)**	R				X	
	LL			X			
Oil tank level	L						
Plain bearing temperature	H						
	HH			X			
(1) May be omitted in the case of restricted navigation notation.							

4.5 Auxiliary systems

4.5.1 Where standby machines are required for other auxiliary machinery essential to propulsion, automatic change-over devices shall be provided.

Change-over restart is to be provided for the following systems:

- cylinder, piston and fuel valve cooling
- cylinder cooling of diesel generating sets (where the circuit is common to several sets)
- main engine fuel supply
- diesel generating sets fuel supply (where the circuit is common to several sets)
- sea water cooling for propulsion plant
- sea water to main condenser (main turbines)
- hydraulic control of clutch, CPP or main thrust unit
- thermal fluid systems (thermal fluid heaters).

4.5.2 When a standby machine is automatically started, an alarm is to be activated.

4.5.3 When the propulsion plant is divided into two or more separate units, the automatic standby auxiliary may be omitted, when the sub-units concerned are fully separated with regard to power supply, cooling system, lubricating system etc.

Some of the propulsive plants may be partially used for reasons of economy (use of one shaft line or one propulsion engine for instance). If so, automatic change-over, necessary for this exploitation mode, is to be provided.

4.5.4 Means shall be provided to keep the starting air pressure at the required level where internal combustion engines are used for main propulsion.

4.5.5 Where daily service fuel oil tanks are filled automatically, or by remote control, means shall be provided to prevent overflow spillages.

4.5.6 Arrangements are to be provided to prevent overflow spillages coming from equipment treating flammable liquids.

4.5.7 Where daily service fuel oil tanks or settling tanks are fitted with heating arrangements, a high temperature alarm shall be provided if the flashpoint of the fuel oil can be exceeded.

4.5.8 For auxiliary systems, the following parameters, according to Tab 12 to Tab 23 are to be monitored or controlled.

Table 13 : Control and monitoring of auxiliary electrical systems

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Main Engine			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Electric circuit, blackout	X						
Power supply failure of control, alarm and safety system	X						

Table 14 : Incinerators

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Incinerator			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Stand-by Start	Stop
Combustion air pressure	L			X			
Flame failure	X			X			
Furnace temperature	H			X			
Exhaust gas temperature	H						
Fuel oil pressure	L						
Fuel oil temperature or viscosity , where heavy fuel is used	H + L						

Table 15 : Auxiliary boilers

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Boiler			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Water level	L + H			X	X		
Fuel oil temperature	L + H			X	X		
Flame failure	X			X			
Combustion air supply fan low pressure				X			
Temperature in boiler casing (fire)	H						
Steam pressure	H **(1)**			X	X		
Steam temperature				X **(2)**			

(1) When the automatic control does not cover the entire load range from zero load.
(2) For superheated steam over 330°C.

Table 16 : Fuel oil system

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			System			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Fuel oil tank level, overflow	H **(1)**						
Air pipe water trap level on fuel oil tanks	H **(2)**						
Outlet fuel oil temperature	H **(4)**			X **(5)**	X		
Sludge tank level	H						
Fuel oil settling tank level	H **(1)**						
Fuel oil settling tank temperature	H **(3)**						
Fuel oil centrifugal purifier overflow	H			X			
Fuel oil in daily service tank level	L						
Fuel oil daily service tank temperature	H **(3)**				X		
Fuel oil in daily service tank level (to be provided if no suitable overflow arrangement)	H **(1)**						

(1) Or sight-glasses on the overflow pipe.
(2) Or alternative arrangement as per Pt C, Ch 1, Sec 8, [9.1.7].
(3) Applicable where heating arrangements are provided.
(4) Or low flow alarm in addition to temperature control when heated by steam or other media.
(5) Cut off of electrical power supply when electrically heated.

Table 17 : Lubricating oil system

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			System			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Air pipe water trap level of lubricating oil tank See Pt C, Ch 1, Sec 8, [9.1.7]	H						
Sludge tank level	H						
Lubricating oil centrifugal purifier overflow	H						
(stop of oil supply)							X

Table 18 : Thermal oil system

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			System			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Forced draft fan stopped				X			
Thermal fluid temperature	H						
				X			
Thermal fluid pressure							X
Flow through each element	L			X			
Heavy fuel oil temperature or viscosity	H + L				X		
Burner flame failure	X			X			
Flue gas temperature (when exhaust gas heater)	H			X			
Expansion tank level	L						X **(1)**
(1) Stop of burner and fluid flow.							

Table 19 : Hydraulic oil system

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			System			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Pump pressure	L + H						
Service tank level	L **(1)**						
(1) The low level alarm is to be activated before the quantity of lost oil reaches 100 litres or 50% of the circuit volume , whichever is the lesser.							

Table 20 : Boiler feed and condensate system

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			System			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Sea water flow or equivalent	L					X	
Vacuum	L						
	LL			X			
Water level in main condenser (unless justified)	H + L						
					X		
	HH			X			
Salinity of condensate	H						
Feed water pump delivery pressure	L					X	
Feed water tank level	L						
Deaerator inside temperature or pressure	L + H **(1)**						
Water level in deaerator	L + H						
Extraction pump pressure	L						
Drain tank level	L + H						
(1) In the case of forced circulation boiler.							

Table 21 : Compressed air system

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			System			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Stand-by Start	Stop
Air temperature at compressor outlet	H						
Compressor lubricating oil pressure (except where splash lubrication)	LL			X			

Table 22 : Cooling system

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			System			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Sea water pump pressure or flow	X					X	
	L						
Fresh water pump pressure or flow	X					X	
	L						
Level in cooling water expansion tank	L						

Table 23 : Thrusters

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Thruster			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Control oil pressure (preferably before cooler)	L					L	
Oil tank level	L						

4.6 Control of electrical installation

4.6.1 Where the electrical power can normally be supplied by one generator, suitable load shedding arrangement shall be provided to ensure the integrity of supplies to services required for propulsion and steering as well as the safety of the ship.

4.6.2 In the case of loss of the generator in operation, adequate provision shall be made for automatic starting and connecting to the main switchboard of a standby generator of sufficient capacity to permit propulsion and steering and to ensure the safety of the ship with automatic restarting of the essential auxiliaries including, where necessary, sequential operations.

4.6.3 The standby electric power is to be available in not more than 45 seconds.

4.6.4 If the electrical power is normally supplied by more than one generator simultaneously in parallel operation, provision shall be made, for instance by load shedding, to ensure that, in the case of loss of one of these generating sets, the remaining ones are kept in operation without overload to permit propulsion and steering, and to ensure the safety of the ship.

4.6.5 Following a blackout, automatic connection of the standby generating set is to be followed by an automatic restart of the essential electrical services. If necessary, time delay sequential steps are to be provided to allow satisfactory operation.

4.6.6 Monitored parameters for which alarms are required to identify machinery faults and associated safeguards are listed in Tab 24. These alarms are to be indicated at the control location for machinery as individual alarms; where the alarm panel with all individual alarms is installed on the engine or in the vicinity, a common alarm in the control location for machinery is required. For communication of alarms from the machinery space to the bridge area and accommodation for engineering personnel, detailed requirements are contained in [5].

5 Alarm system

5.1 General

5.1.1 A system of alarm displays and controls is to be provided which readily allows identification of faults in the machinery and satisfactory supervision of related equipment. This may be arranged at a main control station or, alternatively, at subsidiary control stations. In the latter case, a master alarm display is to be provided at the main control station showing which of the subsidiary control stations is indicating a fault condition.

5.1.2 Unless otherwise justified, separation of monitoring and control systems is to be provided.

5.1.3 The alarm system is to be designed to function independently of control and safety systems, so that a failure or malfunction of these systems will not to prevent the alarm system from operating. Common sensors for alarms and automatic slowdown functions are acceptable as specified in each specific table.

Table 24 : Auxiliary medium/high speed reciprocating I.C. engines driving generators

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote					
Identification of system parameter	Alarm	Remote indication	Slow-down with alarm	Shut-down with alarm	Automatic start of stand-by pump with alarm
Fuel oil viscosity or temperature before injection pumps	L + H				
Fuel oil leakage from high pressure pipes	H				
Lubricating oil temperature	H				
Lubricating oil pressure	L				
				X **(1)**	
Oil mist concentration in crankcase **(3)**				X	
Pressure or flow of cooling water	L				
Temperature of cooling water or cooling air	H				
Level in cooling water expansion tank, if not connected to main system	L				
Overspeed activated				X	
Level in fuel oil daily service tank	L				
Starting air pressure	L				
Exhaust gas temperature after each cylinder **(2)**	H				
Common rail fuel oil pressure	L				
Common rail servo oil pressure	L				

(1) Not applicable to emergency generator set.
(2) For engine power above 500 kW/cyl.
(3) When required by Pt C, Ch 1, Sec 2, [2.3.5] or by SOLAS Reg.II-1/47.2.
One oil mist detector for each engine having two independent outputs for initiating the alarm and shut-down would satisfy the requirement for independence between alarm and shut-down system.

5.1.4 The alarm system shall be continuously powered and shall have an automatic change-over to a standby power supply in the case of loss of normal power supply.

5.1.5 Where remote indications (R) are mentioned in the tables of this Section, they are required only for ships which are operated with the machinery space unattended but under continuous supervision from a position where control and monitoring devices are centralised, without the traditional watch service being provided by personnel in the machinery space.

5.2 Alarm system design

5.2.1 The alarm system and associated sensors are to be capable of being tested during normal machinery operation.

5.2.2 Insulation faults on any circuit of the alarm system are to generate an alarm, when an insulated earth distribution system is used.

5.2.3 An engineers' alarm is to be activated when the machinery alarm has not been accepted in the machinery spaces or control room within 2 minutes.

5.2.4 The alarm system is to have a connection to the engineers' public rooms and to each of the engineers' cabins

through a selector switch, to ensure connection to at least one of those cabins.

5.3 Machinery alarm system

5.3.1 The local silencing of the alarms on the bridge or in accommodation spaces is not to stop the audible machinery space alarm.

5.3.2 Machinery faults are to be indicated at the control locations for machinery.

5.4 Alarm system on navigating bridge

5.4.1 Alarms associated with faults requiring speed reduction or automatic shutdown are to be separately identified on the bridge.

5.4.2 The alarm system is to activate an audible and visual alarm on the navigation bridge for any situation which requires action by or the attention of the officer on watch.

5.4.3 Individual alarms are to be provided at the navigation bridge indicating any power supply failures of the remote control of propulsion machinery.

6 Safety systems

6.1 General

6.1.1 Safety systems of different units of the machinery plant are to be independent. Failure in the safety system of one part of the plant is not to interfere with the operation of the safety system in another part of the plant.

6.1.2 In order to avoid undesirable interruption in the operation of machinery, the system is to intervene sequentially after the operation of the alarm system by:

- starting of standby units
- load reduction or shutdown, such that the least drastic action is taken first.

A suitable alarm is to be activated at the starting of those pumps for which automatic starting is required.

6.1.3 If overriding devices of the required automatic reduction of power (slowdown) are provided, they are to be so arranged as to preclude their inadvertent operation, and a suitable alarm is to be activated by their operation.

6.1.4 If overriding devices of the required automatic stops (shutdown) are provided, they are to be so arranged as to preclude their inadvertent operation, and a suitable alarm is to be operated by their activation. When the engine is stopped automatically, restarting after restoration of normal operating conditions is to be possible only after manual reset, e.g. bypassing the control lever through the 'stop' position.

Automatic restarting is not permissible.

6.1.5 After stoppage of the propulsion engine by a safety shutdown device, the restart is only to be carried out, unless otherwise justified, after setting the propulsion bridge control level on «stop».

7 Testing

7.1 General

7.1.1 Tests of automated installations are to be carried out according to Pt C, Ch 3, Sec 6 to determine their operating conditions. The details of these tests are defined, in each case, after having studied the concept of the automated installations and their construction. A complete test program is to be submitted to the Society and may be as follows.

7.1.2 The tests of equipment carried out alongside the quay under normal conditions of use include, for instance:

- the electrical power generating set
- the auxiliary steam generator
- the automatic bilge draining system
- automatic centrifugal separators or similar purifying apparatus
- automatic change-over of service auxiliaries
- detection of high pressure fuel leaks from diesel generating sets or from flexible boiler burner pipes.

7.1.3 Sea trials are used to demonstrate the proper operation of the automated machinery and systems. For this purpose, for instance, the following tests are to be carried out:

- Test of the remote control of propulsion:
  - checking of the operation of the automatic control system: programmed or unprogrammed starting speed increase, reversal, adjusting of the propeller pitch, failure of supply sources, etc.
  - checking of the crash astern sequence, to ensure that the reversal sequence is properly performed from full away, the ship sailing at its normal operation speed. The purpose of this check is not to control the nautical performances of the ship (such as stopping distance, etc.)
  - finally, checking of the operation of the whole installation in normal working conditions, i.e. as a general rule without watch-keeping personnel for the monitoring and/or running of the machinery during 6 h at least
  - The following procedure may, for instance, be chosen: «underway» during 3 h, then increasing to «full ahead». Staying in that position during 5 min. Then stopping for 15 min. Then, putting the control lever in the following positions, staying 2 minutes in each one: astern slow, astern half, astern full, full ahead, half ahead, stop, full astern, stop, ahead dead slow, half ahead, then increasing the power until «underway» position for the remaining time.

- Test of the operating conditions of the electrical production :
  - automatic starting of the generating set in the event of a blackout
  - automatic restarting of auxiliaries in the event of a blackout
  - load-shedding in the event of generating set overload
  - automatic starting of a generating set in the event of generating set overload.
- Test of fire and flooding system:
  - Test of normal operation of the fire detection system (detection, system faults)
  - Test of detection in the scavenging air belt and boiler air duct
  - Test of the fire alarm system
  - Test of protection against flooding.
- Test of operating conditions, including manoeuvring, of the whole machinery in an unattended situation for 4 h.

SECTION 2 CENTRALISED CONTROL STATION (AUT-CCS)

1 General

1.1 Application

1.1.1 The additional class notation **AUT-CCS** is assigned in accordance with Pt A, Ch 1, Sec 2, [6.3.3] to ships fitted with a machinery installation operated and monitored from a centralised control station, and complying with the requirements of this Section.

It applies to ships which are intended to be operated with machinery spaces unattended, but with continuous supervision from a position where control and monitoring devices of machinery are centralised.

Note 1: Machinery spaces are defined in Pt C, Ch 1, Sec 1, [1.4.2].

1.1.2 Remote indications for continuous supervision of the machinery are to be located in a centralised control position, to allow a watch service of the machinery space.

1.2 Exemptions

1.2.1 Exemptions mentioned in Sec 1, [1.2] may also be considered for the notation **AUT-CCS**.

1.3 Communication system

1.3.1 A means of communication is to be provided between the centralised control station, the navigation bridge, the engineers's accommodation and, where necessary, the machinery spaces.

1.3.2 Means of communication are to be operable even in the case of failure of the main source of electrical power supply.

1.3.3 The requirements mentioned in Sec 1, [1.3] are applicable.

2 Documentation

2.1 Documents to be submitted

2.1.1 In addition to those mentioned in Pt C, Ch 3, Sec 1, Tab 1, documents according to Tab 1 are required.

3 Fire and flooding precautions

3.1 General

3.1.1 The requirements mentioned in Sec 1, [3] are applicable, except for Sec 1, [3.4.5].

3.1.2 The flooding alarms are to be transmitted to the centralised control position.

Table 1 : Documentation to be submitted

No.	I/A **(1)**	Document
1	A	Means of communication diagram
2	A	Central control position layout and location
3	A	System of protection against flooding

(1) A: to be submitted for approval
I: to be submitted for information.

4 Control of machinery

4.1 Propulsion plant operation

4.1.1 The centralised control position is to be designed, equipped and installed so that the machinery operation is as safe and effective as if it were under direct supervision.

4.1.2 Monitoring and control of main systems are to be designed according to the requirements mentioned in Sec 1, [4]. Additional indications in the centralised control position are required, and shown in the table with the symbol R.

4.1.3 In the centralised control position, it is to be possible to restore the normal electrical power supply in the case of power failure (e.g. with remote control of the generating sets), unless an automatic restart is provided.

4.1.4 Automatic restart of essential auxiliaries for propulsion and steering may be replaced by remote control from the centralised control position.

4.1.5 The status of machinery (in operation or on standby) and all parameters crucial to the safe operation of essential machinery are to be shown at the centralised control position.

4.1.6 Under all sailing conditions including manoeuvring, the speed, direction of thrust and, if applicable, the pitch of the propeller are also to be fully controllable from the centralised control position.

4.1.7 In addition to the requirements in Sec 1, [4.1.10], the device to prevent overload, when automatic or remote controlled from the centralised control position, is to be fitted with an alarm indicating the necessity of slowing down.

4.2 Control position location

4.2.1 The centralised control position is to be located in the machinery space or adjacent to it. Other arrangements are to be submitted to the satisfaction of the Society.

4.2.2 If the centralised control position is an enclosed space located in the machinery spaces, it is to be provided with two safe fire escapes.

5 Alarm system

5.1 General

5.1.1 The alarm system is to be designed according to Sec 1, [5].

5.1.2 Every alarm is to be indicated visually and audibly at the centralised control position. If an alarm function has not received attention locally within a limited time, an alarm clearly audible in the engineers' accommodation is to be activated.

6 Safety system

6.1 General

6.1.1 Safeguard disactivation, if provided at the centralised control position, is to be so arranged so that it cannot be operated accidentally; the indication «safety devices off» is to be clearly visible. This device is not to disactivate the overspeed protection.

6.1.2 Safety systems provided with automatic operation may be replaced by remote manual operation from the centralised control position.

7 Testing

7.1 Tests after completion

7.1.1 Tests are to be carried out of all systems which are required to be in operation at the quay, such as the fuel oil purifier system, electrical power generation, auxiliary steam generator, etc.

7.2 Sea trials

7.2.1 The sea trials are to demonstrate the proper operation of automation systems. A detailed test program is to be submitted for approval. As a minimum, the following are to be tested:

- the remote control system of propulsion machinery
- electrical production and distribution
- efficiency of the fire detection and fire alarm system
- protection against flooding
- continuous operation in all sailing conditions, including manoeuvring, for 4 hours with unattended machinery spaces and at least one person in CCS.

SECTION 3 AUTOMATED OPERATION IN PORT (AUT-PORT)

1 General

1.1 Application

1.1.1 The additional class notation **AUT-PORT** is assigned in accordance with Pt A, Ch 1, Sec 2, [6.3.4] to ships fitted with automated installations enabling the ship's operation in port or at anchor without personnel specially assigned for the watch-keeping of the machinery in service, and complying with the requirements of this Section.

1.1.2 The arrangements provided are to be such as to ensure that the safety of the ship in port is equivalent to that of a ship having the machinery spaces manned.

1.2 Exemptions

1.2.1 Exemptions mentioned in Sec 1, [1.2] may also be considered for the notation **AUT-PORT**.

1.2.2 Ships whose gross tonnage is less than 1600 are exempted from the requirements in [3.1.2].

1.3 Communication system

1.3.1 The requirements of Sec 1, [1.3] are applicable.

2 Documentation

2.1 Documents to be submitted

2.1.1 In addition to the those mentioned in Pt C, Ch 3, Sec 1, Tab 1, Pt C, Ch 3, Sec 1, Tab 2 and Sec 1, Tab 1, documents according to Tab 1 are required.

Table 1 : Documentation to be submitted

No.	I/A **(1)**	Document
1	A	Means of communication diagram
2	A	Technical description of automatic engineers' alarm and connection of alarms to accommodation and bridge, when applicable
3	A	System of protection against flooding
4	I	List of machinery to be in operation in port

(1) A: to be submitted for approval
I: to be submitted for information.

3 Fire and flooding precautions

3.1 General

3.1.1 The requirements given in Sec 1, [3] are applicable unless otherwise indicated below.

3.1.2 The remote control of the main fire pump for the pressurisation of the fire main may be located at the bridge running station if the wheelhouse and officers' cabins are close together. Failing this, such remote control is to be fitted at a place close to the officers' cabins or to the engine room exit. Alternatively, the fire main may be permanently under pressure.

3.1.3 Transmission to the navigating bridge of fire alarm and flooding is not required, but these alarms are to be directed at the intervention personnel.

4 Control of machinery

4.1 Plant operation

4.1.1 The machinery and systems which are to be in operation in port are to be designed according to Sec 1, [4], unless otherwise stated.

4.1.2 The requirements regarding electrical production for propulsion Sec 1 are not applicable.

4.1.3 The operation of auxiliaries, other than those associated with propulsion, is to be designed according to Sec 1.

5 Alarm system

5.1 General

5.1.1 The alarm system is to be designed according to Sec 1, [5], unless otherwise stated in this Section.

5.1.2 The alarm system is to be designed so as to inform of any situation which requires attention of the personnel on watch.

For this purpose, an audible and visual alarm is to be activated in the centralised control station, in the engineers' public rooms and at each engineer's cabin through a selector switch. Any other arrangement is to be to the satisfaction of the Society.

6 Testing

6.1 Tests after completion

6.1.1 Tests are to be carried out of all systems which are required to be in operation in port, such as: the fuel oil purifier system, electrical power generation, auxiliary steam generator, etc.

Part F
Additional Class Notations

Chapter 3
MONITORING EQUIPMENT (MON)

SECTION 1 HULL STRESS AND MOTION MONITORING (MON-HULL)

1 General

1.1 Application

1.1.1 The additional class notation **MON-HULL** is assigned in accordance with Pt A, Ch 1, Sec 2, [6.4.2] to ships equipped with a Hull Stress and Motion Monitoring System (hereafter referred to as Hull Monitoring System for easy reference), complying with the requirements of this Section.

1.1.2 A Hull Monitoring System is a system which:

- provides real-time data to the Master and officers of the ship on hull girder longitudinal stresses and motions the ship experiences while navigating and during loading and unloading operations in harbour.
- allows the real-time data to be condensed into a set of essential statistical results; the set is to be periodically updated, displayed and stored on a removable medium.

  The information to be stored may be selected in view of later exploitation by the Owner, for instance as an element in the exploitation of the ship or as an addition to its logbook.

Note 1: The information provided by the Hull Monitoring System is to be considered as an aid to the Master. It does not replace his own judgement or responsibility.

1.2 Documentation

1.2.1 The following documents are to be submitted to the Society for approval:

- specification of the main components: sensors, processing units, display unit, storage unit, power supply and cabling
- functional scheme of the system
- principles and algorithm used for the data processing
- determination of measurement ranges
- determination of data limits
- calibration procedure including calibration values and tolerances.

1.3 Data limits, warning levels

1.3.1 The information provided by the transducers is to be compared against limits corresponding to maximum values obtained from the requirements on the basis of which the hull structure is approved.

These limits cannot be crossed and their approach is to be signalled to the crew in order for a corrective action to be carried out.

1.3.2 The above information and the related statistics can also be compared against warning levels determined by the Owner.

These warning levels are always to be less than the maximum values obtained from the requirements on the basis of which the hull structure is approved.

When a warning level is reached, a signal is to be emitted, different from the signals for the limits mentioned in [1.3.1].

2 Hull monitoring system

2.1 Main functions

2.1.1 The Hull Monitoring System is to be able to ensure the following main functions:

- collection of data
- data processing: scaling, consistency checking, statistical processing
- display management, handling of alarms and warnings
- selection, compression, if any, and storage of the results.

Note 1: The resources needed for the later onshore exploitation of the recorded results need not be considered as part of the Hull Monitoring System, provided that they cannot access the storage medium in order to modify the content.

2.2 Sensors

2.2.1 The sensors are to consist of a set of devices able to provide at least:

- information on the longitudinal stresses in the main deck, at least at one location where the maximum hull girder normal stress can be expected during navigation, loading and unloading.

  For a more consistent monitoring of the loading and unloading operations, information on longitudinal stresses in still water is to be collected in way of each cargo hold.
- information on the vertical acceleration at the bow.

  For a consistent monitoring of the vertical acceleration in any point of the hull girder, acceleration is also to be collected at the stern.
- information on the transverse acceleration due to the roll and to the heel.

2.2.2 Attention is drawn to the possible existence of local strains induced by temperature gradients in the hull structure.

The strain sensors are to be located in areas free from these temperature gradients.

If a temperature compensation device is implemented, the Manufacturer is to demonstrate its effectiveness on site.

2.2.3 The sensors are to comply with the applicable requirements concerning protection against conducted and radiated electric and radioelectric emissions.

2.2.4 The sensors are to be selected and installed in such a way that a periodical on-site recalibration can be carried out without extra equipment.

When this operation is impossible, the Manufacturer is to declare the period and procedure for the bench test calibration and demonstrate that the initial calibration remains valid within the period.

2.3 Specifications

2.3.1 For each type of measurement, the Manufacturer is to state the limits of the domain, according to the ship.

The limits are to include:

- the strain ranges
- the acceleration ranges
- the corresponding frequency range
- the temperature ranges: sea water, open air, hull structure, sheltered, accommodation.

2.3.2 The global resolution of the instrument is to be such that the incertitude as to the displayed information is less than 7% of its full scale display. The global resolution applies on the entire domain; the specification of the components is to be set accordingly.

2.3.3 The system is to be able to detect and signal the malfunctions which can impair the validity of the data, e.g.:

- data are out of range
- data remain strictly constant
- data are corrupted by high intensity noise
- the system stops or hangs.

2.4 Data processing

2.4.1 Wave-induced data are to be processed through a cyclical statistical procedure; the procedure (maximum peak value, RMS, mean value, frequency spectrum, etc.) is to be selected in order that the displayed information is significant, not confusing, immediately understood and as close as possible to the nautical experience of the crew.

The procedure is to produce smoothed results that are not to deviate by more than 10% from one cycle to the next when in steady navigation conditions.

The procedure is to be such that a significant change in the navigation conditions appears on the display after no more than three cycles.

The system is to switch automatically from port to sea conditions, and vice versa.

2.4.2 It is recommended that the Hull Monitoring System should be linked to the loading instrument for a secure transfer of information from the instrument to the system.

This arrangement is to allow for the actual still water hull girder stresses, converted to longitudinal bending moments, as issued by the system, to be compared against the predicted values from the loading instrument.

2.4.3 Provision is to be made for a connection with a Voyage Data Recorder where this is fitted on board. The Manufacturer is to declare a limited set of parameters to be forwarded to the Voyage Data Recorder.

2.5 Visual display

2.5.1 A graphical display is to be fitted, with the following features:

- it is to be simple, clear and non-confusing
- the user is to be able to obtain the information through one reading
- it is to be readable at a distance of at least 0,5 m
- two major pieces of information (e.g. stress and vertical acceleration at bow) are declared as "default conditions" and displayed at power up and in the absence of keystroke from the user
- when an alarm is emitted, the corresponding information is to be displayed instead of the above "default conditions".

2.5.2 When the system detects a malfunction, the corresponding status is to be superimposed on the display.

2.6 Alarms

2.6.1 For each limit stated in [1.3.1], visual and audible alarms are to be fitted on the bridge to indicate when the limit is approached and exceeded.

The alarms associated with each limit are to be clearly distinguishable from those relevant to other limits.

2.6.2 When a warning level is reached (see [1.3.2]), a visible signal is to be issued, distinct from those of the alarms for limits stated in [2.6.1].

2.6.3 When the system detects a malfunction, the alarms and warnings associated with the data are to be inhibited and a malfunction alarm is to be issued (see also [2.5.2]).

2.7 Data storage

2.7.1 The data are to be stored either by a recording device which is part of the Hull Monitoring System, according to [2.7.2] to [2.7.4], or by the integrated bridge system, if any.

2.7.2 An electronic data storage recording device suitable for accumulating statistical information for feedback purposes is to be fitted.

2.7.3 The data storage recording device is to be:

- entirely automatic, excluding replacement operations of the storage support
- such that its operation does not interrupt or delay the process of collecting and treating data.

2.7.4 Data are to be recorded with information on the date and time.

2.8 Exploitation and checking of stored data

2.8.1 The data stored according to [2.7] are to be treated by the Owner through a statistical process.

2.8.2 Periodicity of exploitation of data is to be defined by the Owner depending on the ship's operation.

2.8.3 Means are to be incorporated which ensure that the integrity of the collected data can be checked at the exploitation stage.

2.9 Power supply unit

2.9.1 The Hull Monitoring System is to be powered by the main power source of the ship and in addition with an internal uninterruptible 30 minute power source.

2.10 Calibration

2.10.1 The initial calibration of the Hull Monitoring System is to be based on an approved loading case in still water.

The differences between results obtained from the Hull Monitoring System and approved values are to be less than 5%.

2.10.2 The initial calibration of the Hull Monitoring System is to be carried out with a Surveyor in attendance.

2.11 Periodical inspections

2.11.1 Checks of the main functions of the Hull Monitoring System are to be carried out at intervals as agreed by the Society and not exceeding one year.

The instrument is to include an auto-checking facility so that the verification of the Hull Monitoring System can be carried out without the need of external devices.

SECTION 2 SHAFT MONITORING (MON-SHAFT)

1 General

1.1 Applicability of MON-SHAFT notation

1.1.1 The additional class notation MON-SHAFT is assigned, in accordance with Pt A, Ch 1, Sec 2, [6.4.3], to ships complying with the requirements of this Section.

1.1.2 This notation is assigned to ships having tailshafts arranged with oil lubricated stern bearing and with approved oil sealing glands or to ships having a rotating and Azimuth thrusters such as Z-DRIVE units.

1.1.3 The assignment of this notation allows a reduced scope for complete surveys of tailshaft or rotating and Azimuth thrusters such as Z-DRIVE units; see Pt A, Ch 2, Sec 2, [5.5.4].

2 Requirements for the issuance of the notation

2.1 Tailshaft Arrangement

2.1.1 In order for the notation MON-SHAFT to be granted, the stern bearing is to be arranged with:

- facilities for measurement of bearing wear down,
- at least one temperature sensor for the aft bearing giving temperature indication and high temperature alarm; an alarm is to be activated in the event of failure of the temperature sensor circuit.

2.1.2 Tailshaft Lubricating oil analysis

a) **Item to be monitored**

In order for the notation MON-SHAFT to be granted, the lubricating oil of the stern bearing is to be analysed as indicated in this Section.

b) **Timing**

Stern bearing lubricating oil is to be analysed regularly; in any event, the interval between two subsequent analyses is not to exceed six months.

c) **Records**

The lubricating oil analysis documentation is to be available on board showing in particular the trend of the parameters measured according to [2.2.4].

d) **Content of analysis**

Each analysis is to include the following parameters:

- water content
- chloride content
- bearing material and metal particle conten
- oil ageing (resistance to oxidation).

The oil samples are to be taken under service conditions and are to be representative of the oil within the sterntube.

e) **Additional data to be recorded**

In addition to the results of the oil sample analysis, the following data are to be regularly recorded:

- oil consumption
- aft bearing temperature.

2.2 Rotating and Azimuth thrusters

2.2.1 In order for the notation **MON-SHAFT** to be granted, the lubricating oil of rotating and Azimuth thrusters such as Z-DRIVE units is to be analysed in function of operating hours, in any case yearly as minimum. The lubricating oil analysis documentation is to be available onboard.

An equipment(s) for recording of propulsion systems working hours is to be provided.

For azimuth thrusters with power in excess of [5000 kW], and propeller shaft running on roller bearings, vibration measurements in way of roller bearings are to be foreseen.

The requirements of other propulsion systems are to be set forth on a case by case.

Part F
Additional Class Notations

Chapter 4
COMFORT ON BOARD (COMF)

SECTION 1 COMFORT WITH REGARD TO NOISE

1 General

1.1 Application

1.1.1 **COMF-NOISE** notation, in accordance with Pt A, Ch 1, Sec 2, [6.5.2], is assigned to ships classed by the Society and complying with the requirements of this Section.

In the event that the ship undergoes modifications, refitting or repairs that may affect its level of comfort, the maintenance of the notation is subject to the results of new measurements as deemed appropriate by the Society.

The notation is completed by a letter **A**, **B** or **C** which represents the merit level achieved for the assignment of the notation, the merit **A** corresponding to the lowest level of noise.

The notation **COMF-NOISE** is only assigned if at least merit level **C** is reached.

When the merit levels achieved for the person spaces (if any) and the crew spaces are different, the notation is completed by the suffix:

- **PAX**, for person spaces, and
- **CREW**, for crew spaces.

1.1.2 Ships not classed by the Society complying with the requirements of this Section are provided with a Certificate of Conformity which attests their comfort quality. The Certificate is valid for a period of 5 years and may be extended, at the request of the Owner, for an additional 5-year period based on a limited set of measurements covering at least 5% of those made when the Certificate was first issued.

1.1.3 The requirements apply to ships irrespective of the ship's age, as far as reasonable and practicable, to the satisfaction of the Society.

For ships less then 65 m (length between perpendiculars), special consideration will be given by the Society, in particular concerning the requirements in [5].

1.2 Basic principles

1.2.1 The requirements of this Section define the limits of acceptability of noise on board, the methods for verification of compliance and the criteria for acceptance. They are based, as appropriate, on international standards and are deemed to preserve the general principles of such standards.

1.2.2 Verification of compliance is based on the measurements of noise levels in ship spaces and of the insulation characteristics of barriers as specified in [3.2]. These measurements are to be carried out either by a Surveyor of the Society or by a technician from a company recognised as suitable by the Society. In the latter case, measurements are to be performed under the surveillance of a Surveyor of the Society.

2 Definitions

2.1 Categories of spaces

2.1.1 General

For the purposes of this Section, a specific, comfort-related categorisation of the ship spaces is used.

2.1.2 Crew spaces

Crew spaces are defined according to IMO Resolution A.468(XII).

2.1.3 Person spaces

With the exception of washrooms and toilets, to which the requirements of this Section do not apply, person spaces are the following:

a) **Standard cabins**

Spaces for private use of the persons, where the primary purpose is to rest.

b) **Suites or mini-suites**

Luxury finish cabins greater than 15m^2 with private lounge area with an extension at least 30% of the total surface.

c) **Type A entertainment spaces**

Enclosed spaces for person recreation and/or prolonged person stay where the noise level is normally high when in use (e.g. discos, theatres, cinemas, casinos, show rooms, etc.).

d) **Type B public spaces**

Enclosed spaces for person recreation and/or prolonged person stay where the noise level is not normally high when in use (e.g. self service restaurants, main restaurant, pullman seat rooms, lounge areas, bars, gymnasiums, conference halls and similar spaces, etc.).

e) **Type C public spaces**

Enclosed spaces for person recreation and/or prolonged person stay where the noise level is low (e.g. reading rooms, libraries, card rooms, chapels, special restaurants, health centre, sitting rooms, small lounges and similar spaces, etc.).

f) **Type D public spaces**

Spaces where persons are not normally expected to stay long (e.g. shops, enclosed walkways, atriums, person laundrettes, halls and similar spaces, etc.).

g) **Type E transit spaces**

Spaces where persons are normally expected to stay for a short period of time (e.g. corridors, stairs, etc.).

h) **Type F open spaces**

Outside spaces for prolonged and/or recreational stay of persons (e.g. open walkways, sun decks, etc.).

2.1.4 Work Spaces

Service spaces (such as galleys, serveries, pantries, technical spaces, workshops, passageways etc.) with significant random noise levels or potential high noise levels above 85dBA.

2.2 Noise

2.2.1 Noise is the audible sound wave level, generally of a random nature, in the 20 to 18000 Hz frequency range. As far as compliance with the requirements of this Section is concerned, noise is measured in the 31,5 to 8000 Hz frequency range unless otherwise specified by the Society in special cases.

2.2.2 For the purposes of this Section, A-weighted noise levels are considered, measured in dB(A) by a precision sound level meter with an accuracy grade of about ± 1 dB.

2.3 Operational power in the CSR condition

2.3.1 Operational power is the propulsion power, in kW, at which the ship is normally operated.

2.3.2 The operational power to be considered for the purpose of these Rules is 85% of the maximum continuous rate (MCR) defined in the following as the continuous service rate (CSR) condition.

2.3.3 Subject to the acceptance of the Society and to the agreement of the Owner and shipyard, a propulsion power at CSR other than 85% MCR is to be used, if such condition corresponds to the normal seagoing conditions.

2.4 Sound Index

2.4.1 Sound Reduction Index (Rw)

According to EN ISO 717 - 1 : 1996 and EN ISO 140 - 3 : 1995, R_w is the laboratory measurement of individual airborne sound insulation of building elements.

2.4.2 Apparent Sound Reduction Index (R'_w)

According to EN ISO 717 - 1 : 1996 and EN ISO 140 - 4 : 1998 , R'_w is the value of field measurements of total airborne sound insulation between rooms.

2.5 Impact Sound Index (L'n,w)

2.5.1

According to EN ISO 717 - 2 : 1996 and EN ISO 140- 7 : 1998, $L'_{n,w}$ is the value of field measurements of the impact sound index of floors and ceiling assembly.

3 General requirements

3.1 Design requirements

3.1.1 Noise insulation characteristics of barriers

For the purpose of the requirements of this Section, the noise insulation characteristic of the divisions formed by walls, ceilings and floors is represented by the R'_w, which is measured in dB.

Depending on the types of spaces separated by divisions (vertical and horizontal), the R'_w is to be at least as given in Tab 1.

The individual noise insulation characteristic (R_w) of cabin divisions is to be selected as appropriate. It is recommended that the R'_w of all surfaces be considered during design, e.g. when carrying out the noise prognosis [3.1.4].

Table 1 : Noise insulation characteristics of the divisions

Division between:	R'_w (dB)		
	A level	B level	C level
• Suite or mini-suite / cabin	43	40	35
• Standard cabin / cabin	40	37	35
• Disco / cabin	65	60	55
• Type A spaces / cabin	60	55	50
• Type B spaces / cabin	55	50	45
• Type C spaces / cabin	50	45	40
• Type D spaces / cabin	50	45	40
• Corridors (Type E spaces) / suite	40	35	33
• Corridors (Type E spaces) / cabin	37	33	30
• Crew Cabin/ work spaces	50	47	45
• Crew cabin/crew cabin	37	35	30
• Crew cabin/corridor	33	30	27

3.1.2 Impact Sound Index characteristics of floor and ceiling combinations

For the purpose of the requirements of this Section, the impact sound insulation characteristic of a floor/ceiling combination is represented by the $L'_{n,w}$, which is measured in dB.

Depending on the types of floors above cabins, the minimum values of $L'_{n,w}$ are provided in Tab 2.

For the purposes of Tab 2:

- soft floor is carpet, moquette and similar
- hard floor is marble, tiles, wood, resins and similar.

Table 2 : Impact Noise Insulation characteristics of floor

Floor above cabin	$L'_{n,w}$ (dB)
• Soft floor	50
• Hard floor	55
• Dance floors, stages, gymnasium floor	45

3.1.3 Acoustic insulation plan

The acoustic insulation plan is a general arrangement plan of the spaces considered in this Section where the following information is provided:

a) the types of space according to the categories given in [2.1];

b) the value of the noise insulation characteristic (Rw) of cabin walls and floors;

c) the values of the impact sound index ($L'_{n,w}$) above cabins;

d) any type of acoustic insulation, even if integrated with the fire and thermal insulation plan.

3.2 Construction requirements

3.2.1 Noise measurement plan

A plan is to be prepared describing the proposed noise measurement campaign developed in compliance with [5.2]. The plan is to include the extension and classification of ship zones with the noise limit level with reference to the expected COMFORT level in compliance with [5.5] and the proposed minimum number of measurements to be taken in each ship space. The aim is to obtain a rational distribution of measurement points throughout the ship.

3.2.2 Noise measurement report

In accordance with [8], the report is to contain:

- position of measurements points
- measured noise levels according to [5]
- resulting global comfort level according to [7].

Furthermore, the following general data are to be recorded and included in the report:

- ship loading condition
- propulsion machinery details
- estimated water depth
- estimated environmental conditions (wind and waves)
- presence of noise sources due to external factors such as additional personnel, ongoing repairs or fitting work, etc;
- values of measurements of R'w and $L'_{n,w}$, if applicable.

4 Documentation to be submitted

4.1 Acoustic insulation plan

4.1.1 The acoustic insulation plan is to be submitted for information as soon as available and well before the execution of the measurement campaign. Although the acoustic insulation plan is not subject to approval, its submission is a necessary prerequisite for compliance with the requirements of this Section.

4.2 Noise Insulation characteristics

4.2.1 The following information is to be submitted:

a) For divisions delimiting cabin spaces:
- Laboratory test certificate of sound reduction index Rw for each type of division installed on board
- Installation details of all panels and outfitting for walls and ceilings
- The apparent sound reduction index R'_w prediction of the on site values in the measurement points specified in [6.1]

b) For floors and ceilings of cabins:
- Impact Sound Index $L'_{n,w}$ prediction of the on site measured values as specified in [6.1].

4.3 Measurement plan

4.3.1 The proposed measurement plan, developed according to [3.2.1], is to be submitted for information well in advance of the measurement campaign.

4.4 Noise measurement results

4.4.1 A duly signed detailed report is to be submitted for approval. The format shown in item [8] is recommended.

The noise measurement report is to be witnessed by a representative of the Builder, the Owner, a representative of the company which carried out the measurements and the Society's Surveyor in charge of surveillance of the measurements.

5 Noise levels: testing conditions and acceptance criteria

5.1 Testing conditions

5.1.1 General

Noise levels are to be measured according to ISO 2923 in the conditions defined below. Different conditions may be accepted as equivalent at the discretion of the Society.

5.1.2 Equipment running during the tests

During measurements, all auxiliary systems, forced ventilation and air conditioning systems (HVAC systems) and hotel service systems are to be operating in normal service conditions; as noise arising from every kind of unnecessary human activity is to be avoided, in general only the personnel needed for the operation of the ship hotel activities and those carrying out the measurements are to be present.

During measurements all entertainment systems are to be switched off.

Doors and windows are to be closed.

The rooms are to be fully equipped with furniture, furnishings, ceiling and actual deck covering (e.g. carpet, etc.).

5.1.3 Ship loading conditions

As far as practicable the ship loading conditions are to be as close as possible to the normal operating conditions.

5.1.4 Environmental conditions

In general, meteorological conditions are to be within the following limits:

- wind: not stronger than Beaufort 3 - strong breeze (speed 7 to 10 knots),
- waves: not stronger than force 3 - rough (significant wave height 0,5 to 1,25 m)
- ice according to technical specifications.

5.1.5 Propulsive Power

a) Measurements are to be carried out with the ship at the operational power in the CSR condition in [2.3].

b) Additional measurements are to be carried out at 100% MCR and at x% MCR, the different propulsion power with respect to CSR is subject to the acceptance of the Society and to the agreement of the Owner and shipyard.

5.1.6 Other equipment

Subject to the acceptance of the Society and to the agreement of the Interested party, equipment such as bow thrusters, stabilising fins etc. is to be operating during measurements if it is necessary for the ship to proceed in normal seagoing conditions and in the environmental conditions specified in [5.1.4].

With the above-mentioned equipment operating, special consideration may be given by the Society concerning the acceptable noise level as per [5.5].

5.2 Measurement positions

5.2.1 General

Measurements are to be carried out in the most representative spaces defined in [2.1] close to the potential noise sources (engine casing, ventilation trunk, HVAC station, machinery room, outlet fan, etc.) according to the following principles.

At the discretion of the Society, additional measurements are to be performed to establish the extension of area with excessive noise levels.

In the assessment of the noise distribution, for all types of enclosed spaces, only the points with an average value representative of an area larger than 50 m^2 will be considered.

If a noise level difference greater than 5 dB(A) exists in the same enclosed space, additional measurements in that space are to be considered.

5.2.2 Person spaces

a) **Cabins, mini-suites and suites**

Measurements are to be carried out, based on the measurement plan, in at least the most representative 30% of the cabins located between the stern and the forward bulkhead of the engine room and in the most representative 10% of the other cabins. The microphone position is to be located in the middle of the cabin at a height of 1.4 m from the deck. No microphone positions are to be closer than 0,5m from the boundary surface of the space.

Each tested cabin larger than 25 m^2 is to contain at least two measurements points, each point at 1/3 of the main dimension. At the discretion of the Society, additional measurements are to be carried out.

Only the average noise will be considered in the comfort level assessment of the cabin.

b) **Enclosed person spaces (Type A, B, C, D and E spaces)**

Measurements are to be carried out in all such spaces with an extension larger than 150 m^2.

One measuring point is to be placed (approximately) every 100 m^2 of area of the space under examination.

Spaces with an area smaller than 150 m^2 are to be considered only if close to potential noise sources.

c) **Type F open spaces**

Measurements are to be carried out in all such spaces. In open recreational spaces, if designed for prolonged stay of persons, a measurement point is to be placed every 100 m^2. For other types of spaces a measurement point is to be placed every 200 m^2. If the open space can be closed by means of mobile elements, such space is to be considered an enclosed space and subject to the relevant requirements.

5.2.3 Crew and work spaces

Measurements are to be taken in at least:

a) three points of the wheelhouse (one at the centre, one at the ends, port or starboard and one of the navigating bridge wing on the lee side of the ship)

b) six cabins (including hospital) on each deck for each main vertical zone (preferably two cabins at the centre, and at the extremities two portside and two starboard side).

c) one point in manned wokspaces

Any other surveyed space larger than 60 m^2 is to contain at least two measurement points.

5.3 Instrumentation

5.3.1 Noise level measurements are to be carried out by means of integrating-averaging sound precision level meters. These sound level meters are to comply with either IEC 61672-1 type 1 requirements or a standard accepted as equivalent by the Society.

This compliance is to be verified at least every two years by an organization recognised by the Society.

The date of last verification and confirmation of compliance with relevant IEC standards is to be recorded. Calibration sheets are to be provided.

5.4 Measurement procedure

5.4.1 Measurements are to be carried out to estimate the sound pressure levels LP by averaging the noise level during at least 30s with the time-weighting slow (S). If the sound is irregular with fluctuations exceeding ± 3 dB(A), the measuring time is to be extended to at least 60s. The measured value is to be rounded to the nearest integer.

Noise level is to be measured in dB (A) units with the A-weighting curve.

A main vertical zone with excessive noise levels respect to the expected limit is to be subjected to additional measurements to highlight the extension of the spatial distribution of the noise.

The averaged space noise level, L_{Aeq}, representative of the COMFORT level of the space type is calculated on an energy basis according to the following equation:

- Space less than 150 m^2, L_{Aeq} is the average of the measured noise levels set for this space

$$L_{Aeq} = 10\log\left(\frac{\sum_{i=1}^{N} 10^{\left(\frac{1}{10}Lp_i\right)}}{N}\right)$$

- Spaces equal to or greater than 150 m^2, L_{Aeq} is the weighted average of the set of measured points taking into account the effective area covered with the single measured value

$$L_{Aeq} = 10\log\left(\frac{\sum_{i=1}^{N} S_i 10^{\left(\frac{1}{10}Lp_i\right)}}{\sum_{i=1}^{N} S_i}\right)$$

where:

L_{Pi} : noise level of i-th point

S_i : area associated to the i-th noise level

N : number of measurements

5.5 Acceptable noise levels in the CSR condition

5.5.1 Limits for the calculation of the noise comfort level are given in Tab 4, for each category of space.

For crew spaces on all types of ships the Society may accept different values depending on the national requirements of the State whose flag the ship is flying, provided that such values are not higher than L_B in Tab 4.

Table 3 : CSR condition - Noise limits levels

Type of space	L_A	L_B
Person spaces		
Suite or mini-suite (S)	45	50
Standard cabins (Cb)	50	55
Type A, B and D spaces	55	60
Type C spaces	52	57
Type E spaces	60	65
Type F spaces **(1)**	65	70
Crew spaces		
Crew cabins	55	60
Senior officer cabins	52	55
Navigation spaces	58	60
Radio Room	58	60
Hospital	50	55
Public crew spaces	60	65
Work spaces without equipment operating	70	75
Offices	58	65
Mess Room / recreation room	60	65
Engine Control Room	70	75
Crew open decks **(2)**	70	75
(1) +10 dB(A) if less than 1 m from the ventilation inlet/outlet **(2)** + 5 dB(A) if less than 1 m from the ventilation inlet/outlet		

5.5.2 For each measured space, the time-space averaged noise level, LAeq, calculated according to [5.4] is compared with the limits in Tab 4.

a) **Noise level: person cabins and Type A, B, C, D spaces less than 150 m²**

1) Comfort level is A if:
   - all L_{Aeq} values are less than or equal to L_A, or
   - all L_{Aeq} values are less than or equal to L_A, except for less than or equal to 5% of the total number of spaces of these types.

   In any case, spaces with L_{aq} exceeding L_a are to be less than or equal to L_B

2) Comfort level is B if:
   - all L_{Aeq} values are less than or equal to L_B

3) Comfort level is C if:
   - all L_{Aeq} values are less than or equal to L_B + 5dB(A).

b) **Noise level Type A, B, C, D, E, F spaces greater than 150 m²**

1) Comfort level is A if:
   - all L_{Aeq} values are less than or equal to L_A

2) Comfort level is B if:
   - all L_{Aeq} values are less than or equal to L_B

3) Comfort level is C if:
   - all L_{Aeq} values are less than or equal to L_B, except for less than 10% of the total number of these types of spaces on board, which are to be less than or equal to L_B + 5dB(A).

c) **Noise level crew spaces**

1) Comfort level is A if:
   - all L_{Aeq} values are less than or equal to L_A, or
   - all L_{Aeq} values are less than or equal to L_A, except for less than or equal to 10% of the total number of crew spaces onboard which are to be less than or equal to L_B

2) Comfort level is B if:
   - all L_{Aeq} values are less than or equal to L_B

3) Comfort level is C if:
   - all L_{Aeq} values are less than or equal to L_B, except for the senior officer cabins, navigation spaces, radio room, hospital, which are to be less than or equal to L_B + 5dB(A).

5.6 Noise levels at power other than the CSR

5.6.1 Measurement positions

The aim of these measurements is to verify that the noise levels do not change excessively. The measurements are to involve critical areas up to 5% of the total number of measurements on each deck taken at the CSR. Critical areas are those where highest noise levels have been measured.

Excluding outside recreational spaces, for each deck the areas in way of the longitudinal position of the propeller and close to the engine casing are to be considered critical.

5.6.2 Acceptable noise level in a condition other than the CSR

The measured noise levels in the operating condition of [5.1.5] b) L_{MCR} (noise level at MCR) and $L_{x\%MCR}$ (noise level at reduced power x% of MCR) are compared with the measured noise level at CSR, $L_{A\,eq}$ of [5.1.5] a).

a) Comfort level is A if:
   - all differences of the noise levels with the corresponding values at CSR are lower than or equal to 3 dB(A),

   or
   - the noise levels are less than or equal to L_A + 5 dB(A).

b) Comfort level is B if:
   - the noise levels are less than or equal to L_B + 5 dB(A).

c) Comfort level is C if:
   - all differences of the noise levels with the corresponding values at CSR are greater than 5 dB(A).

6 Acoustic insulation characteristics: testing conditions and acceptance criteria

6.1 Testing conditions

6.1.1 General

Measurements also to be carried out in person cabins according to the following indications. At the discretion of the Society, additional measurements are to be carried out in particular locations within the measurement area.

Measurements are also carried out in crew spaces if the installation and assembly of barriers, ceiling, floors and acoustic insulation is different from person spaces.

The noise insulation characteristics of division (R'w) and the impact noise characteristics of floors and ceilings ($L'_{n,w}$) are to be measured only in cabin areas with the ship at berth once the installation of the walls, floors, ceilings and furnishings is complete.

6.1.2 Measurement positions

For each type of wall and deck division, measurements are to be taken for the cabin with the largest area separating measured spaces.

a) For each type of vertical and horizontal division, measurements are to be taken of acoustic insulation from airborne noise index R'_{Wmis}.

   R'_{Wmis} values are to be compared with the limits in Tab 1.

b) For each kind of accommodation, below different type of floor, measurements are to be taken of acoustic insulation from impact sound $L'_{n,Wmis}$.

   Two types of floor are to be considered:
   - hard: marble, wood, tiles
   - soft: moquette, synthetic green.

   For each kind of floor measured values are to be compared with the limits in Tab 2.

6.1.3 Measurement procedure

Measurements of acoustic insulation indexes from airborne noise and from impact noise are to be taken according to ISO Standards in [2.4] and [2.5].

6.2 Acceptance criteria

6.2.1 For each floor or wall measured according to [6.1.2] and with reference to the characteristic value of R'w in Tab 1 and L'n,w in Tab 2, the resulting comfort level is:

A if:

- Acoustic insulation of vertical division R'_{Wmis} greater than or equal to R'_w at A level, and
- Acoustic insulation of horizontal division R'_{Wmis} between person cabin and type A spaces, greater than or equal to R'_w at A level, and
- Impact noise $L'_{n,Wmis}$ lower than or equal to L'_{nw}

B if:

- Acoustic insulation of vertical division R'_{Wmis} greater than or equal to R'_w at B level, and
- Acoustic insulation of horizontal division R'_{Wmis} between person cabin and type A spaces, greater than or equal to R'_w at B level

C if:

- Acoustic insulation of vertical division R'_{Wmis} greater than or equal to R'_w at C level, and
- Acoustic insulation of horizontal division R'_{Wmis} between person cabin and type A spaces, greater than or equal to R'_w at C level.

7 Global noise comfort level of the ship

7.1 General

7.1.1 The comfort level is rated on the basis of the actual rating reached by noise levels and acustic insulation indexes, provided that at least C level is reached.

For the purposes of these Rules, the global noise comfort level is assigned as follows.

7.1.2 COMF-NOISE A

Comfort level is A, if:

- noise levels at the CSR in [5.5]
- conditions other than the CSR in [5.6]
- acoustic insulation indexes in [6.2]

are A level.

7.1.3 COMF-NOISE B

Comfort level is B, if one of the following:

- noise levels at the CSR in [5.5]
- condition other than the CSR in [5.6]
- acoustic insulation indexes in [6.2]

is B level (the others are to be A or B).

7.1.4 COMF-NOISE C

Comfort level is C, if one of the following:

- noise level at the CSR in [5.5]
- condition other than the CSR in [5.6]
- acoustic insulation indexes in [6.2]

is C level.

Note 1: In any case the three above-mentioned items are to be evaluated.

8 Report

8.1

8.1.1 The report for noise measurements is to contain the followings Tables.

Table 4 : Characteristics of the ship

Name of the ship			
Register number - RI			
Flag			
Name of the Owner			
Name of the shipyard			
Construction number			
Type of ship			
Dimensions			
	Length - L	m	
	Breadth - B	m	
	Depth - D	m	
	Max. draught - T	m	
Displacement at draught T		t	
Velocity at MCR		knots	
Propulsion Power at MCR		kW	
Propulsion Power at CSR		kW	%MCR

Table 5 : Characteristics of the machinery

Propulsion machinery		
	Manufacturer	
	Type	
	Number of units	
	Max. continuous power	kW
	Shaft speed	rev./min
Type of propeller		
	Number of propellers	
	Number of blades	
	Shaft speed at MCR	rev/min
	Propeller Diameter	m
	Propeller Pitch at MCR	
Controllable Pitch	YES	NO
Stabilising fins, bow thruster etc. needed for normal operation:	YES	NO

Table 6 : Measuring instrumentation - noise

Instrumentation / Manufacturer	
Sound level meter	
Microphone	
Filter	
Calibrator	
Calibration of the sound level meter	
	Date of calibration in laboratory
	Date of calibration prior to measuring

Table 7 : Conditions during measurement

Date				
Starting time				
End time				
Position of the craft				
Type of voyage				
Conditions during measurement				
	Draught forward	m		
	Draught aft	m		
	Depth of water under keel	m		
Weather conditions				
	Wind force / speed	Bf - m/s		
	Sea state / average wave height	SS - m		
		CSR	MCR	x%MCR
Speed of the ship	knots			
Propeller shaft speed	rev/min			
Propeller pitch setting				
Propulsion machinery speed	rev/min			
Propulsion machinery power	kW			
Percentage of the Maximum Continuous Rate	%		100	
No. of propulsion machinery units operating				
No. of generators operating				
No. of units of auxiliary machinery operating				

Table 8 : Measuring results: measurements at operational power - details

Position No.	Type of space: Cb: Std. Cabin; S: Suite or mini-suite;A, B, C, D, E, F; Crew Cb: Crew Std. Cabin; Crew S: Senior officer cabins ; Crew office, Crew workspace, Crew navigation Crew public	S [m^2]	L_P [dB(A)]	L_{Aeq} [dB(A)]	$L_{X\%MCR}$ [dB(A)]	L_{MCR} [dB(A)]
1						
2						
...						

Table 9 : Measuring results: measurements at operational power - summary

Total number of measurements		Total number of Spaces	
No. of measurements ≤ L_A		% of measurements ≤ L_A	
No. of measurements ≤ L_B		% of measurements ≤ L_B	
No. of measurements ≤ L_B + 5 dB(A)		% of measurements ≤ L_B + 5 dB(A)	

Table 10 : Measuring results: measurements in conditions other than the CSR - summary

No. of measurements x% MCR		%	
No. of measurements $L_{x\%MCR}$ -L_{Aeq} ≤ 3 dB or $L_{x\%MCR} \leq L_A$ + 5 dB (A)		No. of measurements $L_{x\%MCR} \leq L_B$ + 5 dB (A)	
No. of measurements MCR		%	
No. of measurements L_{MCR} -L_{Aeq} ≤ 3 dB or $L_{MCR} \leq L_A$ + 5 dB (A)		No. of measurements $L_{MCR} \leq L_B$ + 5 dB (A)	

Table 11 : Measurements at berth (Acoustic insulation from airborne noise)

Type of wall:			
Delimited spaces:			
Position No.	R'_W measured	R'_W admitted	Deviation [dB]
1			
2			
...			

Table 12 : Measurements at berth (Acoustic insulation from impact sound)

Type of floor:			
Above space:			
Position No.	$L'_{n,W}$ measured	$L'_{n,W}$ admitted	Deviation [dB]
1			
2			
...			

SECTION 2 COMFORT WITH REGARD TO VIBRATIONS

1 General

1.1 Application

1.1.1 **COMF-VIB** notation, in accordance with Pt A, Ch 1, Sec 2, [6.5.3] is assigned to ships classed by the Society and complying with the requirements of this Section.

In the event that the ship undergoes modifications, refitting or repairs that may affect its level of comfort, the maintenance of the notation is subject to the results of new measurements as deemed appropriate by the Society.

The notation is completed by a letter **A**, **B** or **C** which represents the merit level achieved for the assignment of the notation, the merit **A** corresponding to the lowest level of vibration. The notation **COMF-VIB** is only assigned if at least merit level **C** is reached.

When the merit levels achieved for the person spaces (if any) and the crew spaces are different, the notation is completed by the suffix:

- **PAX**, for person spaces, and
- **CREW**, for crew spaces.

1.1.2 Ships not classed by the Society complying with the requirements of this Section are provided with a Certificate of Conformity which attests their comfort quality. The Certificate is valid for a period of 5 years and may be extended, at the request of the Owner, for an additional 5-year period based on a limited set of measurements covering at least 5% of those made when the Certificate was first issued.

1.1.3 The requirements apply to ships irrespective of the ship's age, as far as reasonable and practicable, to the satisfaction of the Society.

For ships of less than 65 m (length between perpendiculars), special consideration will be given by the Society, in particular concerning the requirements in item [7].

1.2 Basic principles

1.2.1 These Rules define the limits of acceptability of vibration on board, the methods for verification of compliance and the criteria for acceptance. They are based, as appropriate, on international standards and are deemed to preserve the general principles of such standards.

1.2.2 Verification of compliance is based on the measurements of vibration levels in ship spaces. These measurements are to be carried out either by a Surveyor of the Society or by a technician from a company recognised as qualified by the Society. In the latter case, measurements are to be performed under the surveillance of a Surveyor of the Society.

2 Definitions

2.1 Categories of spaces

2.1.1 General

For the purposes of this Section, a specific, comfort-related categorisation of the ship spaces is used.

2.1.2 Crew spaces

Crew spaces are those described in IMO Resolution A.468(XII).

2.1.3 Persons spaces

With the exception of garages, washrooms and toilets, to which the requirements of this Section do not apply, person spaces are the following:

a) **Standard cabins**

Spaces for private use of the persons, where the primary purpose is to rest.

b) **Suites or mini-suites**

Luxury finish cabins greater than 15m^2 with private lounge area with an extension at least 30% of the total surface.

c) **Type A entertainment spaces**

Enclosed spaces for person recreation and/or prolonged person stay where the noise level is normally high when in use (e.g. discos, theatres, cinemas, casinos, show rooms, etc.).

d) **Type B public spaces**

Enclosed spaces for person recreation and/or prolonged person stay where the noise level is not normally high when in use (e.g. self service restaurants, main restaurant, pullman seat rooms, lounge areas, bars, gymnasiums, conference halls and similar spaces, etc.).

e) **Type C public spaces**

Enclosed spaces for person recreation and/or prolounged person stay where the noise level is low (e.g. reading rooms, libraries, card rooms, chapels, special restaurants, health centre, sitting rooms, small lounges, and similar spaces, etc.).

f) **Type D public spaces**

Spaces where persons are not normally expected to stay long (e.g. shops, enclosed walkways, atriums, person laundrettes, halls and similar spaces, etc.).

g) **Type E transit spaces**

Spaces where persons are normally expected to stay for a short period of time (e.g. corridors, stairs, etc.).

h) **Type F open spaces**

Outside spaces for prolonged and/or recreational stay of persons (e.g. open walkways, sun decks, etc.).

2.1.4 Work Spaces

Service spaces (such as galleys, serveries, pantries, technical spaces, workshops, passageways, etc.) with significant random noise levels or potential high noise levels above 85dBA.

2.2 Vibration

2.2.1 Time variation of the value of a physical quantity described by either the motion or the position of a mechanical system when this value is alternatively greater or smaller than a mean reference value.

As far as these Rules are concerned, the physical quantity for reference is: in the frequency range from 1 to 5 Hz, the structural acceleration measure in mm/s^2, and in the frequency range from 5 to 100 Hz, the structural velocity measure in mm/s.

2.3 Operational power in the CSR condition

2.3.1 Operational power is the propulsion power, in kW, at which the ship is normally operated.

2.3.2 The operational power to be considered for the purpose of these Rules is 85% of the maximum continuous rate (MCR) defined in the following as the continuous service rate (CSR) condition.

2.3.3 Subject to the acceptance of the Society and to the agreement of the Owner and shipyard, a propulsion power at CSR other than 85% MCR is to be used, if such condition corresponds to the normal seagoing conditions.

3 General Requirements

3.1 Design requirements

3.1.1 Vibration design prognosis

A vibration design prognosis is a forecast based on Finite Element Models (FEM) of the full ship (3D models), carried out early in the design stage, of the expected vibration velocities in the ship spaces.

Although a vibration design prognosis is not required to be submitted, it is recommended that it should be carried out by the Designer, in particular for living quarter barges, in order to properly design the structural arrangements so as to prevent high vibration levels.

3.2 Constructional Requirements

3.2.1 Vibration measurement plan

A plan describing the proposed vibration measurement campaign, in compliance with [5.2], is to be developed. The plan is to include the extension and classification of ship zones and the proposed minimum number of measurements to be taken in each ship space. The aim is to obtain a rational distribution of measurement points throughout the ship.

3.2.2 Vibration measurement report

A duly signed detailed report is to be submitted. The forms shown in item [8] may be used for this purpose.

The report is to contain:

- position of measurement points
- measured vibration levels
- for each vibration measuring point, the spectrum of the structural velocity in the frequency range of investigation, as produced by the portable analyser, together with an indication of the frequency and value of the main peaks
- resulting comfort level

The following general data and conditions are to be recorded and included in the report:

- ship loading condition
- propulsion machinery, main auxiliaries, navigational aids, radio and radar sets
- water depth
- environmental conditions (wind and waves)

4 Documentation to be submitted

4.1 Measurement plan

4.1.1 The proposed detailed measurement plan, developed according to [3.2.1], is to be submitted for approval well in advance of the measurement campaign.

4.2 Vibration measurement results

4.2.1 A duly signed detailed report is to be submitted for approval. The format shown in item [8] is recommended.

The vibration measurement report is to be witnessed by a representative of the Builder, the Owner, a representative of the company which carried out the measurements and the Surveyor in charge of surveillance of the measurements.

5 Measurements of vibration levels

5.1 Testing conditions

5.1.1 General

Vibration levels are to be measured in the conditions defined below. Different conditions may be accepted as equivalent at the discretion of the Society.

As far as possible the ship is to proceed on a straight course.

5.1.2 Equipment running during the tests

During measurements, all auxiliary systems, forced ventilation and air conditioning systems (HVAC systems) and hotel service systems are to be operating in normal service conditions.

The rooms are to be fully equipped with furniture, furnishings, ceiling and actual deck covering (e.g. carpet).

5.1.3 Ship loading conditions

As far as practicable the ship loading conditions are to be as close as possible to the normal operating conditions.

5.1.4 Environmental conditions

In general, meteorological conditions are to be within the following limits:

- wind: not stronger than Beaufort 3 - strong breeze (speed 7 to 10 knots),
- waves: not stronger than force 3 - rough (significant wave height 0,5 to 1,25 m)
- ice according to technical specifications.

5.1.5 Propulsive Power

a) Measurements are to be carried out with the ship working at the operational power in the CSR condition in [2.3].

b) Additional measurements are to be carried out at 100% MCR and at x% MCR, the different propulsion power with respect to CSR is subject to the acceptance of the Society and to the agreement of the Owner and shipyard.

5.1.6 Other equipment

Subject to the acceptance of the Society and to the agreement of the interested party, equipment such as bow thrusters, stabilising fins etc., is to be operating during measurements if it is necessary for the ship to proceed in normal seagoing conditions and in the environmental conditions specified in [5.1.4].

With the above-mentioned equipment operating, special consideration may be given by the Society concerning the acceptable vibration level as per [7].

5.2 Measurement positions

5.2.1 General

Measurements are to be carried out in the spaces defined in [2.1] according to the general principles of ISO 4867-1984 and ISO 4868-1984. At the discretion of the Society, additional measurements are to be carried out where evidence of local vibration occurs.

For reference purposes, the components of vibration at least in 2 points on the same deck as close as possible to the longitudinal position of the propeller(s), one on the centreline, one on the side, are to be measured. It is recommended that for these 2 points, a real-time record of vibration with the time histories wave-form and the frequency spectra is provided.

5.2.2 In person spaces, at least 10 measurements points for each deck, with at least 3 measurements for the main vertical zone, are to be taken. 50 % of the measurement points are to be located in the zone between the ship's extreme aft and the forward bulkhead of the engine room.

For crew spaces at least 6 measurements for each deck are to be taken.

6 Instrumentation

6.1 General

6.1.1 Vibration levels (Vmis) are to be recorded by means of a portable analyser (vibrometer) in the frequency domain (spectrum). Instrumentation is to comply with the requirements of ISO 8041. This compliance is to be verified at least every two years by an organization recognised by the Society.

The date of last verification and confirmation of compliance with relevant standards is to be recorded. Calibration sheets are to be provided.

Where applicable, the fast fourier transform (FFT) analyser settings to obtain the vibration spectrum are to be the following:

- frequency range 1 - 100 HZ
- time window type hanning with overlap equal to 2/3 or 3/4 (66,7% or 75%)
- number of spectral line at least 400
- linear or exponential averaged spectra.

Different instrumentation settings will be considered by the Society on a case-by-case basis.

6.2 Measurement procedure

6.2.1 Vibration level measurements are to be carried out by recording the 0 - peak value of harmonic components of structural acceleration, in mm/s2 in the frequency range form 1 to 5 Hz and the structural velocity, in mm/s, in the frequency range from 5 to 100 Hz, by means of a portable analyser connected to an accelerometer.

Alternatively, Root Mean Square (RMS) values may be recorded instead of the 0 - peak values. It is noted that RMS values correspond to the 0 - peak value divided by 21/2.

The vibration levels of the spectra line are to be averaged over a length of time of at least 30 s. If significant evidence of modulation appears in the vibration levels, the spectrum will be averaged over a length of time of 60 s.

In the comfort level assessment, for each measurement position only the maximum vibration among the vertical, transversal or longitudinal components will be considered.

7 Acceptance Criteria

7.1 Vibration levels in the CSR condition

7.1.1 For each type of space, limit values (Vlim) depending on the vibration comfort level are given in Tab 1, as well as in Fig 1, which also shows the numerical limits (constant acceleration curve) for frequencies below 5 Hz.

Values of vibration levels above V_{lim} may be neglected provided that:

- they do not concern more than 10 % of the total area of deck within the main vertical zone

and they are below:

- V_{lim} + 1,5 mm/s for for frequency f: $5 \le f \le 100$ Hz.
- $a_{mis} \le a_{lim}$ + 47,1 mm/s^2 for frequency f: $1 \le f \le 5$ Hz.

7.2 Vibration levels at different condition than CSR

7.2.1 The aim of these measurements is to verify that on each deck the vibration levels are not excessive. The measurements are to involve critical areas up to 10 % of the total

number of measurements for each deck, taken at the operational power.

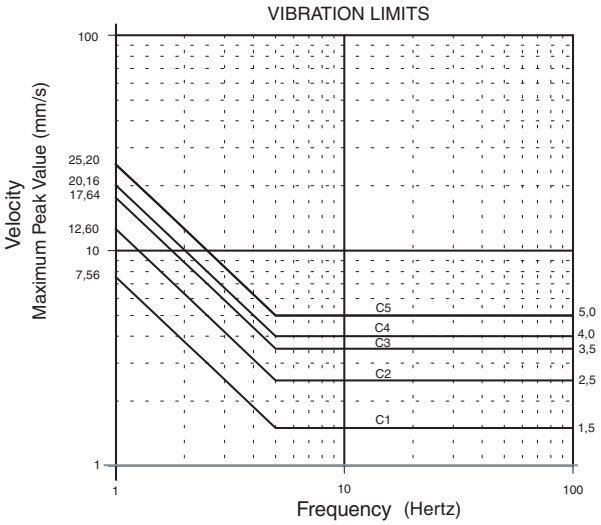
Critical areas are those where highest vibration levels have been measured.

For each critical area the measured values are to be compared with the following vibration limits.

Comfort level is assigned if at least:

- $V_{mis} \leq V_{lim} + 2,0$ mm/s for frequency f: $5 \leq f \leq 100$ Hz.
- $a_{mis} \leq a_{lim} + 62,8$ mm/s^2 for frequency f: $1 \leq f \leq 5$ Hz.

Figure 1 : All ships



7.3 Comfort Levels

7.3.1 The comfort level is rated on the basis of the actual rating reached by vibration level, provided that at least C level is reached.

The global vibration comfort level is assigned as follows:

a) Comfort level is A if:
   - at CSR all $V_{mis} \leq V_A$, and
   - the criteria in [7.2.1] in a condition other than the CSR are satisfied

b) Comfort level is B:
   - at CSR all $V_{mis} \leq V_A$,

   or
   - at CSR all $V_{mis} \leq V_B$, and the criteria in [7.2.1] in a condition other than the CSR are satisfied

c) Comfort level is C if at CSR all:
   - $V_{mis} \leq V_B + 1,5$ mm/s for frequency f: $5 \leq f \leq 100$ Hz.
   - $a_{mis} \leq a_B + 47,1$ mm/s^2 for frequency f: $1 \leq f \leq 5$ Hz.

Table 1 : CSR condition - Vibration limit levels

Type of Spaces	V_A		V_B	
Person spaces	1< f < 5 Hz Acceleration 0-peak mm/s^2 (RMS values = Peak / $2^{1/2}$)	5≤ f ≤ 100 Hz Vibration 0-peak mm/s (RMS values = Peak / $2^{1/2}$)	1< f < 5 Hz Acceleration 0-peak mm/s^2 (RMS values = Peak / $2^{1/2}$)	5≤ f ≤ 100 Hz Vibration 0-peak mm/s (RMS values = Peak / $2^{1/2}$)
Suites or mini-suites	31,4	1,0	78,5	2,5
Standard cabins	47,1	1,5	94,3	3,0
Type A, B, and D spaces	62,8	2,0	125,7	4,0
Type C spaces	47,1	1,5	94,3	3,0
Type E spaces	62,8	2,0	157,1	5,0
Type F spaces	94,3	3,0	157,1	5,0
Crew spaces	1< f < 5 Hz Acceleration 0-peak mm/s^2 (RMS values = Peak / $2^{1/2}$)	5≤ f ≤ 100 Hz Vibration 0-peak mm/s (RMS values = Peak / $2^{1/2}$)	1< f < 5 Hz Acceleration 0-peak mm/s^2 (RMS values = Peak / $2^{1/2}$)	5≤ f ≤ 100 Hz Vibration 0-peak mm/s (RMS values = Peak / $2^{1/2}$)
Crew cabins	62,8	2,0	110,0	3,5
Senior crew cabins	47,1	1,5	94,3	3,0
Navigation spaces	78,5	2,5	125,7	4,0
Radio Room	78,5	2,5	125,7	4,0
Hospital	47,1	1,5	94,3	3,0
Public crew spaces	78,5	2,5	157,1	5,0
Service spaces	78,5	2,5	157,1	5,0
Work spaces	78,5	2,5	125,7	4,0
Offices	78,5	2,5	125,7	4,0
Mess Room	78,5	2,5	125,7	4,0
ECR	78,5	2,5	125,7	4,0
Crew open deck	94,3	3,0	157,1	5,0

8 Report

8.1

8.1.1 The report for vibration measurements is to contain the following tables.

Table 2 : Characteristics of the ship

Name of the ship			
Register number RI			
Flag			
Name of the Owner			
Name of the shipyard			
Construction number			
Type of ship			
Dimensions			
	Length - L	m	
	Breadth - B	m	
	Depth - D	m	
	Max. draught - T	m	
Displacement at draught T		t	
Velocity at MCR		knots	
Propulsion Power MCR		kW	
Propulsion Power CSR		KW	%MCR

Table 3 : Characteristics of the machinery

Propulsion machinery		
	Manufacturer	
	Type	
	Number of units	
	Max. continuous power	kW
	Shaft speed	rev./min
Type of propeller		
	Number of propellers	
	Number of blades	
	Shaft speed at MCR	rev/min
	Propeller Diameter	m
	Propeller Pitch at MCR	
Controllable Pitch	YES	NO
Stabilising fins, bow thruster etc. needed for normal operation:	YES	NO

Table 4 : Measuring instrumentation - vibration

Instrumentation / Manufacturer
Type

Table 5 : Conditions during measurement

Date			
Starting time			
Finishing time			
Position of the craft			
Type of voyage			
Conditions during measurement			
Draught forward m			
Draught aft m			
Depth of water under keel m			
Weather conditions			
Wind force / speed Bf -m/s			
Sea state / average wave height SS -m			
	CSR	MCR	x%MCR
Speed of the ship knots			
Propeller shaft speed rev/min			
Propeller pitch setting			
Propulsion machinery speed rev/min			
Propulsion machinery power kW			
Percentage of the Maximum Continuous Rate %		100	
No. of propulsion machinery units operating			
No. of generators operating			
No. of units of auxiliary machinery operating			

Table 6 : Measuring results: measurements at operational power - details

Position No.	Type of space: Cb: Std. Cabin; S: Suite or mini-suite;A, B, C, D, E, F; Crew Cb: Crew Std. Cabin; Crew S: Senior officer cabins ; Crew office, Crew workspace, Crew navigation, Crew public	Freq. V_{mis} [hz]	V_{mis} 0 - peak [mm/s] CSR	V_{mis} 0 - peak mm/s MCR	V_{mis} 0 - peak mm/s x%MCR
1					
2					
...					

Table 7 : Measuring results: measurements in the CSR condition - summary

Total number of measurements			
No. of measurements ≤ V_A		% of measurements ≤ V_A	
No. of measurements ≤ V_B		% of measurements ≤ V_B	
No. of measurements ≤ V_B + 1 mm/s		% of measurements ≤ V_B + 1,0 mm/s	

Table 8 : Measuring results: measurements in conditions other than the CSR - summary

No. of measurements x% MCR		%	
No. of measurements x% MCR ≤ V_A + 2 mm/s		% ≤ V_A + 2 mm/s	
No. of measurements x% MCR ≤ V_B + 2 mm/s		% ≤ V_B + 2 mm/s	
No. of measurements MCR		%	
No. of measurements MCR ≤ V_A + 2mm/s		% ≤ V_A + 2 mm/s	
No. of measurements MCR ≤ V_B + 2mm/s		% ≤ V_B + 2 mm/s	

SECTION 3 COMFORT WITH REGARD TO CLIMATE

1 General

1.1 Application

1.1.1 Premise

The feeling of comfort with regard to climate is subjective and depends on many different factors, such as environmental factors (air temperature, temperature gradient, thermal radiation, light, air speed, humidity, etc.) and personal factors (metabolism, state of person's health, clothing, activity, etc.). This makes it almost impossible to determine a standard which may establish satisfactory conditions for all people.

However, there are certain ranges of temperatures, humidity, air speed, etc. that may give a feeling of comfort to the majority of healthy people, wearing standard type of clothes and performing normal activity in a certain space, the number of unsatisfied people being limited to a small percentage of the total occupants of such a space.

The purpose of these Rules is to establish a number of climatice parameters that can satisfy the majority of crew and persons on a ship and the way to ascertain that the HVAC system of the ship is adequate to provide such arrangements in all the design conditions.

1.1.2 Application

a) The notation **COMF-AIR**, in accordance with Pt A, Ch 1, Sec 2, [6.5.4], will be granted to ships complying with the requirements of this section.

b) The notation **COMF-AIR** may have one of the suffixes **W** and/or **S** meaning that the HVAC system has been satisfactorily tested in Winter and/or Summer conditions, respectively, as stated in [1.5.1].

c) These Rules apply to spaces in which there are normally people (accommodation spacesfor crew and persons, wheelhouses, control rooms, offices).

d) The Rules are not applicable to service spaces, such as laundries, galleys, workshops, stores, service stairs and garages, which are to comply with the existing applicable national standards (if any).

1.1.3 Ship categories

Ships are divided into two main categories, taking into consideration the specifics of the ship in the air control field, and the technical feasibility for the ship to comply with these Rules at a reasonable cost:

a) Heavy duty ships, namely all types of cargo ships, including tankers, bulk carriers, etc. where minimum comfort is necessary to prevent human errors due to excessive stress of the crew, caused by an unsatisfactory climatic condition in those spaces where activities essential for the safety of the ship are performed.

b) Not propelled unit, including living quarter barges.

1.2 Definitions

1.2.1 HVAC

HVAC is a combined heating-ventilation-air conditioning system.

1.2.2 Crew accommodation

Crew accommodation includes cabins, offices, hospitals, mess rooms, recreation rooms and open deck areas to be used by the ship's officers and crew.

1.2.3 Person accommodation

Person accommodation includes all areas intended to be used by the persons.

1.2.4 Public spaces

a) Public spaces are all those spaces allocated to persons, including public spaces for prolonged and/or recreational stay, as well as spaces for non prolonged person stay.

b) Service stairs and garages are not considered as part of this definition.

c) As far as these Rules are concerned, the following definitions of enclosed public spaces are used:

1) Type A spaces:

Enclosed spaces for either person recreation and/or prolonged person stay intended for intensive physical activity (discos, gymnasiums, etc.)

2) Type B spaces:

Enclosed spaces for either person recreation and/or prolonged person stay intended for medium physical activity or which are normally crowded (restaurants, bars, cinemas, gaming rooms, conference halls, theatres, casinos, lounges, etc.)

3) Type C spaces:

Enclosed spaces for either person recreation and/or prolonged person stay intended for light physical activity (reading rooms, libraries, card rooms, chapels, etc.)

4) Type D spaces

Spaces where persons are not normally expected to stay long (shops, enclosed walkways, halls, corridors, etc.).

1.2.5 Person cabins, suites and mini-suites

Person cabins, suites and mini-suites are spaces for private use of persons.

1.2.6 Climate

Climate is the set of physical factors that affect the feeling of comfort or discomfort of persons in a certain environment.

1.2.7 Ambient temperature (internal)

The ambient temperature is the average temperature resulting from a number of different temperature measurements taken in a certain time in a specific space.

1.2.8 Temperature gradient

For the purpose of these Rules, the temperature gradient is the vertical difference in temperature in a certain location between a point located at a distance of 0,1 m from the floor and a point located at a distance of 1,7 m from the floor.

1.2.9 Outside air temperature

The outside air temperature is the temperature measured outside the space considered in a position which is not exposed to the sun.

1.2.10 Dry bulb temperature

The dry bulb temperature is the temperature indicated by a dry temperature-sensing element shielded from the effects of radiation.

1.2.11 Wet bulb temperature

The wet bulb temperature is the temperature measured by a thermometer whose bulb is covered by a wetted wick and exposed to a current of rapidly moving air.

1.2.12 Relative humidity

Relative humidity is the ratio between the mass of vapour present in a volume of air and the mass of vapour required to saturate the same volume of air.

1.2.13 Air velocity

Air velocity is the mean velocity of a mass of air.

1.2.14 Draught

Draught is the local cooling of the body due to air movement. In general this is an unpleasant feeling.

1.2.15 Thermo-refrigerating station

The thermo-refrigerating station includes the refrigerating units and the thermal units.

a) The refrigerating unit includes one or more refrigerant compressors with associated condensers and evaporators, with the relevant control and regulation apparatus, as well as the sea water pumping system for cooling the condenser.

   The refrigeration of the air may be obtained by one of the following methods:

   - by expansion of the refrigerant;
   - by heat exchange with a flow of cooled air. In such case the refrigerating unit includes the pumping system necessary for the circulation of the secondary refrigerants.

b) The thermal unit includes one or more heat exchangers for the production of the hot water necessary to heat the air, the control and regulation apparatus, as well as the pumping system for the circulation of the hot water.

1.2.16 Air treatment unit

The air treatment unit is an adequately fitted and insulated metallic box containing all the equipment (fans, cold and hot heat exchangers, humidifying filters, condensate water collecting pans, etc.) necessary to treat the external air and to prepare the mixture of air to be sent to the various spaces.

1.3 Basic principles

1.3.1 Compliance with the Rules

Compliance with these Rules is verified by means of plan review and measurements to be carried out on board in the conditions and locations indicated in this Section.

1.3.2 Measurements

The measurements, required by this Section, are to be taken either by a Surveyor from the Society or by a technician from a company recognised as suitable by the Society. In the latter case, measurements are to be carried out under the surveillance of a Surveyor.

1.3.3 International standards

These Rules are based on the most recent international standards and requirements relevant to climatic conditions. Tab 1 lists some of these standards. The list is given for information; where some of the listed standards have more severe requirements than those indicated in this Section, compliance with the following requirements is considered sufficient for the issuance of the **COMF-AIR** notation, unless otherwise indicated.

1.4 Documentation to be submitted

1.4.1 Description of HVAC system

A description of the HVAC system is to be submitted to the Society. Such description is to include the technical specification of the system and the design criteria.

The subsequent analysis will be used as the basis for the assessment of the results of the measurements on board (see [1.5.1] and [3.2.4]).

Table 1 : International standards

Standard	Number	Title
ISO	7726	Thermal environments - Instruments and methods for measuring physical quantities
ISO	7730	Moderate thermal environments - Determination of PMV and PPD indices
ISO	7547	Air conditioning and ventilation of accommodation spaces on board ships - Design considerations and basis of calculations
ISO	8862	Air conditioning and ventilation of machinery control rooms on board ships - Design conditions and basis for calculations
ISO	8864	Air conditioning and ventilation of wheelhouse on board ships - Design conditions and basis for calculations
ANSI /ASHRAE	55-1992	Thermal environmental conditions for human occupancy
ANSI /ASHRAE	62-1989	Ventilation for acceptable indoor air quality
ANSI /ASHRAE	1995 Handbook	HVAC applications
ANSI /ASHRAE	1997 Handbook	Fundamentals
WHO **(1)**	EURO reports and studies 78, 83	Indoor air pollutants -Exposure and health effects
WHO **(1)**	Series 23,1987	Air quality guidelines for Europe
(1) World Health Organization		

1.4.2 Measurement plan

a) In order to obtain the notation, measurements of temperature, air velocity and humidity are to be taken as indicated in [3.1] and [3.2].

b) A detailed measurement plan is to be submitted, in order to assess compliance with these Rules.

c) The plan is to include:
- extension and classification of ship zones
- position of ventilation and HVAC system inlets and outlets
- type and minimum number of measurements to be taken in each ship space concerned
- proposed locations of measurement points
- expected environmental conditions during the measurements.

1.5 Measurements on board

1.5.1 Measurement conditions

a) Due to the impossibility of performing enough representative measurements to demonstrate the functioning of the HVAC in the full range of design climatic environmental conditions, at least two sets of measurements are to be performed to represent the Winter and Summer conditions respectively, as follows:

1) Winter conditions
- Difference of temperature between actual outside air temperature and design indoor temperature not less than 50% of the difference between the design outside air temperature and the design indoor temperature.
- Weather conditions may be cloudy to partly cloudy sky.

2) Summer conditions
- Difference of temperature between actual outside air temperature and design indoor temperature not less than 50% of the difference between the design outside air temperature and the design indoor temperature.
- Difference of humidity between actual outside air humidity and indoor humidity not less than 50% of the difference between the design outside air humidity and the design indoor humidity.
- Weather conditions are to be clear to partly cloudy sky.

b) Subject to satisfactory completion of one of the two sets of measurements, the **COMF-AIR** notation followed by the appropriate suffix **W** or **S,** depending on the actual testing conditions, will be granted to the ship. Subject to satisfactory completion of the second set of measurements, if requested by the Owner, the full **COMF-AIR** notation (without any limitation) will be granted. In general this second set of measurements is to be performed within one year from the completion of the first set.

c) The results of these two sets of measurements will be compared with the documents mentioned in [1.4.1] and [3.2.4]. Where these results are not found to be in

substantial agreement, additional measurement sets may be requested by the Society.

d) In the case of ships mainly intended for particular trades, alternative requirements may be considered by the Society on a case -by-case basis.

1.5.2 Reporting of results

a) Upon completion of a measurement set, as per [1.4.2] [1.5.1]and [3.2], a detailed report is to be submitted. The forms shown in [5] may be used for this purpose.

b) The report is to contain:

- position of measurement points
- measured levels

c) The following general data and conditions are to be recorded and included in the report:

- ship loading condition
- propulsion machinery, main auxiliaries, navigational aids, radio and radar sets
- water depth
- environmental conditions.

2 Basic design requirements

2.1 Design criteria

2.1.1 General

Alternative design conditions may be used, provided acceptable technical justification are forwarded to the Society.

2.1.2 Air design temperature

a) The design outside air temperature is to be taken as follows:

- WINTER

  not over - 5 °C,

- SUMMER

  not less than + 32 °C.

b) The design inside air temperatures are given in [3.2].

2.1.3 Sea water design temperature

The design sea water temperature is to be taken as follows:

- WINTER

  not more than - 2 °C,

- SUMMER

  not less than 30 °C.

2.1.4 Humidity

a) The design outside relative humidity in Summer is to be taken not less than 70%.

b) The design inside relative humidity in Winter and in Summer is to be in accordance with [3.2.5], however in any case it is to be not less than 30% and not more than 60%.

2.2 Design details

2.2.1 Temperature control

a) An adequate system for the control and the regulation of the temperature is to be provided.

b) For living quarter barges all the above regulators fitted in the suites, mini-suites and person cabins are to be arranged with a device for automatic regulation of the temperature.

2.2.2 Temperature gradient

The temperature gradient, as defined in [1.2.8], is not to exceed 3 ° C.

2.2.3 Temperature difference

In general the difference in temperature between two different locations at the same level (height from the floor) of a space is not to exceed 2 °C.

2.2.4 Floor temperature

The surface temperature of the floors is to be not less than 19°C and not greater than 26°C. Where a floor heating system is used, different values may be agreed with the Society.

2.2.5 Service continuity

a) A reduction of the plant capability due to a failure of equipment is acceptable for the refrigerating part of the system.

b) In the case of any failure of the plant, it is to be capable of continuing to work in those spaces which are not affected by the failure.

2.2.6 Machinery and equipment

The various system components such as prime movers, compressors, pressure vessels, heat exchangers, ducts, filters, etc. are to be designed, built and tested in accordance with the applicable parts of the Rules.

2.3 Ventilation

2.3.1 Calculation of air supply

The supply of air to each space is to be calculated in accordance with the Standard “ISO 7547”, considering the gross volume of the space considered without any deduction for furniture and other stationary equipment.

2.3.2 Air recirculation

The air supply may partly consist of recirculated air. However, the supplied air to each space is to have an airflow of outdoor air not less than 0,008 m^3/s for each person for which the space is designed, or equal to at least 40% of the total supplied air, whichever is the greater.

2.3.3 Air temperature

The temperature at the inlet of the air supplied to a space is to be:

- not less than 10 °C lower than the average temperature in the space , when in the cooling mode;
- not more than 23 °C higher than the average temperature in the space, when in the heating mode.

2.3.4 Air velocity

For air velocity design requirements see [3.2.10].

2.3.5 Air quality

a) Ventilation ducts are to be constructed and maintained in such a way as to minimise the opportunities for the growth and dissemination of micro-organism through the ventilation system.

b) Airborne particulate contaminants, such as microrganisms, dust, fumes, smoke, and other dangerous substances are to be captured by adequate filters and/or dust collectors.

2.3.6 Filters

a) Filters are to be of a type that is easy to clean or replace and only requiring the shut off for a limited time of the ventilation of one sector of the ship.

b) Tab 2 indicates the minimum required filtering capacity for certain spaces of the ships.

Table 2 : Filtering capacity

Space	Minimum dimensions of 90% of particles trapped by new filters in micron	
	Living quarter barges	Heavy cargo ships
Suites or mini-suites	1	-
Standard person cabins	4	-
Type A recreational space	4	-
Type B recreational space	4	-
Type C recreational space	1	-
Type D recreational space	9	-
Wheelhouse	4	4
Radio room	4	4
Crew cabins	9	9
Offices	4	9
Mess rooms	9	9
Hospitals	1	4
Engine control rooms	9	9

2.3.7 Alternative ventilation system

An alternative natural or forced ventilation system is to be provided for wheelhouses, control rooms and hospitals, in case of a major failure of the main HVAC system.

2.4 Calculations of heat gains and losses

2.4.1 The calculations of heat gains and losses are to be carried out by means of a Standard acceptable to the Society, using parameters obtained from standards, experience, direct measurement and data banks.

2.5 Maintenance

2.5.1 The HVAC is to be designed and arranged in such a way as to enable inspections, cleaning and ordinary maintenance without stopping the entire system, and shutting off only one section of the plant at a time for a limited period.

2.6 Inspection and tests during manufacturing

2.6.1 Prime movers, compressors, pressure vessels, heat exchangers, ducts, etc. are to be tested at the Manufacturer's premises in accordance with the applicable parts of the Rules.

2.7 Inspection and testing after completion

2.7.1 Hydrostatic tests

After installation on board and prior to starting operation, the plant is to be subjected to a test at its maximum working pressure.

However, all pressure piping portions which have welded joints made on board are to be subjected to a strength test at a pressure equal to 1,5 times the rated working pressure before being insulated.

2.7.2 Tests of the ventilation system

a) After installation, the ventilation system is to be tested and the pressure, air capacity in cubic metres per minute, maximum rotational speed and power absorbed by the fans are to be recorded.

b) The distribution of air in the various spaces is to be checked.

c) The setting systems of the various plants are to be tested.

2.7.3 Water system tests

The hot and cold water system is to be subjected to working tests.

2.7.4 Operational tests

For the operational tests on board see [1.5] and [3.2].

3 Experimental test criteria

3.1 General

3.1.1 Different conditions may be considered, if accepted, as equivalent for the purposes of these Rules at the discretion of the Society.

3.2 Comfort level

3.2.1 Parameters to be measured

a) In each of the spaces indicated in Tab 3 the following parameters are to be measured and recorded:
- Ambient temperature (internal)
- Average air velocity
- Average relative humidity.

b) Additional measurements of temperature gradient and floor temperature in certain representative locations will be agreed on a case-by-case basis with the Society.

3.2.2 Measurement positions

a) Measurements are to be taken in all the public and working spaces as well as in at least one cabin for each type and for each plant sector; however not more than 30% of the cabins, suites and mini-suites need to be tested.

b) The cabins selected for the measurements are to be evenly distributed in the various decks and fire zones of the ship.

c) For small sloating hotels and heavy cargo ships, at least three cabins are to be measured for each deck and/or each fire zone.

d) The minimum number of measuring points is to be as follows:

- Cabins having a floor surface equal to or less than 25 m^2, 1 measurement point.
- Suites, mini-suites and hospitals having a floor surface greater than 25 m^2, 1 measurement point for every additional 25 m^2 (or fraction) of floor surface.
- Other spaces having a floor surface equal to or less than 60 m^2, 1 measurement point.
- Other spaces having a floor surface greater than 60 m^2, 1 measurement point for the first 60 m^2 plus 1 measurement point for every additional 80 m^2 (or fraction) of floor surface.

e) The temperature measurements are to be taken either in the middle of the space concerned (when only one measurement point is foreseen) or in positions which can be considered representative of the whole space (when more than one measurement point is foreseen). However, the distance of the measurement points from the walls and/or the HVAC system inlets and outlets is not to be less than 0,5 m. The distance of the measurement points from the floor is to be between 1,0 m and 1,7 m.

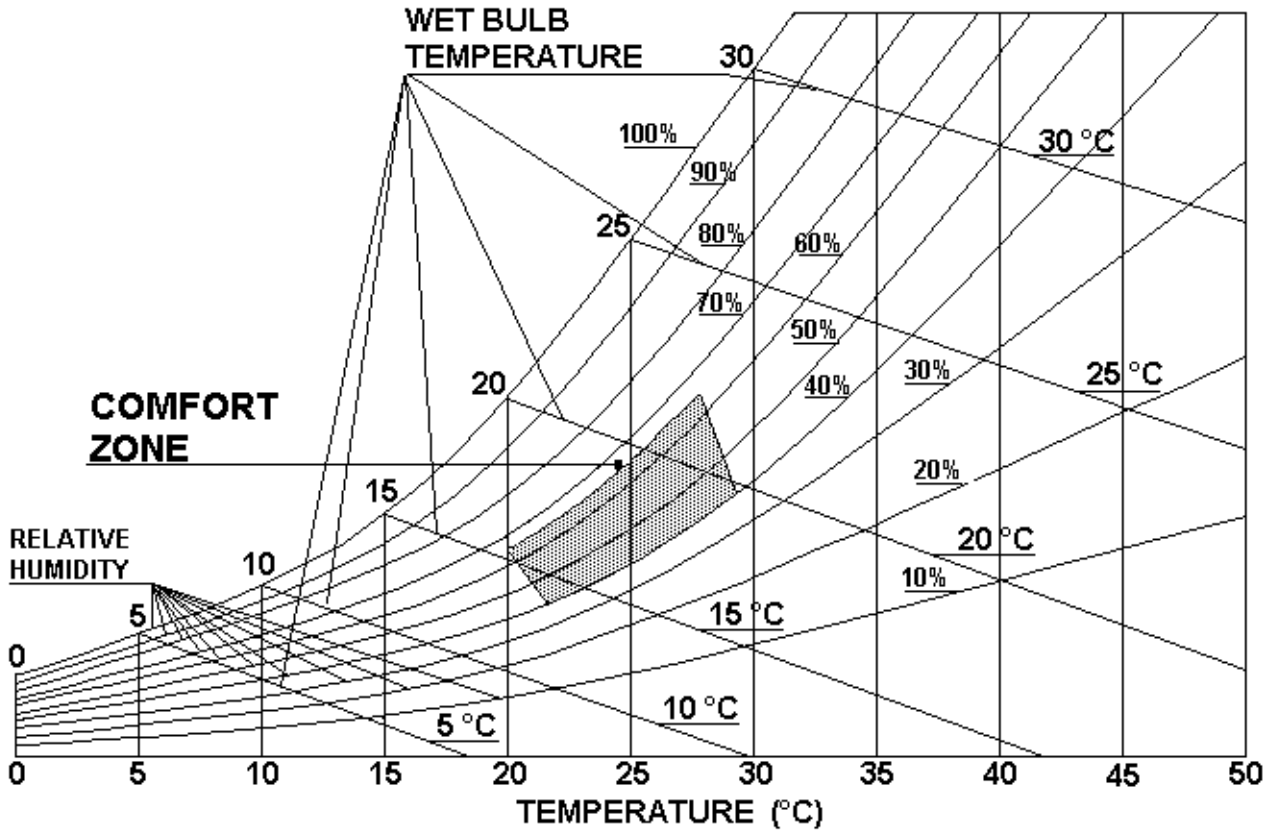
3.2.3 Temperature ranges

Tab 3 indicates the nominal ranges of the reference temperature T_o in Winter and in Summer conditions in the various spaces of the ship. The values actually obtained during the measurement are to be within the limits indicated in Tab 3, as modified in [3.2.6] [3.2.7], [3.2.8], [3.2.9].

Table 3 : Reference internal temperature ranges

Space	Winter conditions				Summer condition			
	Living quarter barges		Heavy cargo ships		Living quarter barges		Heavy cargo ships	
	Max T_o (°C)	Min T_o (°C)	Max T_o (°C)	Min T_o (°C)	Max T_o (°C)	Min T_o (°C)	Max T_o (°C)	Min T_o (°C)
Suites or mini-suites	23	22	-	-	25	22	-	-
Standard person cabins	23	22	-	-	26	22	-	-
Type A space	23	20	-	-	26	22	-	-
Type B space	23	21	-	-	26	22	-	-
Type C space	23	22	-	-	26	22	-	-
Type D space	23	21	-	-	26	22	-	-
Wheelhouse	23	22	23	22	25	22	25	22
Safety stations	23	22	23	22	25	22	25	22
Crew cabins	23	20	23	21	26	22	26	22
Offices	23	22	23	21	25	22	25	22
Mess rooms	23	21	23	21	26	22	26	22
Hospitals	23	22	23	22	25	22	25	22
Engine control rooms	23	22	23	22	25	22	25	22

Figure 1 : Psychrometric chart



3.2.4 Evaluation and correction of measured data

Where the measurements are carried out with an outside air temperature different from the design temperature, the measured values are to be checked against the lines of a compensation chart prepared by the shipyard and accepted by the Society.

3.2.5 Relative humidity

For all the spaces indicated in Tab 3 the measured relative humidity is to be contained in the shadowed area of the psychrometric chart in Fig 1.

3.2.6 Temperature comfort limits for living quarter barges in Winter conditions

For each measured temperature, the T_{meas} values are to be compared with Tab 3.

a) Suites or mini-suites, type C spaces, hospitals

Comfort level is considered satisfactory if:

all T_{meas} values are between T_{max} - 1 °C and T_{max} + 1,5 °C, except for less than 20% of measured values, which are to be not less than T_{min} - 0,5 °C.

b) Person cabins, type A, B and D spaces, wheelhouses, safety stations, control rooms

Comfort level is considered satisfactory if:

all T_{meas} values are between T_{max} - 1,5 °C and T_{max} + 1,5 °C, except for less than 20% of measured values, which are to be not less than T_{min} - 1 °C.

c) All other spaces

Comfort level is considered satisfactory if:

all T_{meas} values are between T_{max} - 2 °C and T_{max} + 1,5 °C, except for less than 30% of measured values, which are to be not less than T_{min} - 1,5 °C

d) Fig 2 gives a graphic representation of the temperature comfort limits for passenger ships in Winter conditions.

The comfort limits for living quarter barges are to be the same.

3.2.7 Temperature comfort limits for heavy cargo ships in Winter conditions

For each measured temperature, the T_{meas} values are to be compared with Tab 3.

a) Wheelhouses, radio rooms, safety stations and hospitals

Comfort level is considered satisfactory if:

all T_{meas} values are between T_{min}- 0,5 °C and T_{max} + 1,5 °C, except for less than 30% of measured values, which are to be not less than T_{min} - 1 °C.

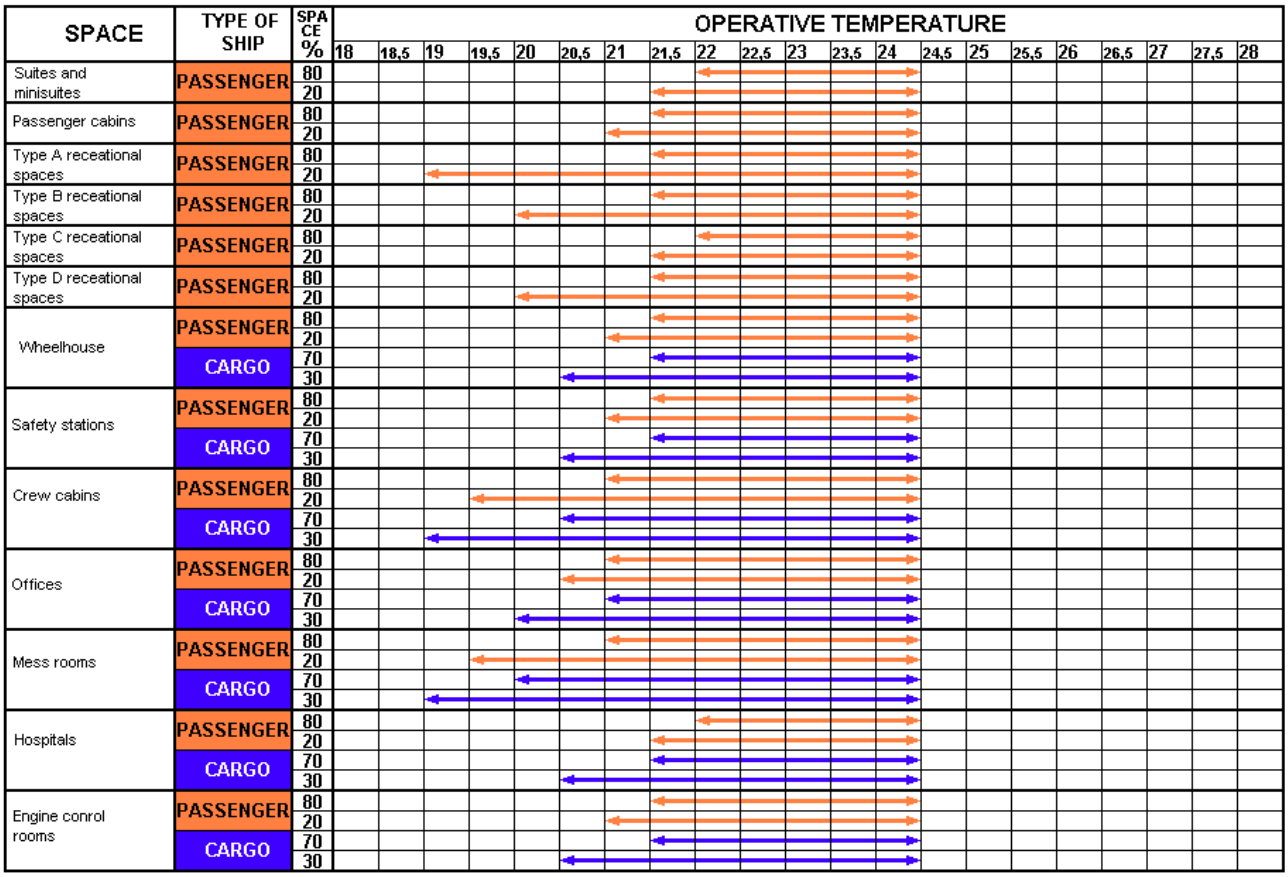
b) All other spaces

Comfort level is considered satisfactory if:

all T_{meas} values are between T_{min}- 0,5 °C and T_{max} +1,5 °C, except for less than 30% of measured values, which are to be not less than T_{min} - 2 °C.

c) Fig 2 gives a graphic representation of the temperature comfort limits for heavy cargo ships in Winter conditions.

Figure 2 : Temperature comfort limits in Winter conditions (passenger and heavy cargo ships)



3.2.8 Temperature comfort limits for floating ships in Summer conditions

For each measured temperature, the T_{meas} values are to be compared with Tab 3.

a) Suites or mini-suites, type C spaces, hospitals

Comfort level is considered satisfactory if:

all T_{meas} values are between T_{min} - 0,5 °C and T_{min} + 2,5 °C, except for less than 20% of measured values, which are to be not greater than T_{max} + 0,5 °C

b) Person cabins, type A, B and D spaces, wheelhouses, safety stations, control rooms

Comfort level is considered satisfactory if:

all T_{meas} values are between T_{min} - 1 °C and T_{min} + 3 °C, except for less than 20% of measured values, which are to be not greater than T_{max} + 1 °C.

c) All other spaces

Comfort level is considered satisfactory if:

all T_{meas} values are between T_{min} - 1,5 °C and T_{min} + 3,5 °C, except for less than 20% of measured values, which are to be not greater than T_{max} + 1,5 °C.

d) Fig 3 gives a graphic representation of the temperature comfort limits for passenger ships in Summer conditions.

The comfort limits for living quarter barges are to be the same.

3.2.9 Temperature comfort limits for heavy cargo ships in Summer conditions

For each measured temperature, the T_{meas} values are to be compared with Tab 3.

a) Wheelhouses, safety stations, control rooms and hospitals

Comfort level is considered satisfactory if:

all T_{meas} values are between T_{min} - 1 °C and T_{max} + 0,5 °C, except for less than 30% of measured values, which are to be not greater than T_{max} + 1,5 °C.

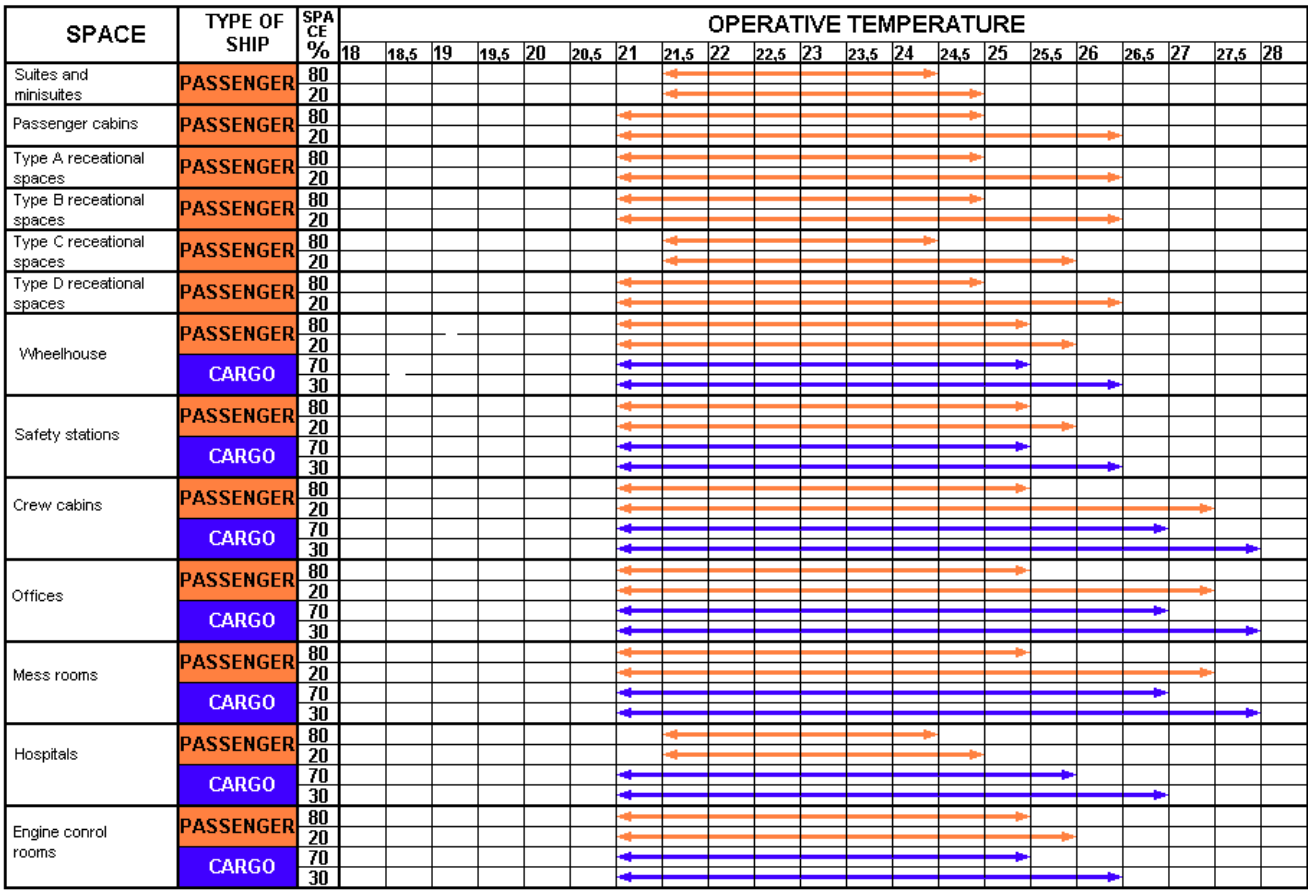
b) All other spaces

Comfort level is considered satisfactory if:

all T_{meas} values are between T_{min} -1,5 °C and T_{max} + 1 °C, except for less than 30% of measured values, which are to be not greater than T_{max} + 2 °C.

c) Fig 3 gives a graphic representation of the temperature comfort limits for heavy cargo ships in Summer conditions.

Figure 3 : Temperature comfort limits in Winter conditions (passenger and heavy cargo ships)



3.2.10 Air velocity ranges

Tab 4 indicates the ranges of the air velocity in Winter and Summer conditions.

Table 4 : Air velocity ranges

Space	Living quarter barges		Heavy cargo ships	
	Max air velocity (m/s)	Min air velocity (m/s)	Max air velocity (m/s)	Min air velocity (m/s)
Suites or mini-suites	0,25	0,15	-	-
Standard person cabins	0,35	0,25	-	-
Type A recreational space	0,40	0,25	-	-
Type B recreational space	0,40	0,25	-	-
Type C recreational space	0,35	0,20	-	-
Type D recreational space	0,40	0,25	-	-
Wheelhouse	0,30	0,20	0,30	0,20
Safety station	0,30	0,20	0,30	0,20
Crew cabins	0,40	0,25	0,45	0,30
Offices	0,35	0,25	0,45	0,30
Mess rooms	0,40	0,25	0,45	0,30
Hospitals	0,25	0,15	0,25	0,15
Engine control rooms	0,30	0,20	0,30	0,20

3.3 Notation for living quarter barges

3.3.1 For living quarter barges the notations may be granted even though the comfort level of the spaces not commonly used by the persons does not reach the values established for such spaces, provided they can at least reach the values established for the same spaces in heavy cargo ships.

4 Testing procedures

4.1 Instrumentation

4.1.1 Thermometers

Temperature and humidity are to be measured by wet-and-dry bulb thermometers or by other approved methods.

4.1.2 Calibration

Measuring instruments are to be properly calibrated according to a recognised standard.

5 Appendix 1 - Forms

5.1 Characteristics of the ship

5.1.1 Tab 5 indicates the suggested format for recording data relative to the ship.

5.2 Characteristics of machinery

5.2.1 Tab 6 indicates the suggested format for recording data relative to the ship machinery.

Table 5 : Characteristics of the ship

Characteristics of ship		
Name of the ship		
Register number - RI		
Flag		
Port of registry		
Name of the shipowner		
Name of the shipyard		
Place of building		
Construction number		
Type of ship		
Dimensions	Length - L_{pp} (m)	
	Breadth -B (m)	
	Depth - D (m)	
	Max. draught - T (m)	
Displacement at draught T		
Date of delivery		

Table 6 : Characteristics of machinery

Characteristics of machinery		
Propulsion machinery	Manufacturer	
	Type	
	Number of units	
	Max continuous power (kW)	
	Shaft speed (rev/min)	
Main reduction gear	Manufacturer	
	Type	
	Reduction ratio	
Type of propeller	Type of propellers	
	Number of propellers	
	Number of blades	
	Shaft speed at max. continuous power (rev/min)	
Main auxiliaries	Manufacturer	
	Type	
	Number of units	
	Max continuous power (kW)	

5.3 Measuring instruments

5.3.1 Tab 7 indicates the suggested format for recording data relative to the measuring instruments.

5.4 Conditions during measurement

5.4.1 Tab 8 indicates the suggested format for recording data relative to the conditions during measuring.

5.5 Measuring results

5.5.1 The following tables are an outline of the general scheme in which the measurement positions of the climate are indicated.

Table 7 : Measuring instruments

Characteristics of instruments			
Instrument		Manufacturer	Type of instrument
Thermometer			
Anemometer			
Calibration of the thermometer	Date in laboratory		
	Date prior to measuring		
Calibration of the anemometer	Date in laboratory		
	Date prior to measuring		

Table 8 : Conditions during measurement

Conditions during measurements		
Date		
Starting time		
Finishing time		
Position of the ship		
Type of voyage		
Conditions during measurement	Draught forward (m)	
	Draught aft (m)	
	Depth water under keel (m)	
Weather conditions	Wind force / speed (Bf -m/s)	
	Sea state / average wave height (SS -m)	
Average outside air temperature		
Speed of the ship (knots)		
Propeller shaft speed (rev/min)		
Propeller pitch		
Propulsion machinery speed (rev/min)		
Propulsion machinery power (kW)		
No. of operating propulsion machineries		
No. of D/A operating engines		
No. of auxiliary machineries		

5.5.2 Tab 9Tab 10, Tab 11 and Tab 12 are the suggested formats for recording the measurements carried out in suites or mini-suites, type C recreational spaces and hospitals.

5.5.3 Tab 13, Tab 14, Tab 15 and Tab 16 are the suggested formats for recording the measurements carried out in person cabins, type A, B and D spaces, wheelhouses, safety stations, control rooms.

Table 9 : Suites, mini-suites, type C recreational spaces and hospitals - Measurement in Winter conditions - Detail

Position number	Type of space	Area (m^2)	Humidity	AV_{meas}	Outside air temperature T_a	Measured ambient temperature (internal) T_{meas}	Corrected internal air temperature T_o **(1)**
1							
2							
3							
.....							
(1) Ambient temperature (internal) corrected in accordance with [3.2.4]							

Table 10 : Suites, mini-suites, type C recreational spaces and hospitals - Measurement in Winter conditions - Summary

Total number of measurements							
Operative temperatures			Air velocity			Humidity	
Measurement	Number	%	Measurement	Number	%	Max.	Min.
T_{max}-0,5≤T_o≤T_{max}+1,5			AV_{meas}≤ AV_{min}				
			AV_{meas}≤ AV_{min}+0,05				
T_{max}-1≤T_o≤T_{max}+1,5			AV_{meas}≤ AV_{min}+0,05				
			AV_{meas}≤ AV_{min}+0,10				
T_{min}≤T_o≤T_{max}+1,5			AV_{meas}≤ AV_{max}				
T_{min}−1≤T_o≤T_{max}+1,5			AV_{meas}≤ AV_{max}+0,10				

Table 11 : Suites, mini-suites, type C recreational spaces and hospitals - Measurement in Summer conditions - Detail

Position number	Type of space	Area (m^2)	Humidity	AV_{meas}	Outside air temperature T_a	Measured ambient temperature (internal) T_{meas}	Corrected internal air temperature T_o **(1)**
1							
2							
3							
.....							
(1) Ambient temperature (internal) corrected in accordance with [3.2.4]							

Table 12 : Suites, mini-suites, type C recreational spaces and hospitals - Measurement in Summer conditions - Summary

Total number of measurements							
Operative temperatures			Air velocity			Humidity	
Measurement	Number	%	Measurement	Number	%	Max.	Min.
T_{min}-0,5≤T_o≤T_{min}+0,5			AV_{meas}≤ AV_{min}				
			AV_{meas}≤ AV_{min}+0,05				
T_{min}-0,5≤T_o≤T_{min}+2,5			AV_{meas}≤ AV_{min}+0,05				
			AV_{meas}≤ AV_{min}+0,10				
T_{min}-0,5≤T_o≤T_{max}			AV_{meas}≤ AV_{max}				
T_{min}-0,5≤T_o≤T_{max}+1			AV_{meas}≤ AV_{max}+0,10				

Table 13 : Person cabins, type A, B, D recreational spaces, wheelhouses, safety stations, control rooms - Measurement in Winter conditions - Detail

Position number	Type of space	Area (m^2)	Humidity	AV_{meas}	Outside air temperature T_a	Measured ambient temperature (internal) T_{meas}	Corrected internal air temperature T_o **(1)**
1							
2							
3							
.....							
(1) Ambient temperature (internal) corrected in accordance with [3.2.4]							

Table 14 : Person cabins, type A, B, D recreational spaces, wheelhouses, safety stations, control rooms - Measurement in Winter conditions - Summary

Total number of measurements							
Temperatures			Air velocity			Humidity	
Measurement	Number	%	Measurement	Number	%	Max.	Min.
T_{max}-1≤T_o≤T_{max}+1,5			AV_{meas}≤ AV_{min}				
			AV_{meas}≤ AV_{min}+0,1				
T_{max}-1,5≤T_o≤T_{max}+1,5			AV_{meas}≤ AV_{min}+0,1				
			AV_{meas}≤ AV_{min}+0,15				
T_{min}≤T_o≤T_{max}+1,5			AV_{meas}≤ AV_{max}				
T_{min}-1,5≤T_o≤T_{max}+1,5			AV_{meas}≤ AV_{max}+0,15				

Table 15 : Person cabins, type A, B, D recreational spaces, wheelhouses, safety stations, control rooms - Measurement in Summer conditions - Detail

Position number	Type of space	Area (m^2)	Humidity	AV_{meas}	Outside air temperature T_a	Measured ambient temperature (internal) T_{meas}	Corrected internal air temperature T_o **(1)**
1							
2							
3							
.....							
(1) Ambient temperature (internal) corrected in accordance with [3.2.4]							

Table 16 : Person cabins, type A, B, D recreational spaces, wheelhouses, safety stations, control rooms - Measurement in Summer conditions - Summary

Total number of measurements							
Operative temperatures			Air velocity			Humidity	
Measurement	Number	%	Measurement	Number	%	Max.	Min.
$T_{min}-1<T_o<T_{min}+1$			$AV_{meas} \leq AV_{min}$				
			$AV_{meas} \leq AV_{min}+0,1$				
$T_{min}-1<T_o<T_{min}+3$			$AV_{meas} \leq AV_{min}+0,1$				
			$AV_{meas} \leq AV_{min}+0,15$				
$T_{min}-1<T_o<T_{max}+0,5$			$AV_{meas} \leq AV_{max}$				
$T_{min}-1<T_o<T_{max}+1,5$			$AV_{meas} \leq AV_{max}+0,15$				

5.5.4 Tab 17, Tab 18, Tab 19 and Tab 20 are the suggested formats for recording the measurements carried out in all other spaces in living quarter barges and heavy cargo ships.

Table 17 : Other spaces - Measurement in Winter conditions - Detail

Position number	Type of space	Area (m^2)	Humidity	AV_{meas}	Outside air temperature T_a	Measured ambient temperature (internal) T_{meas}	Corrected internal air temperature T_o **(1)**
1							
2							
3							
.....							
(1) Ambient temperature (internal) corrected in accordance with [3.2.4]							

Table 18 : Other spaces - Measurement in Winter conditions - Summary

Total number of measurements							
Operative temperatures			Air velocity			Humidity	
Measurement	Number	%	Measurement	Number	%	Max.	Min.
T_{max}-1,5≤T_o≤T_{max}+1,5			AV_{meas}≤ AV_{min}				
			AV_{meas}≤ AV_{min}+0,15				
T_{max}-2≤T_o≤T_{max}+1,5			AV_{meas}≤ AV_{min}+0,15				
			AV_{meas}≤ AV_{min}+0,2				
T_{min}-0,5≤T_o≤T_{max}+1,5			AV_{meas}≤ AV_{max}+0,05				
T_{min}-2≤T_o≤T_{max}+1,5			AV_{meas}≤ AV_{max}+0,2				

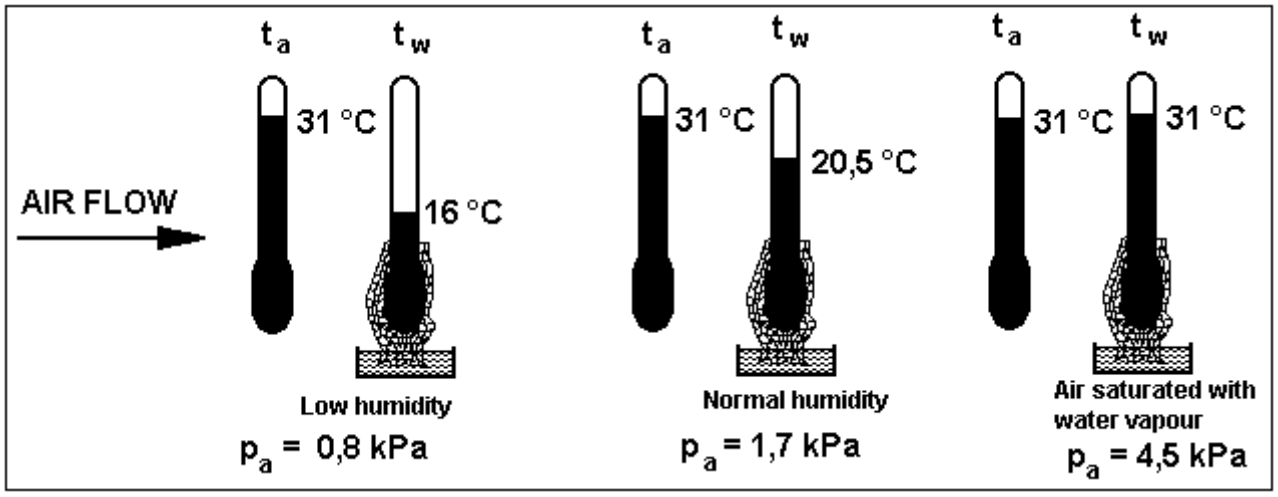
Table 19 : Other spaces - Measurement in Summer conditions - Detail

Position number	Type of space	Area (m^2)	Humidity	AV_{meas}	Outside air temperature T_a	Measured ambient temperature (internal) T_{meas}	Corrected internal air temperature T_o **(1)**
1							
2							
3							
.....							
(1) Ambient temperature (internal) corrected in accordance with [3.2.4]							

Table 20 : Other spaces - Measurement in Summer conditions - Summary

Total number of measurements							
Operative temperatures			Air velocity			Humidity	
Measurement	Number	%	Measurement	Number	%	Max.	Min.
T_{min}-1,5≤T_o≤T_{min}+1,5			AV_{meas}≤ AV_{min}				
			AV_{meas}≤ AV_{min}+0,15				
T_{min}-1,5≤T_o≤T_{min}+3,5			AV_{meas}≤ AV_{min}+0,15				
			AV_{meas}≤ AV_{min}+0,2				
T_{min}-1,5≤T_o≤T_{max}+1			AV_{meas}≤ AV_{max}+0,05				
T_{min}-1,5≤T_o≤T_{max}+2			AV_{meas}≤ AV_{max}+0,2				

Figure 4 : Principle of operation of a psychrometer



6 Measurement of humidity

6.1 Measuring of the absolute humidity using psychrometry

6.1.1 Principles

a) A psychrometer consists of two thermometers and a device to ensure ventilation of the thermometers at a minimum air velocity (see Fig 4).

b) The first thermometer is an ordinary thermometer indicating the air temperature t_a. This will be referred to as the "dry" temperature of the air as opposed to the "wet" temperature indicated by the second thermometer.

c) The latter consists of a thermometer surrounded by a wet wick generally made from close-meshed cotton. The end of the wick lies in a container of water. The water is raised by capillary attraction from the container to the thermometer and then evaporates at a rate dependent upon the humidity of the air. This results in a greater cooling of the thermometer the drier the air (this cooling is limited by the heat transfer due to air convection). The temperature indicated by the thermometer surrounded by the wet wick is referred to as the wet temperature (psychometric) t_w.

d) The observed dry temperature and wet temperature are used in the determination of the absolute humidity of the air.

6.1.2 Precaution to be taken using a psychrometer

a) Unless proper precautions are taken during measurement, the simplicity of the principle and the use of a psychrometer can lead to very considerable measuring errors.

b) The psychometric wet temperature is not be confused with the natural wet temperature which is measured using a naturally ventilated sensor with a wet wick.

c) The wet thermometer is to be ventilated at a sufficient velocity generally at least within 4 or 5 m/s. The air may be renewed either by rapidly moving the wet thermometer manually in the environment (whirling psychrometer), or by sucking air with a microturbine or a small ventilator driven by an electric or mechanical motor. In general, small sized temperature sensors require lower minimum air velocities.

d) The dry and wet thermometers are to be protected from radiation by a screen. When the mean radiant temperature is higher or lower than the air temperature, the air temperature sensor is to be protected by using one or more screens. As the wet temperature may also be different from the mean radiant temperature, it is important that the thermometer be protected.

e) The wick around the wet thermometer is to extend beyond the sensitive part of the sensor in order eliminate errors due to thermal conduction in the thermometer. If this precaution is not taken, the sensitive part of the sensor cooled by evaporation is at the wet temperature, whereas the non-sensitive part, not being cooled, is at the air temperature. This results in a transfer of heat conduction between the two parts and consequently in an error in the measurement of the wet temperature. The wet wick is therefore to extend sufficiently far along the thermometer to cool the thermometer beyond the sensitive part. Tab 21 indicates the wick lengths which have been recommended for different types of thermometer.

f) The water wetting the wick is to be distilled water, since the water vapour pressure in the case of salt solutions is less than that in the case of pure water.

g) The wick of the wet thermometer is to allow the water to circulate easily by capillary attraction particularly when the absolute humidity of the air is low. In the latter condition, the increased evaporation of water at the thermometer requires the water to rise quickly from its reservoir. The wick is to be replaced, if soiled.

h) It is necessary to measure the barometric pressure when this deviates perceptibly (2 %) from 101,3 kPa. As the phenomenon of evaporation depends on the atmospheric pressure (variable in particular as a function of altitude), it is necessary to use charts corresponding to the barometric pressure measured.

Table 21

Type	Diameter (mm)	Wick length (mm)
Mercury thermometer	All	20 (above the bulb)
Thermocouple	1,2 0,45 0,12	60 30 10

6.2 Relative humidity

6.2.1

a) The values giving the composition of the air in terms of water vapour in relation to the maximum amount it can hold at a given temperature characterise the relative humidity of the environment.

b) The relative humidity e is the ratio between the partial pressure of water vapour p_a, in humid air and the water vapour saturation pressure p_{as} at the same temperature and the same total pressure.

$$e = \frac{p_a}{p_{as}}$$

c) The relative humidity is often expressed as a percentage in accordance with the following relationship:

$$RH = 100 \cdot e$$

d) With regard to the heat transfer between man and his environment by evaporation, it is the absolute humidity of the air which needs to be taken into account.

Part F
Additional Class Notations

Chapter 5
POLLUTION PREVENTION (CLEAN)

SECTION 1 SEA AND AIR POLLUTION PREVENTION (GREEN PLUS)

1 General

1.1 Application

1.1.1 The additional class notation GREEN PLUS is assigned to ships designed and provided with systems, components and procedural means to control and prevent the emission of polluting substances into the sea and the air, in accordance with the requirements of [6].

2 Definitions

2.1

2.1.1 Definitions are those given in:

- MARPOL 73/78 as amended and
- App 1.

3 Documents to be submitted

3.1

3.1.1 The list of plans and documents to be submitted is given in Tab 1. The Society reserves the right to request the submission of additional documents in the case of non-conventional design or if it is deemed necessary for the evaluation of the systems and components.

Table 1 : Documents to be submitted

No.	A/I **(1)**	Document
1	I	Ship Environmental Management Plan
2	A	Drawings with indication of capacities of fuel, sludge and lubricating oil tanks and distances from the base line and shell plates
3	A	Tank general arrangement plan showing the bilge tanks, their capacities and alarms
4	I	General arrangement plan with indication of the zone intended for the stowage of packaged harmful substances in relation to the other zones of the ship
5	I	Plans of systems and equipment to discharge harmful substances in case of emergency and to dispose of and wash possible leaks
6	A	Tank general arrangement plan showing the treated sewage holding tanks, their capacities and their alarms
7	I	Tank general arrangement plan showing the grey water holding tanks, their capacities and relevant alarms
8	A	Garbage management plan including information on garbage treatment equipment and its control and monitoring system
9	I	General arrangements of refrigeration plants including the indication of retention facilities
10	I	Data sheets with list of intended refrigerants to be used in the different refrigeration systems, their quantities and their GWP and ODP
11	I	Data sheets with the list of fixed fire-fighting means used, their quantities and GWP values
12	I	Detailed plans of systems and equipment to limit SOx emission
13	I	Drawings of fuel oil system, arrangements and procedures for use of separate fuel oil
14	A	Green Passport or Green Passport Plus
15	A	EEDI: documents as per Annex 3 of MEPC 61/WP.10
16	A	Ship Energy Efficiency Management Plan (SEEMP)
(1) A = to be submitted for approval in four copies; I = to be submitted for information in duplicate.		

4 Requisites

4.1 General requirements

4.1.1 A Ship Environmental Manager, as defined in App 1, [1.2], is to be available on board.

4.1.2 An Environmental Management Plan, specific to the ship, is to be developed and made available on board. The Plan is to contain at least the procedures listed in App 2.

4.1.3 Adequate training on environmental issues is to be planned, carried out and documented for all the persons on board having influence on the environmental behavior of the ship.

4.2 Basic systems, components and procedural means

4.2.1 Basic systems, components and procedural means, a ship is to be equipped with, are those defined in the requirements of the MARPOL 73/78 and AFS Convention in force, as applicable to the ship.

4.3 Additional systems, components and procedural means

4.3.1 The list of additional systems, components and procedural means which can be considered for the assignment of the notation and the values to be used for the calculation of the relevant environmental index, as indicated in [5], are given in the third and fourth column of Tab 2, respectively.

Table 2 : Additional systems, components and procedural means

No.	Pollution source	Item	Environmental index	References (App 2)
1	Oil from Machinery Spaces	Bilge Water Treatment (15 ppm with alarm and automatic stop)	2	[1.1.2]
		Bilge Water Treatment (5 ppm with alarm and automatic stop)	5	[1.1.3]
		Bilge Water Treatment (5 ppm with alarm, automatic stop and recorder)	7	[1.1.4]
		Bilge oil tank	2	[1.1.5]
		Sludge tank	1	[1.1.6]
		Restrictions in the use of ship's fuel tanks for ballast	1	[1.1.7]
		Fuel oil tank protection by means of tank boundary distance from the ship side and bottom	8	[1.1.8]
		Fuel oil tank protection by means of outflow calculation	5	[1.1.9]
		Lubricating oil and sludge tank protection by means of tank boundary distance from the ship side and bottom	7	[1.1.10]
		Lubricating oil and sludge tank protection by means of outflow calculation	5	[1.1.11]
		Oil tank overflow	1	[1.1.12]
		Gutters	1	[1.1.13]
		Dry bilge concept	3	[1.1.14]
		Sludge oil collection and handling facilities	2	[1.1.15]
		Water-lubricated stern tube bearings	5	[1.1.16]
		Magnetic coupling on oil pumps	5	[1.1.17]
		Biodegradable lube oil	5	[1.1.18]
		Restriction in the use of hydraulic plants	7	[1.1.19]
(1) To be weighted				

No.	Pollution source	Item	Environmental index	References (App 2)
2	Sewage	Treatment plant: effluent quality as per IMO MEPC.2(VI)	2	[1.5.1]
		Treatment plant: effluent quality as per IMO MEPC.159(55)	5	[1.5.2]
		Advanced treatment plant or additional polishing stage: effluent quality as per ADEC Title XIV (33 CFR Part 159 Subpart E)	8	[1.5.3]
		Holding tank	3	[1.5.4]
		Sewage record book	2	[1.5.5]
3	Grey water	Treatment plant: effluent quality as per IMO MEPC.2(VI)	3	[1.6.1]
		Treatment plant: effluent quality as per IMO MEPC.159(55)	7	[1.6.2]
		Advanced treatment plant or additional polishing stage: effluent quality as per ADEC Title XIV (33 CFR Part 159 Subpart E)	10	[1.6.3]
		Holding tank	5	[1.6.4]
		Grey water record book	2	[1.6.5]
4	Garbage	Garbage Management Plan	2	[1.7.1]
		Recycling	5	[1.7.2]
		Advanced recycling	10	[1.7.3]
5	Other sources	Marine growth prevention systems	3	[1.8.1]
6	Ozone-depleting substances	Refrigerating facilities	5	[2.1.2]
		Restrictions in the use of GWP substances	10 **(1)**	[2.1.3]
7	Green house gases and pollutants	Non fossil fuels (use of electric power generators and/or propulsion systems that do not use prime movers generating GHGs and pollutants (e.g. sails, fuel cells, etc.))	30 **(1)**	[2.2.1]
		Second generation of bio-fuels	20 **(1)**	[2.2.2]
		Cold ironing	5	[2.2.3]
		Tool to manage handling and consumption of fuels	2	[2.2.4]
		Energy saving and energy conservation	10	[2.2.5]
		Computerized system to monitor fuel consumption	3	[2.2.6]
		Optimization of Air Conditioning (AC) plant (including passive means to decrease AC demand, e.g. reflective glazing)	10	[2.2.7]
		Low energy consumption lights	5	[2.2.8]
		Hull transom design (adoption of means capable to increase propulsion efficiency by minimum 0,5% at design speed)	3	[2.2.9]
		Stabilizer openings	3	[2.2.10]
		Silicone-based antifouling paint	10	[2.2.11]
		Fluoropolymer antifouling paint	15	[2.2.12]
		Fins on propeller boss cups	3	[2.2.13]
		High-performing propellers (capable to increase propulsion efficiency by minimum 1%)	5	[2.2.14]
		Support tool to assist the Master in keeping most efficient sailing draft and trim	10	[2.2.15]
(1) To be weighted				

No.	Pollution source	Item	Environmental index	References (App 2)
8	NOx	Gas to liquids (GTL) fuels (NOx emission lower than the limits as per Annex VI to MARPOL 73/78 as amended from prime movers and auxiliary boilers)	15 **(1)**	[2.3.2]
		Fossil fuel pre-treatment (e.g. water emulsion), or water injection into combustion chamber, or scavenging air, or combination of these (NOx emissions lower than the limits as per Annex VI to MARPOL 73/78 as amended from prime movers and auxiliary boilers)	5 **(1)**	[2.3.3]
		Dual-fuel engines running with LNG (NOx emissions lower than the limits as per Annex VI to MARPOL 73/78 as amended from prime movers)	15	[2.3.4]
		Exhaust gas treatment (abatement of not less than 85% of total generated NOx by prime movers)	20	[2.3.5]
		NOx emissions monitoring and recording	3	[2.3.6]
9	SOx	SOx limits (global 3% and SECA as required by MARPOL 73/78 Annex VI)	5	[2.4.1]
		SOx limits (1,0%)	20	[2.4.2]
		SOx limits (0,1%)	30	[2.4.3]
		Gas to liquids (GTL) fuels	10 **(1)**	[2.4.4]
		Blending fossil fuel with second-generation bio-fuels	10 **(1)**	[2.4.5]
		Dual-fuel engines running with LNG (gasoil only used as back-up in an emergency)	10	[2.4.6]
		Exhaust gas treatment (abatement of not less than 85% of total generated SOx by prime movers)	20	[2.4.7]
		SOx emissions monitoring and recording	3	[2.4.8]
10	Particulates	Gas to liquids (GTL) fuels (lower PMs emissions)	20 **(1)**	[2.5.1]
		Fuel treatment (lower PMs emissions achieved by fossil fuel pre-treatment (e.g. water emulsion), or blending of pre-treated fossil fuel with second-generation bio-fuels, or combination of these)	15 **(1)**	[2.5.2]
		Lower PMs emission achieved by modifications in prime movers (e.g. common rail) that do not increase other pollutants and GHGs emissions	15 **(1)**	[2.5.3]
		Dual-fuel engines running with LNG (gasoil only used as back-up in emergency)	20	[2.5.4]
		Exhaust gas treatment (abatement of not less than 85% of total generated PMs by prime movers)	10	[2.5.5]
(1) To be weighted				

No.	Pollution source	Item	Environmental index	References (App 2)
11	CO_2	Gas to liquids (GTL) fuels (reduction in CO_2 emission)	10 **(1)**	[2.6.1]
		Blending fossil fuel with second-generation bio-fuels (reduction in CO_2 emission)	10 **(1)**	[2.6.2]
		Dual-fuel engines running with LNG (gasoil only used as back-up in emergency)	5	[2.6.3]
		CO_2 monitoring and recording	3	[2.6.4]
		Attained Energy Efficiency Design Index (EEDI) ? Required EEDI (Phase 0)	2	[2.6.5]
		Attained Energy Efficiency Design Index (EEDI) ? Required EEDI (Phase 1)	4	
		Attained Energy Efficiency Design Index (EEDI) ? Required EEDI (Phase2)	6	
		Attained Energy Efficiency Design Index (EEDI) ? Required EEDI (Phase3)	10	
		Management Plan (SEEMP)	5	[2.6.6]
12	Ship at scrap	Ship recycling - Green Passport	7	[2.7.1]
		Ship recycling - Green Passport Plus	10	[2.7.2]
(1) To be weighted				

4.4 Applicable requirements

4.4.1 The applicable requirements for each basic and additional system, component installed and procedural means adopted are given in App 2.

5 Environmental index

5.1 Index calculation

5.1.1 The environmental index is obtained by adding up the values of the contributions for each additional system, component and procedural means (items) the ship is equipped with, according to Tab 2.

No contribution to the ship's environment index or to the coverage of the relevant pollution source (see [6.1] b) will be given by those items which are compulsory for the ship, due to:

a) ship tonnage, navigation, etc, or

b) entry into force of IMO Conventions' new requirements.

6 Assignment

6.1 Criteria

6.1.1 The additional class notation GREEN PLUS is assigned to a ship:

a) complying with [4.1] and [4.2]

b) having additional systems, components and procedural means selected from items of Tab 2, pertaining to at least nine different pollution sources (as listed in the second column of Tab 2) and

c) having an environmental index calculated in accordance with [5.1] greater than or equal to 100.

7 Novel features

7.1 General

7.1.1 For the assignment of the notation the Society may consider systems, components and procedural means not listed in Tab 2 based on novel principles and features on the basis of tests, calculations or other supporting information.

7.2 Examples

7.2.1 Equipment to maximize the recovery of waste heat, electrical propulsion systems designed to have the maximum efficiency at the different operational conditions of the ship and any other fuel saving techniques may be considered by the Society, on the basis of comparative studies to be submitted, for the calculation of the ship's environmental index.

8 Systems and components

8.1 Systems and components certification

8.1.1 When systems and components are recognized as being capable of improving the ship's environmental behavior, the Society may issue, upon request of the applicant (manufacturer or responsible vendor) a certificate stat-

ing the environmental properties of the system or component.

The certificate may be issued in accordance with applicable national or international standards or, in the absence of such standards, on the basis of the manufacturer's standards or specifications.

The compliance to the reference document is ascertained by means of:

- execution of tests; or
- review of test documentation; or
- evidence of positive results during in-service operation; or
- any combination of the above criteria.

SECTION 2 SEA AND AIR POLLUTION PREVENTION (GREEN STAR)

1 Green Star Design

1.1 General

1.1.1 When ships are assigned the notations CLEAN-SEA and CLEAN-AIR, the two separate notations are superseded by the cumulative additional class notation GREEN STAR 3 DESIGN, in accordance with Pt A, Ch 1, Sec 2, [6.6.4] b).

2 Green Star

2.1 General

2.1.1 Application

The additional class notation **GREEN STAR 3** is assigned, in accordance with Pt A, Ch 1, Sec 2, [6.6.4] c), to ships fitted with efficient means to control and prevent the emission of polluting substances in the sea and in the air, in accordance with the requirements of this item [2].

2.1.2 Required certificates

In order to be granted and to maintain the **GREEN STAR 3** class notation, the validity of the following documents is to be ensured, if applicable to the ship:

- "International Oil Pollution Prevention Certificate" (IOPP Certificate), in accordance with MARPOL 73/78, Annex I.
- Approved Shipboard Oil Pollution Emergency Plan (SOPE Plan).
- "International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk" (NLS Certificate) in accordance with MARPOL 73/78 Annex II, as applicable.
- "International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk" (ICOF CHE Certificate) in accordance with the IBC Code, as applicable.
- "International Sewage Pollution Prevention Certificate" (ISPP Certificate) in accordance with MARPOL 73/78, Annex IV.
- "International Anti-fouling System Certificate" (AFS Certificate) or statement of compliance, issued in accordance with IMO Resolution MEPC.102(48) as amended.
- Oil filtering equipment type approval certificate, in accordance with IMO Resolution MEPC.60(33) as amended or MEPC.107(49) as amended, as applicable.
- Sewage treatment plant type approval certificate in accordance with IMO Resolution MEPC.2(VI) as amended.
- Incinerator type approval certificate in accordance with IMO resolution MEPC.59(33) as amended or MEPC.76(40) as amended, as applicable.
- "Engine International Air Pollution Prevention Certificate" (EIAPP Certificate or Document of Compliance), in accordance with NOx technical code defined in [2.1.3], l).

Should one of the above-mentioned Certificates be suspended or not be renewed for any reason, the **GREEN STAR 3** notation will be automatically suspended until the ship is granted a new valid certificate.

2.1.3 Definitions

a) Sewage

Sewage means:

- drainage and other wastes from any form of toilet and urinal;
- drainage from medical premises (dispensary, sick bay, etc.) via wash basins, wash tubs and scuppers located in such premises;
- drainage from spaces containing live animals; or
- other waste waters when mixed with the drainages defined above.

b) Treated sewage holding tank

Treated sewage holding tank means a tank used for the collection and storage of the effluent of the sewage treatment plant.

c) Garbage

Garbage means all kinds of victual, domestic and operational waste excluding fresh fish and parts thereof, generated during the normal operation of the ship and liable to be disposed of continuously or periodically, except those substances which are defined or listed in Annexes I, II, III and IV to MARPOL 73/78.

d) Grey water

Grey water means drainage from dishwasher, galley, shower, laundry, bath, washbasin drains and WC scuppers.

e) TBT free antifouling system

Antifouling system means a coating, paint, surface treatment or device used to control or prevent attachment of organisms.

TBT free antifouling system means an antifouling system in compliance with the IMO Resolution MEPC.102(48) as amended.

f) Oily wastes

Oily wastes means the water removed from the machinery space bilges, used lube and hydraulic oils, sludge from fuel oil and from lube oil treatment systems.

g) Harmful substances carried in packaged form

- Harmful substances are those substances which are identified as marine pollutants in the International

Maritime Dangerous Goods Code (IMDG Code) as amended.

- Packaged form is the form of containment specified for harmful substances in the IMDG Code.

h) Ozone depleting substances

Ozone depleting substances are those substances which are defined in paragraph 4 of Article 1 of the Montreal Protocol on Substances that Deplete the Ozone Layer, 1987, listed in Annexes A, B, C or E to the Protocol in force at the time of the application of these Rules.

In general, the following ozone depleting substances are used on ships; however, this list is not to be considered comprehensive of all the ozone depleting substances that for any reason may be found in a ship.

- Halon 1211 - Bromochlorodifluoromethane
- Halon 1301 - Bromotrifluoromethane
- Halon 2402
- Halon 114B2 - 1,2-Dibromo-1,1,2,2- tetrafluoroethane
- CFC-11 - Trichlorofluoromethane
- CFC-12 - Dichlorodifluoromethane
- CFC-113 - Trichloro-1,2,2-trifluoroethane
- CFC-114 - 1,2-Dichloro-1,1,2,2- tetrafluoroethane
- CFC-115 - Chloropentafluoroethane.

i) SOx emission control area

SOx emission control area is an area where the adoption of special mandatory measures for SOx emissions from ships is required to prevent, reduce and control air pollution from SOx and its attendant adverse impacts on land and sea areas. SOx emission control areas are listed in Regulation 14 of Annex VI to MARPOL 73/78 as amended.

j) Global Warming Potential

Global Warming Potential (GWP) is the potential global warming of a gas compared with CO_2 on a time horizon of 100 years. Values of GWP for various refrigerants and gases are published by the US Environmental Protection Agency (EPA); if more than one value is listed, the lowest is to be used for the purpose of compliance with these Rules.

k) NOx technical code

NOx technical code is the Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines adopted by IMO Conference MP/CONF.3/35 - Resolution 2, as amended.

l) Engine major conversion

For the purpose of these Rules, major conversion means:

- the engine is replaced by a new engine built on or after 1 January 2000; or
- any substantial modification, as defined in the NOx technical code, is made to the engine; or
- the maximum continuous rating of the engine is increased by more than 10%.

m) Ship Environmental Manager

The Ship Environmental Manager is an officer in service on board, in charge of the management and control of the procedures and activities relevant to the requirements of this section.

n) Maximum number of persons on board, for the purpose of calculating grey water and sewage retention capacity means the maximum number of passengers that can be accommodated in cabins plus the crew.

2.1.4 Documents to be submitted

a) Plans and documents

Tab 1 lists the plans and documents to be submitted.

b) Operational procedures and log-books

Tab 2 lists the procedures and record books to be submitted.

2.2 Prevention of sea pollution

2.2.1 Oily wastes

a) Compliance with MARPOL 73/78 Annex I

The applicable requirements of MARPOL 73/78 Annex I, as amended, are to be complied with in addition to those in b) to e) and [2.2.2].

b) Bilge water

1) All machinery spaces bilges are to be drained into a holding tank for pre-separation upstream of the oil separation and filtering equipment.

Alternative installations may be considered on a case-by-case basis.

The volume V of the holding tank, in m^3, is to be at least:

$$V = 1 + 5{,}5\ P \cdot 10^{-4}$$

where P is the power of the propulsion engine plant, in kW. In any event, it is not required that the volume V is greater than 15 m^3.

Taking into account the ship service, navigation and installed power, a smaller volume V may be accepted on a case-by-case basis.

2) The oil filtering equipment is to be provided with an oil content meter and with a 15 ppm alarm combined with automatic stopping device.

3) The effluent from the 15 ppm filtering equipment is to be capable of being recirculated to the bilge or bilge water holding tank.

4) The tank is to be so arranged as to allow periodical removal of sediments.

c) Sludge

The sludge tank is to be so arranged as to allow periodical removal of sediments.

Sludge is to be disposed of on board through the incinerator or discharged ashore and is to be recorded in the oil record book.

Use of boilers for sludge disposal on board is not allowed.

d) Use of oil tanks for ballast

Irrespective of their volume, tanks intended for fuel or lubricating oil cannot be used for ballast.

e) Procedures and checks

The Ship Environmental Management Plan referred to in [2.4.2] is to include procedures covering the following:

- oily waste management including discharge criteria;
- preparation, filling in and maintenance of the oil record book;
- periodical calibration of the oil content meter referred to in b), to be carried out when required by the Manufacturer's instructions or, in the absence of specific indications, at least every six months; documentation is to be kept on board for examination during periodical surveys;
- periodic cleaning of the bilge holding tank and of the sludge tank.

Table 1 : Documents to be submitted

No.	A/I	Document
1	I	Copy of the NLS or ICOF Certificate, if applicable
2	I	Copy of the IOPP Certificate
3	A	Drawings of the bilge system including volume of the bilge holding tank **(4)**
4	I	Copy of the type approval certificate of the oil filtering equipment and alarm
5	A	Schemes of the fuel oil, lubricating oil and relevant overflow system containing the information necessary to verify the requirements of [2.2.2], b) **(4)**
6	I	Copy of the approved SOPE Plan including the list of emergency equipment
7	I	Details of enrolment in an Emergency Response Service according to [2.2.2], a)
8	I	Copy of the ISPP Certificate and copy of the sewage treatment plant type approval certificate
9	A	Drawings of the sewage system including piping, holding tank for treated sewage and alarms **(4)**
10	A	Calculation of volume of holding tank for treated sewage **(4)**
11	I	Copy of the AFS Certificate or statement of compliance
12	A	Drawings of the greywater system including piping, holding tank and alarms **(1) (4)**
13	A	Calculation of volume of grey water holding tank **(1) (4)**
14	A	Data sheets with the list of refrigerants and fixed fire-fighting means used, their quantity and GWP values **(4)**
15	A	Details of plans of systems and equipment to limit SOx emissions in SOx emission control areas **(2) (4)**
16	A	Drawings of fuel oil system, arrangements and procedures for use of separate fuel oil according to **(4)**
17	I	Incinerator type approval certificate **(2)**
18	I	Documentation of compliance with technical requirements for the class notation VCS **(3)**
19	I	Copy of the EIAPP Certificate or statement of compliance for each engine detailed in [2.3.2] a), 2) issued by a recognized organization, as applicable
20	A	Engine Technical File and record book [2.3.2] d) for each engine detailed in [2.3.2] a), 2)
21	A	Details and operating manual(s) of NOx control equipment referred to in [2.3.2] e) **(2)**

(1) Living quarter barge only
(2) Only if such a system is installed on board
(3) Only ships having service notation according to
(4) For ships in service, alternative documentation may be accepted provided it is sufficient for the execution of the initial survey
Note 1: A - to be submitted for approval in four copies
I - to be submitted for information in duplicate

No.	A/I	Document
22	I	General arrangement plan with indication of the zone intended for the stowage of the harmful packaged substances in relation to the other zones of the ship
23	I	Plans of systems and equipment to discharge the harmful substances in case of emergency and to dispose of and wash possible leaks

(1) Living quarter barge only
(2) Only if such a system is installed on board
(3) Only ships having service notation according to
(4) For ships in service, alternative documentation may be accepted provided it is sufficient for the execution of the initial survey
Note 1: A - to be submitted for approval in four copies
I - to be submitted for information in duplicate

Table 2 : Operational procedures and record books

No.	A/I	Document
1	I	Oil Systems Record Book
2	I	Sewage record book
3	A	Garbage management plan including garbage record book
4	I	Grey water record book **(1)**
5	I	Refrigerant log book and procedures [2.3.1]
6	I	Oily wastes management procedures according to [2.2.1], e)
7	I	Accidental oil discharge management procedures according to [2.2.2], c)
8	I	Sewage management procedures according to [2.2.3], d)
9	I	Garbage management and waste recycling procedures according to [2.2.4] **(1)**
10	I	Grey water management procedures according to [2.2.5] **(1)**
11	I	Ship Environmental Management Plan
12	I	Fuel management procedures for controlling SOx
13	I	Incinerator management procedures according to [2.3.4]
14	A	Green Passport or Green Passport Plus according to [2.2.5]

(1) Only for living quarter barge
Note 1: A - to be submitted for approval in four copies
I - to be submitted for information in 2 copies

2.2.2 Accidental oil discharge

a) Emergency response

1) The ship is to be enrolled in Society's Emergency Response Service.

2) A Shipboard Oil Pollution Emergency Plan (SOPE Plan) is to be available on board in accordance with Regulation 26 of MARPOL 73/78 Annex I.

b) Accidental spillage of oils

1) All fuel oil and lubricating oil tanks of capacity greater than $10m^3$ are to be fitted with:

- an overflow system and a high level alarm or
- an overflow system and flow alarm in the overflow main or
- two high level alarms (90% and 95% of filling).

The alarm signals are to be given in a suitable station from which bunkering or transfer operations are controlled.

2) On the weather and/or superstructure decks each fuel or lubricating oil tank vent, overflows and fill pipe connection is to be fitted with a fixed container or enclosed deck area with a capacity of:

- 80 litres if the gross tonnage of the ship is between 300 and 1600
- 160 litres if the gross tonnage of the ship is greater than 1600.

3) Emergency equipment (e.g. containment boom) is to be available on board and listed in the SOPE Plan. On board procedures and training are to be foreseen for the use of such equipment.

4) The lube oil consumption of all systems having an oil to sea interface, such as main and auxiliary engines cooled by sea water, controlled pitch propellers, stern-tubes, bow and stern thruster, stabilisers, PODs etc, is to be recorded at least once a week in an "Oil Systems record book" aimed at detecting, through unusually high consumption, oil leakage through sealing.

The record book is to contain the list of all systems concerned, the consumption of each system recorded at least every week and corrective actions when carried out.

c) Procedures and checks

The Ship Environmental Management Plan referred to in [2.4.2] is to include procedures for the management of:

- spillage during bunkering;
- collision or grounding involving oil spillage and including use of emergency equipment referred to in b);
- preparation, filling in and maintenance of the oil record book and of the "Systems oil consumption log-book";
- periodical checks of the overflow systems/alarms.

2.2.3 Sewage

a) Compliance with MARPOL 73/78 Annex IV

The applicable requirements of MARPOL 73/78 Annex V, as amended, are to be complied with, in addition to the requirements in b) to d).

b) Sewage treatment plant

1) The ship is to be provided with a sewage treatment plant certified according to the standards and test methods of MEPC.2(VI).

2) In addition, the ship is to be equipped with holding tank(s) for sewage with sufficient capacity to allow storage of sewage when in port or in no discharge areas.

The minimum total capacity of such tank(s) is to be 2 days based on the maximum number of persons on board and 96 litres/person/day if a conventional (flushometer) system is used and 11 litres/person/day if a vacuum system is used.

A smaller volume, though in any case not lower than 50% of the above capacity, may be accepted provided that:

- the ship is equipped with a post-treatment system for sewage, able to reduce the volume of the effluent (e.g. by recycling part of the treated sewage water for on board use);
- 2 days' retention is ensured;
- technical documentation, including results of on-board tests, of the system's efficiency and of effluent volume reduction, is documented to the satisfaction of the Society.

3) Sewage holding tanks are to be equipped with high level alarms.

c) Sewage Record Book

All sewage discharges whether to sea or shore based facilities are to be recorded in a sewage record book with indication of the date, location and quantity of sewage discharged.

If the sewage is discharged to sea, the records are to include information on the ship speed and distance to the nearest land.

d) Procedures and checks

The Ship Environmental Management Plan referred to in [2.4.2] is to include procedures covering the following:

- sewage management, including discharge criteria and use of holding tanks in port and no discharge areas;
- preparation, filling in and maintenance of the sewage record book;
- disposal of sewage treatment plant residues. If the ship is not in a condition to dispose at sea of sewage treatment plant residues in accordance with international or national regulations, such residues are to be disposed of ashore or by incineration.

2.2.4 Garbage

a) Compliance with MARPOL 73/78 Annex V

The applicable requirements of MARPOL 73/78 Annex V, as amended, are to be complied with, in addition

to those in b) to d).

b) Garbage management plan and garbage record book

1) The ship is to be provided with an approved garbage management plan to be kept on board. This plan is to provide written procedures for collecting, storing, processing and disposing of garbage, including the use of the equipment on board. It is also to designate the person in charge of carrying out the plan.

The plan is to be in accordance with the guidelines in App 3 and written in the working language of the crew.

2) For living quarter barge, procedures are to be foreseen for the collection and safe disposal ashore of the following hazardous wastes:
   - Dry-cleaning solvents and waste fluids
   - Photocopying and laser printer cartridges
   - Unused pharmaceuticals and those which are past their use-by date
   - Batteries
   - Fluorescent and Mercury vapor lamp bulbs.
3) Records of discharges are to be maintained in the garbage record book.

c) Waste recycling

For living quarter barges:

1) a strategy of waste recycling is to be foreseen, adopted and documented;
2) the minimum total quantity of wastes landed for recycling (Wr) is to be 50% of recyclable wastes produced on board (Wb), where Wb = 40 Kg/person/year based on the number of persons the ship is certified to carry.

The amount of waste landed for recycling is to be recorded in the garbage record book, and different wastes are to be collected and landed separately.

For the purpose of this Rule, recyclable wastes are:
- Plastic
- Aluminum
- Glass
- Paper-Cardboard

d) Procedures

The Ship Environmental Management Plan referred to in [2.4.2] is to include procedures covering the following:
- Garbage management according to b)
- waste recycling according to c).

2.2.5 Other sources

a) Antifouling system

Antifouling systems for the hull are to be of TBT-free type, according to IMO Resolution MEPC.102(48), as amended.

Antifouling systems applied on existing ships and not in compliance with the appendix of IMO Res./MEPC.102(48) are to be removed or sealed the next time the ship is in dry dock.

b) Grey water

Grey water requirements in this paragraph and in [2.2.5] c) and [2.2.5] d) apply only to living quarter barge, except 4) which applies to all ships.

1) Grey water is always to be discharged at a distance of more than 4 nautical miles from the nearest land or to a reception facility.

   The discharging criteria do not apply when the discharge of grey water is necessary for securing the safety of the ship and those on board, or saving life at sea, or when the discharge results from damage to the ship or its equipment.
2) Living quarter barges are to be equipped with holding tank(s) for grey water with sufficient capacity to allow storage of grey water when in port for at least 1 day. The total capacity of grey water holding tank(s) is to be based on the maximum number of persons on board and 200 litres/person/day.
3) Grey water holding tanks are to be equipped with high level alarms.
4) If the same tanks are used to hold treated sewage and grey water:

   - the capacity of such tanks is to be at least the sum of the capacities for the treated sewage holding tank in [2.2.3] b) and the tank for grey water, and the sewage treatment and discharge criteria apply.

c) Grey water record book

All grey water discharges are to be recorded in a grey water record book with indication of the date, location and quantity of grey water discharged.

If the grey water is discharged to sea, the records are to include information on distance to the nearest land.

d) Procedures and checks

In addition to the requirements in [2.2.5] d), the Ship Environmental Management Plan referred to in [2.4.2] is to include procedures covering grey water discharge criteria, including use of holding tanks in ports and in no discharge areas.

e) Harmful substances carried in packaged form

Harmful substances are to be properly stowed and secured so as to minimise the hazards to the marine environment, according to MARPOL 73/78 Annex III, as amended.

f) Ship recycling

The Green Passport or the Green Passport Plus is to be developed according to Resolution A.962(23) - IMO Guidelines on Ship Recycling (paragraph 5) or to Resolution MEPC.179(59) - Guidelines for the development of the inventory of hazardous materials, respectively.

- Green Passport

  In order to contribute towards minimising potential problems related to protection of the environment in the recycling of vessels, guidelines on ship recycling have been adopted by IMO with Resolution A.962(23) to give guidance to all stakeholders in the ship recycling process.

  The Green Passport is to be developed according to the above mentioned Resolution A.962(23) - IMO Guidelines on Ship Recycling, paragraph 5.

  The Green Passport for ships is a document facilitating the application of these Guidelines providing information with regard to materials known to be potentially hazardous utilised in the construction of the ship, its equipment and systems.

  This is to accompany the ship throughout its operating life. Successive Owners of the ship are to maintain the accuracy of the Green Passport and incorporate into it all relevant design and equipment

changes, with the final Owner delivering the document, with the ship, to the recycling facility.

- Green Passport Plus

  Following Resolution A.962(23) a new Convention on ship recycling has been adopted by IMO, the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009.

  In application of the requirements of the new Convention, the Green Passport Plus is an updated version of the Green Passport, providing more detailed information with regard to potentially hazardous materials utilised in the construction of the ship, its equipment and systems, and developed taking into account IMO Resolution MEPC.179(59) - Guidelines for the Development of the Inventory of Hazardous Materials".

  This document accompanies the ship throughout its operating life and incorporates all relevant design and equipment changes, with the final owner delivering the document, with the ship, to the recycling facility.

2.3 Prevention of air pollution

2.3.1 Ozone depleting substances

a) General

1) The following requirements apply to ships with refrigerating facilities, such as refrigerated cargo ships, liquefied gas carriers with reliquefaction plants, and other ships with centralised cargo refrigeration systems.

2) They also apply to:

- centralised refrigeration systems for provision stores;
- centralised air conditioning plants;
- fixed fire-fighting systems.

3) They do not apply to domestic type stand-alone refrigerators and air conditioning units.

b) Ozone depleting substances

1) The use of halogenated substances (e.g. Halon and CFC) as refrigerant or fire-fighting means is prohibited, with the exception of hydro-chlorofluorocarbons ($HCFC_n$), which are permitted until 1 January 2020.

2) Refrigerants of centralised refrigeration systems are to have a global warming potential, GWP < 2000. When this is not possible due to assessed technical reasons (documented in a technical report), 2000 < GWP < 4000 is accepted in accordance with c).

c) Control of leakage

1) Annual refrigerant leakage is to be less than 10% of the total refrigerant charge of each system. When 2000 ≤ GWP < 4000, the refrigerant leakage is to be less than

$$10 \cdot \frac{2000}{GWP}$$

% of the total refrigerant charge of each system.

The leakage is to be documented by consumption figures recorded in a refrigerant log-book to be kept on board and made available during periodical surveys.

2) Procedures need to be established such that, in the event that the annual leakage exceeds the maximum allowed, corrective actions are undertaken.

d) Procedures and checks

The Ship Environmental Management Plan referred to in [2.4.2] is to include procedures covering the following:

1) refrigerant management including control of leakage and preparation, filling in and maintenance of the refrigerant log-book according to c);

2) minimizsation of the risk of depleting the refrigerant in the various operating conditions including during maintenance.

2.3.2 Emissions of nitrogen oxides (NOx)

a) Procedures and checks

The Ship Environmental Management Plan referred to in [2.4.2] is to include procedures covering the following:

1) periodical checks of the emission relevant engine parameters and components referred to in d), at least every 6 months and after maintenance or replacement of any such component;

2) preparation, filling in and updating of the engine maintenance record book.

b) Periodical maintenance

For the purpose of minimising polluting emissions, maintenance of engines is to be duly carried out according to the Manufacturer's requirements.

2.3.3 Oxides of sulphur (SOx) emissions - Fuel oil management procedures

The sulphur content of fuel oil used on board ships (average percentage calculated on a yearly basis) is not to exceed 3% by mass. In any case, the sulphur content of any fuel oil used on board ships is not to exceed the percentage by mass as required by MARPOL 73/78 Annex VI.

The Ship Environmental Management Plan referred to in [2.4.2] is to include procedures covering the following:

a) maximum sulphur content to be specified in the fuel oil purchase orders and to be verified in the fuel oil receipt at the delivery of bunker;

b) laboratory check of samples of the SOx content in the bunker delivered according to a recognised standard acceptable to the Society;

c) records of purchase orders, receipts and laboratory analysis including results are to be kept on board and made available to the Surveyor;

d) changeover from normal to low sulphur fuel required in SOx emission control areas;

e) maintenance of the SOx emission control system, if present on board.

2.3.4 Incinerators

a) Sludge disposal

Sludge can only be disposed of on board through incineration, according to [2.2.1] c).

Sludge disposal through incineration is to be recorded in the oil record book.

b) Procedures

The Ship Environmental Management Plan referred to in [2.4.2] is to include procedures covering:

- the operation of the incinerator(s) within the limits (e.g. temperature, humidity, ecc.) recommended by the Manufacturer
- substances not permitted to be incinerated.

2.3.5 Additional requirements for specific ship types

A ship which is classed with one or more of the following service notations:

a) oil tanker

b) FLS tanker

is also to comply with the requirements of Ch 13, Sec 7 relative to the prevention of vapour emissions, excluding ships as per a), b), c), e) and f) intended for the carriage of products having flashpoint > 60°C.

In order for the **GREEN STAR 3** notation to be granted to such a ship, it is necessary that the **VCS** notation is also granted.

2.4 Ship Environmental Management

2.4.1 Ship Environmental Manager

A Ship Environmental Manager, as defined in [2.1.3] n), is to be available on board.

2.4.2 Ship Environmental Management Plan

An Environmental Management Plan, specific to the ship, is to be developed and made available on board.

The Manual is to contain the procedures requested in these Rules and is to include at least:

- the indication of person(s) in charge for each procedure to be carried out
- documents and manuals required
- log-books/records to be filled in
- time schedule when applicable (e.g. checking, sampling, etc.)

The Ship Environmental Management Plan is to be submitted to the Society for information.

2.5 Inspections, tests and surveys

2.5.1 Inspections and testing during construction

Materials, systems or equipment which are installed on board or modified in order to comply with the requirements of this Sec 2 are to be surveyed and tested according to the applicable Rules of the Society.

2.5.2 Initial survey

Following the satisfactory review and approval of the plans and other documentation requested in [2.1.4], an initial survey is to be carried out on board in order to:

- verify that hull and machinery arrangements are in accordance with the approved documentation;
- test, in the presence of the Surveyor and under working conditions, the equipment and systems covered by these Rules including their control, monitoring and alarms;
- verify and presence on board of the Ship Environmental Manager;
- verify the presence on board of the certificates, record and log-books, and Environmental Management Plan requested by these Rules;
- carry out the engine parameter check according to the engine technical file, of the engines referred to in [2.3.2], d);
- for existing ships, assess and document (e.g. by photo) the satisfactory maintenance of equipment and systems;

2.5.3 Periodical surveys

During periodical surveys, the checks and inspections requested in Pt A, Ch 5, Sec 5, as applicable, are to be carried out.

SECTION 3 AIR POLLUTION PREVENTION (CLEAN-AIR)

1 General

1.1 Application

1.1.1 This Section applies to the assignment of the notations CLEAN-AIR and LOWSOx(N).

2 CLEAN-AIR

2.1 Application

2.1.1 Coverage

a) The notation CLEAN-AIR is assigned to ships fitted with efficient means to control and prevent the emission of polluting substances in the air, in accordance with Pt A, Ch 1, Sec 2, [6.6.3].

b) The requirements of this Section are intended to prevent air pollution from any of the following hazards in addition to those stipulated by MARPOL 73/78 Annex VI:

- emissions of ozone depleting substances
- emissions contributing to global warming
- emission of nitrogen oxides (NOx)
- incinerators

In order for the notation **CLEAN-AIR** to be granted, all the above polluting hazards are to be considered and the ship is to be fitted with means and/or operational measures to simultaneously prevent all those which are applicable, in relation to its characteristics and the likelihood of producing any or all of such emissions.

2.1.2 Additional requirements for oil tankers

A ship which is classed with the class notation **oil tanker** is also to comply with the requirements of Ch 13, Sec 7 relative to the prevention of vapour emissions, excluding ships as per a), b), c), e) and f) intended for the carriage of products having flashpoint > 60°C.

In order for the **CLEAN-AIR** notation to be granted to such a ship, it is necessary that the **VCS** notation is also granted.

2.2 Definitions

2.2.1 MARPOL 73/78

MARPOL 73/78 is the IMO "International Convention for the Prevention of Pollution from Ships, 1973/78", including the Annexes from I to VI, as amended.

2.2.2 Emission

Emission is any release to the atmosphere of substances which are covered by this Section.

2.2.3 Ozone depleting substances

Ozone depleting substances are those substances which are defined in paragraph 4 of Article 1 of the Montreal Protocol on Substances that Deplete the Ozone Layer, 1987, listed in Annexes A, B, C or E to the Protocol in force at the time of the application of these Rules.

In general, the following ozone depleting substances are used on ships; however, this list is not to be considered comprehensive of all the ozone depleting substances that for any reason may be found in a ship.

- Halon 1211 - Bromochlorodifluoromethane
- Halon 1301 - Bromotrifluoromethane
- Halon 2402
- Halon 114B2 - 1,2-Dibromo-1,1,2,2-tetrafluoroethane
- CFC-11 - Trichlorofluoromethane
- CFC-12 - Dichlorodifluoromethane
- CFC-113 - Trichloro-1,2,2-trifluoroethane
- CFC-114 - 1,2-Dichloro-1,1,2,2-tetrafluoroethane
- CFC-115 - Chloropentafluoroethane.

2.2.4 Shipboard incineration

Shipboard incineration is the incineration of wastes or other matter on board a ship, if such wastes or other matter are generated during the normal operation of that ship.

2.2.5 Shipboard incinerator

Shipboard incinerator is a shipboard facility designed for the primary purpose of incineration.

2.2.6 Ozone Depleting Potential

Ozone Depleting Potential (ODP) is the potential of ozone depletion compared to CFC 11. Values of ODP for ozone depleting gasses are provided in the "Montreal Protocol on Substances that Deplete the Ozone Layer" .

Table 1 : Documents to be submitted for prevention of emission of ozone depleting substances

No.	A/I **(1)**	Document
1	I	General arrangements of refrigeration plants
2	A	Scheme of refrigerating plant(s) showing the retention facilities as per [2.4.4]
3	A	Data sheets with list of intended refrigerants to be used in the different refrigeration systems and their GWP and ODP
4	I	Refrigerant record book
(1) A = to be submitted for approval in four copies; I = to be submitted for information in duplicate.		

Table 2 : Documents to be submitted for incinerators

No.	A/I **(1)**	Document
1	I	Copy of type approval certificate or statement of compliance with IMO Res. MEPC 76(40)
2	I	Design data, including at least design pressure and design temperature, as applicable **(2)**
3	A	Piping diagram **(2)**
4	I	System for waste supply and incinerator feeding **(2)**
5	A	Instrumentation, monitoring, alarm and control systems **(2)**
6	I	Operating manual
(1) A = to be submitted for approval in four copies; I = to be submitted for information in duplicate. **(2)** Not required if the incinerator is of an approved type.		

Table 3 : Documents to be submitted in connection with the Ship Environmental Management

No.	**(1)**	Document
1	I	Ship Environmental Management Plan as per [2.4.6] , [2.5.1], [2.7.2] and [2.8.1]
(1) I = to be submitted for information in duplicate.		

2.2.7 Global Warming Potential

Global Warming Potential (GWP) is the potential global warming of a gas compared with CO_2 on a time horizon of 100 years. Values of GWP for various refrigerants and gases are published by the US Environmental Protection Agency (EPA).

2.3 Documents to be submitted

2.3.1 Documents to be submitted for prevention of emission of ozone depleting substances

Tab 1 lists the documents to be submitted for the assessment of the measures taken to prevent the emission of ozone depleting substances.

The documents in Tab 1 are additional to those relative to refrigerating installations and fire-fighting systems listed in the applicable Sections of the Rules.

2.3.2 Documents to be submitted for incinerators

Tab 2 lists the documents to be submitted for incinerators.

2.3.3 Documents to be submitted in connection with the Ship Environmental Management

Tab 3 lists the documents to be submitted in connection with the Ship Environmental Management.

2.4 Emission of ozone depleting substances

2.4.1 Applicability

a) The following requirements apply to ships with refrigerating facilities, such as refrigerated cargo ships, liquefied gas carriers with reliquefaction plants, and other ships with centralised cargo refrigeration systems.

b) They also apply to:

- centralised refrigeration systems for provision stores
- centralised air conditioning plants
- fixed fire-fighting systems.

c) They do not apply to domestic type stand-alone refrigerators and air conditioning units.

2.4.2 Halogenated substances

a) The use of halogenated substances (e.g. Halon and CFC) as refrigerant or fire-fighting means is prohibited, with the exception of hydro-chlorofluorocarbons (HCFCn), which are permitted until 1 January 2020.

b) Refrigerants of centralised refrigeration systems are to have a global warming potential, GWP < 2000.

2.4.3 Prevention of leakage

a) Means are to be provided to limit leaks to the atmosphere of refrigerants or their vapours in the event of failure of the plant, as well as in the case of discharge of refrigerant to an onshore reception facility.

b) Annual refrigerant leakage is to be less than 10% of the total refrigerant charge of each system. The leakage is to be documented by consumption figures recorded in a refrigerant log-book to be kept on board and made available during periodical surveys.

c) Procedures need to be established such that, in the event that annual leakage exceeds 10%, corrective actions are undertaken.

2.4.4 Evacuation facilities

The system is be fitted with evacuation (e.g. compressors) and retention facilities having the capability to retain all the refrigerants, should the need to evacuate the whole plant arise in an emergency.

2.4.5 Maintenance and servicing

The plant is to be designed in such a way as to minimise the risk of medium release in the case of maintenance, repair or servicing; i.e. it is to be designed considering the possibility of isolating those sections which are to be serviced by a system of valves and bypasses, in such a way as not to stop the operation of the plant while in service, preventing the risk of release of the medium outside of the plant.

2.4.6 Procedures

The Ship Environmental Management Plan, as per [2.8.1], is to contain the following:

- procedures to be followed to minimise the risk of depleting the refrigerant or the refrigerant vapours in all operative and emergency conditions
- procedures for preparing, filing and updating the refrigerant log-book.

2.5 Emission of oxides of nitrogen (NOx)

2.5.1 Procedures

The Ship Environmental Management Plan is to contain the following:

a) procedures for periodical checks of the emission relevant engine parameters and components referred to in the technical file. The periodical checks are to be carried out at least every 6 months and after maintenance or replacement of any such component;

b) procedures for preparing, filling in and updating the engine record book.

2.5.2 NOx control equipment

a) Methods to control NOx emissions

NOx emissions may be controlled by:

- after treatment (e.g. selective catalytic reduction) or
- other methods (e.g. emulsion of water in fuel, intake air humidification, direct water or steam injection).

The relevant equipment will be subject to special consideration by the Society.

b) General requirements

1) Means are to be provided to check proper operation of the equipment;

2) Failure of the NOx emission control system and/or equipment is not to affect the normal functioning of the engine.

2.6 Emission of oxides of sulphur (SOx)

2.6.1 Maximum allowable sulphur content in fuel oil

The sulphur content of fuel oil used on board ships (average percentage calculated on a yearly basis) is not to exceed 3% by mass. In any case, the sulphur content of any fuel oil used on board ships is not to exceed the percentage by mass as required by MARPOL 73/78 Annex VI.

2.7 Incinerators

2.7.1 Applicability

a) The following requirements apply to ships with a permanently installed shipboard incinerator, generally complying with the requirements of IMO Resolution MEPC.(76)40, adopted on 25 September 1997, "Standard specifications for shipboard incinerators", which is contained in App 4. The content of this Appendix is to be considered as part of the requirements to be complied with in order for the **CLEAN-AIR** notation to be issued.

b) Ships without a permanently installed incinerator, which use the main or auxiliary boilers for incinerating oil sludge generated during normal operations, cannot be granted the **CLEAN-AIR** notation.

c) Additional requirements on incinerators are in App 3, [5.4].

2.7.2 Miscellaneous requirements

a) Substances not permitted to be incinerated

Shipboard generators cannot be used to incinerate the following substances:

- cargo residues of substances indicated in Annexes I, II and III of the IMO International Convention for the Prevention of Pollution from Ships 1973/78, "MARPOL 73/78" as amended, and related contaminated packing materials
- polychlorinate biphenyls (PCB_n)
- garbage, as defined in Annex V of "MARPOL 73/78", containing more than traces of heavy metals.

b) Operating manual

A Manufacturer's operating manual for the incinerator is to be provided on board.

c) Safety measures

1) The flue gas outlet temperature is to be continuously monitored.

2) For incinerators fed continuously by an automatic feeding system, the waste supply is to be shut off if the temperature indicated above falls below 850 °C.

3) For batch loaded incinerators, the unit is to be designed in such a way that the temperature in the combustion chamber reaches 600 °C in not less than 5 minutes.

d) Procedures

The Ship Environmental Management Plan as per [2.8.1] is to contain the procedures needed to comply with a).

2.8 Ship Environmental Management

2.8.1 Ship Environmental Management Plan

An Environmental Management Plan, specific to the ship, is to be developed and made available on board.

The Manual is to contain at least the procedures requested in [2.4.6], [2.5.1] and [2.7.2] d) and is also to include:

- the indication of person(s) in charge for each procedure to be carried out
- documents and manuals required
- log-books/records to be filled in
- time schedule when applicable (e.g. periodical checks)

The Ship Environmental Management Plan is to be submitted to the Society for information.

2.9 Inspections and tests

2.9.1 Installations to limit the emission of refrigerants

a) Materials

Materials for piping and equipment specifically designed to limit the emission of refrigerants are to be tested in accordance with the applicable requirements for testing materials intended to be used for the construction of similar types of piping and equipment and their classes and/or design conditions.

b) Tests and inspection during fabrication

Piping and equipment specifically designed to limit the emission of refrigerants are to be inspected and tested during fabrication in accordance with the requirements applicable to similar types of piping or equipment and their classes and/or design conditions.

c) Tests after installation

After installation on board, the plant acceptance trials are to include the operation of the evacuation of all of the refrigerant from the plant to the reception facilities without any release of refrigerant and/or refrigerant vapours. The control, monitoring and alarm systems are also to be tested in the presence of the Surveyor, or their functioning is to be simulated by a procedure agreed with the Society.

2.9.2 Incinerators

Unless the incinerator is of a type approved by the Society, the tests described in App 4 are to be carried out.

2.9.3 Periodical surveys

During periodical surveys, the checks and inspections requested in Pt A, Ch 5, Sec 5, as applicable, are to be carried out.

3 LOWSOx(N)

3.1 Application and general

3.1.1

The sulphur content of any fuel oil used on board ships is not to exceed the percentage by mass as required by MARPOL 73/78 Annex VI. The notation LOWSOx(N) is assigned to ships that use on board fuel oil having sulphur content (average percentage calculated on a yearly basis) less than 3%. The value N in brackets is the maximum sulphur content used on board according to ship's procedures.

3.2 Maximum allowable sulphur content in fuel oil

3.2.1

a) The sulphur content of any fuel oil used on board ships is not to exceed N% by mass as per [3.1] above.

b) For navigation within SOx emission control areas, see [3.4].

3.3 Fuel oil management procedures

3.3.1 The Ship SOx Environmental Management Plan is to contain the following:

a) Procedures to detail the maximum sulphur content in the fuel oil purchase orders and to check the actual content of sulphur at the delivery of bunker.

b) Procedures for testing and analysis, in accordance with a recognised standard acceptable to the Society, to be used if the actual sulphur content is checked by sampling.

c) Procedures to manage records of purchase orders, type of checking carried out and results, to be kept on board and made available to the Surveyor.

d) Fuel management procedures to be followed as part of the vessel's certified ship management system.

3.4 Navigation in SOx emission control areas

3.4.1 Limitation of sulphur emission

Ships are to be provided with effective means to limit the sulphur content of the SOx emission when sailing in Sox emission control areas, as detailed in [2.4.2], [2.4.3] or [2.4.4].

3.4.2 Exhaust gas cleaning system

a) An exhaust gas cleaning system is to be provided. This cleaning system is to have the capability to reduce the total emission of sulphur oxides from ships, including both auxiliary and main propulsion engines, to 6,0 g SOx/kWh or less, calculated as the total weight of sulphur dioxide emission.

b) Waste streams from the use of such equipment are not to be discharged into enclosed ports, harbours and estuaries unless it can be thoroughly documented by the ship that such waste streams have no adverse impact on the ecosystems of such enclosed ports, harbours and estuaries.

3.4.3 Alternative methods

Any other technological method that is verifiable and enforceable to limit SOx emissions to a level equivalent to that indicated in [3.4.2] may be considered by the Society on a case-by-case basis.

3.4.4 Ships using separate fuel oils

a) The sulphur content of fuel used within SOx emission control areas is not to exceed 1,0% by mass.

b) Ships using separate fuel oils in order to comply with a) above are to allow sufficient time for the fuel oil service system to be fully flushed of all fuels exceeding 1,0% sulphur content prior to entry into an SOx emission control area. The volume of low sulphur fuel oils (equal to or less than 1,0% sulphur content) in each tank as well as the date, time and position of the ship when any fuel-changeover operation is completed are to be recorded in the log-book.

3.5 Documents to be submitted

3.5.1 Tab 4 lists the documents to be submitted for the assessment of the measures taken to prevent SOx emission.

3.6 Installations to limit the emission of SOx

3.6.1 General

If the SOx emission is controlled by an exhaust gas cleaning system, the requirements in [3.6.2] to [3.6.4] apply.

3.6.2 Materials

Materials for piping and equipment which are part of the cleaning system are to be tested in accordance with the requirements applicable to similar types of piping or equipment and their class and/or design conditions.

3.6.3 Tests and inspection during fabrication

Piping and equipment are to be inspected and tested during fabrication in accordance with the requirements applicable to the types of piping or equipment which are part of the plant, and their class and/or design conditions.

3.6.4 Tests after installation

After installation on board, the cleaning system is to be tested in the presence of the Surveyor under operating conditions. The control, monitoring and alarm systems are also to be tested in the presence of the Surveyor or their functioning is to be simulated by a procedure agreed with the Society.

Table 4 : Documents to be submitted

No.	(1)	Document
1	A	Detailed plans of systems and equipment to limit SOx emission in the SOx emission control areas **(2)**
2	A	Ship SOx Environmental Management Plan **(3)**

(1) A = to be submitted for approval in four copies;
I = to be submitted for information only.
(2) Only if such systems and equipment are installed.
(3) The Ship SOx Environmental Management Plan is to be approved if class notation LOWSOx(N) is assigned to the ship.

SECTION 4 SEA POLLUTION PREVENTION (CLEAN-SEA)

1 General

1.1 Application

1.1.1 Coverage

The notation **CLEAN-SEA** is assigned to ships fitted with efficient means to control and prevent the emission of polluting substances in the sea, in accordance with Pt A, Ch 1, Sec 2, [6.6.2].

The requirements of this Section are intended to prevent sea pollution from any of the following hazards:

- release of oil or oily substances into the sea
- release of noxious liquid substances into the sea
- release of harmful substances carried as cargo by sea in packaged form
- release of sewage into the sea
- release of garbage into the sea
- transfer of harmful aquatic organisms and pathogens through ballast water
- release of TBT (tributyltin) of antifouling paints
- release of grey water to sea
- ship recycling.

In order for the notation **CLEAN-SEA** to be granted, all the above hazards are to be considered within the relevant application limits. Accordingly, in relation to its characteristics and the likelihood of producing any or all of such uncontrolled release, each ship is to be fitted with means to simultaneously prevent all possible polluting hazards among those listed above.

1.2 Required certificates

1.2.1 In order to be granted and to maintain the CLEAN-SEA class notation, the validity of the following Certificates is to be ensured, if applicable to the ship:

- "International Oil Pollution Prevention Certificate" (IOPP Certificate), in accordance with MARPOL 73/78, Annex I.
- "International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk" (NLS Certificate) in accordance with MARPOL 73/78 Annex II, as applicable.
- "International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk" (ICOF CHE Certificate) in accordance with the IBC Code, as applicable.
- "International Sewage Pollution Prevention Certificate" (ISPP Certificate) in accordance to MARPOL 73/78, Annex IV.
- "International Antifouling System Certificate" (AFS Certificate) or statement of compliance issued in accordance with IMO Resolution MEPC.102(48) as amended.

Should one of the above-mentioned Certificates be suspended or not be renewed for any reason, the CLEAN-SEA notation will be automatically suspended until the ship is granted a new valid certificate.

1.3 Definitions

1.3.1 MARPOL 73/78

MARPOL 73/78 is the IMO "International Convention for the Prevention of Pollution from Ships, 1973/78, including the Annexes from I to VI as amended.

1.3.2 Definitions in connection with prevention of sea pollution by oil

Within these Rules all the terms used have the meaning provided in Annex I to MARPOL 73/78 as amended.

1.3.3 Definitions in connection with prevention of sea pollution by noxious liquid substances carried in bulk as cargo

Within these rules all the terms used have the meaning provided in Annex II to MARPOL 73/78 as amended.

1.3.4 Definitions in connection with prevention of sea pollution by harmful substances carried by sea in packaged form as cargo

Within these rules all the terms used have the meaning provided in Annex III to MARPOL 73/78 as amended.

1.3.5 Definitions in connection with prevention of sea pollution by sewage

Within these rules all the terms used have the meaning provided in Annex IV to MARPOL 73/78 as amended. In addition the following definitions apply:

a) Sewage

Sewage means:

- drainage and other wastes from any form of toilets and urinals,
- drainage from medical premises (dispensary, sick bay, etc.) via wash basins, wash tubs and scuppers located in such premises,
- other waste waters when mixed with the drainages defined above.

b) Treated sewage holding tank

Treated sewage holding tank means a tank used for the collection and storage of sewage downstream of the treatment plant.

c) Maximum number of persons on board.

For living quarter barges the maximum number of persons on board is the maximum number of persons that can be accommodated in cabins plus the crew.

1.3.6 Definitions in connection with prevention of sea pollution by garbage

Within these rules all the terms used have the meaning provided in Annex V to MARPOL 73/78 as amended and in addition garbage means all kinds of victual, domestic and operational waste excluding fresh fish and parts thereof, generated during the normal operation of the ship and liable to be disposed of continuously or periodically, except those substances which are defined or listed in Annexes I, II, III and IV to MARPOL 73/78.

1.3.7 Definitions in connection with prevention of sea pollution by other sources

a) Grey water means drainage from dishwater, shower, laundry, bath, washbasin drains and WC scuppers.

b) Maximum number of persons on board, for the purpose of calculating grey water retention capacity for living quarter barges, means the maximum number of persons that can be accommodated in cabins plus the crew.

c) Antifouling system means a coating, paint, surface treatment or device that is used in a ship to control or prevent attachment of fouling organisms.

d) TBT free antifouling means an antifouling paint in compliance with IMO Resolution MEPC.104(48), as amended.

e) AFS Certificate means "International Antifouling System Certificate" or statement of compliance, issued in accordance with IMO Resolution MEPC.104(48), as amended.

Note 1: For further definitions see App 3, [2.2].

1.3.8 Definitions in connection with the Ship Environmental Management

The Ship Environmental Manager is an officer in service on board, in charge of the management and control of the procedures and activities relevant to the requirements of this Section.

1.3.9 Definition in connection with ship recycling

The terms regarding ship recycling used in this Section have the meaning provided in IMO Resolution A.962(23).

1.4 Documents to be submitted

1.4.1 Documents to be submitted in connection with prevention of sea pollution by oil

Tab 1 lists the documents to be submitted in connection with prevention of sea pollution by oil.

The documents listed in Tab 1 do not take account of drawings necessary for the issuance of the IOPP Certificate.

1.4.2 Documents to be submitted in connection with prevention of sea pollution by noxious substances

Tab 2 lists the documents to be submitted in connection with prevention of sea pollution by noxious substances.

The documents listed in Tab 2 do not take account of drawings necessary for the issuance of the “International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk” or of the "International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk", as applicable.

1.4.3 Documents to be submitted in connection with prevention of sea pollution by harmful substances carried by sea in packaged form

Tab 3 lists the documents to be submitted in connection with prevention of sea pollution by harmful substances carried by sea in packaged form.

1.4.4 Documents to be submitted in connection with prevention of sea pollution by sewage

Tab 4 lists the documents to be submitted in connection with prevention of sea pollution by sewage.

The documents listed in Tab 4 do not take account of drawings necessary for the issuance of the ISPP Certificate.

1.4.5 Documents to be submitted in connection with prevention of sea pollution by garbage

Tab 5 lists the documents to be submitted in connection with prevention of sea pollution by garbage.

1.4.6 Documents to be submitted in connection with prevention of sea pollution by other sources

Tab 6 lists the documents to be submitted in connection with prevention of sea pollution by other sources.

The documents listed in Tab 6 do not take account of documentation necessary for the issuance of the AFS Certificate.

1.4.7 Documents to be submitted in connection with the Ship Environmental Management

Tab 7 lists the documents to be submitted in connection with the Ship Environmental Management.

1.4.8 Documents to be submitted in connection with ship recycling

The Green Passport or the Green Passport Plus are to be submitted for approval, in four copies, in connection with ship recycling.

2 Design and procedural requirements

2.1 Prevention of sea pollution by oils

2.1.1 General

Provided the ship has been granted a valid IOPP Certificate issued by an Administration or by a recognised organisation on behalf of an Administration, in accordance with MARPOL 73/78 Annex I, as applicable, the additional specific requirements as per [2.1.2] to [2.1.4] apply.

2.1.2 Tank arrangement

a) For the purpose of these Rules, tanks for fuel oil, sludge tanks and tanks for lubricating oil, whether or not for waste, of capacity exceeding the greater of 20 m^3 and V/100, where V is the total aggregate volume of such tanks, are to be considered. Overflow tanks are to be included unless they are provided with an alarm for

detection of liquid and operational procedures are foreseen for keeping such tanks empty.

b) Double bottoms for lubricating oil located under the main engine are not considered in these Rules.

c) Such tanks, irrespective of their location, are to have the bottom at a distance h above the base line equal to or greater than B/15, 2T/11 or 2 m, whichever is the lesser, with a minimum of 0,7 m.

d) The minimum distance w from the side and bottom shell plating, measured at any cross-section at right angles to the outer shell, is to be, in m:

- $w = 0,01 \cdot (68,69 + 0,0657 \cdot v)$

  for tanks having a volume between 20 and 2000 m^3

- $w = 2$

  for tanks having a volume greater than 2000 m^3,

  where:

  v : Volume of the tank, in m^3.

e) Small suction wells may extend below such limit for a height lower than 350 mm or h/2, whichever is the lesser, provided that they are as small as possible.

f) Tanks of any volume intended to contain fuel or lubricating oil are not to be used also for ballast water.

g) All tanks and cofferdams, if any, around the tanks are to be so arranged as to be adequately inspected; such cofferdams are to be effectively protected against corrosion by means of proper protective coatings of a light colour in order to be easily examined.

Table 1 : Documents to be submitted in connection with prevention of sea pollution by oil

No.	A/I	Document
1	I	Copy of the IOPP Certificate
2	A	Drawings with indication of tanks' volume and distance from the base line and shell plates as per [2.1.2] **(1)**
3	A	Schemes of the fuel oil, lubricating oil and relevant residue systems, containing the indications necessary to verify the requirements as per [2.1.3] **(1)**
4	I	Oil Systems Record Book

(1) If these indications are contained in the drawings and schemes used for the classification of the ship, such drawings and schemes may also be used to verify the requirements of these Rules.

Note 1: A = to be submitted for approval in four copies;
I = to be submitted for information in duplicate.

Table 2 : Documents to be submitted in connection with prevention of sea pollution by noxious substances

No.	**(1)**	Document
1	I	Copy of the "International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk" or copy of the "International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk", as applicable

(1) I = to be submitted for information in duplicate.

Table 3 : Documents to be submitted in connection with prevention of sea pollution by harmful substances carried by sea in packaged form

No.	**(1)**	Document
1	I	General arrangement plan with indication of the zone intended for the stowage of the harmful packaged substances in relation to the other zones of the ship
2	I	Plans of systems and equipment to discharge the harmful substances in case of emergency and to dispose of and wash possible leaks

(1) I = to be submitted for information in duplicate.

Table 4 : Documents to be submitted in connection with prevention of sea pollution by sewage

No.	A/I **(1)**	Document
1	I	General arrangement plan with indication of the sewage treatment plant enclosing details on treatment procedures **(2)**
2	I	Copy of the ISPP Certificate and type approval certificate for the sewage treatment plant according to MEPC.2(VI), as amended
3	A	Calculation of volume of holding tank(s) for treated sewage
4	I	General information on control and monitoring systems **(2)**
5	I	Sewage record book
(1) A = to be submitted for approval in four copies; I = to be submitted for information in duplicate. **(2)** Not required if the sewage treatment plant is of an approved type.		

Table 5 : Documents to be submitted in connection with prevention of sea pollution by garbage

No.	A/I **(1)**	Document
1	I	General information on garbage treatment equipment **(2) (3)**
2	A	Garbage management plan including garbage record book as specified by MARPOL 73/78 Appendix to Annex V
3	I	General description of control and monitoring systems of garbage treatment equipment **(2)**
(1) A = to be submitted for approval in four copies; I = to be submitted for information in duplicate. **(2)** Not required if the garbage treatment equipment is of an approved type. **(3)** For incinerators see Sec 3.		

Table 6 : Documents to be submitted in connection with prevention of sea pollution by other sources

No.	A/I **(1)**	Document
1	I	Copy of the AFS Certificate and details of TBT free antifouling paint
2	A	Calculation of volume of grey water holding tank(s) (living quarter barge only)
3	I	Grey water record book (living quarter barge only)
(1) A = to be submitted for approval in four copies; I = to be submitted for information in duplicate.		

Table 7 : Documents to be submitted in connection with the Ship Environmental Management

No.	A/I **(1)**	Document
1	I	Ship Environmental Management Plan as per [2.1.4], [2.3.6], [2.4.4], [2.5.4], [2.6.4] and [2.8.2]
2	A	Green Passport or Green Passport Plus as per [2.7.5] and [2.7.6]
(1) A = to be submitted for approval in four copies; I = to be submitted for information in duplicate.		

2.1.3 Systems

a) All fuel oil and lubricating oil tanks of capacity greater than 10 m^3 are to be fitted with an overflow system and a high level alarm.

Acceptable alternatives are:

- an overflow system and a flow alarm in the overflow main
- no overflow system and two high level alarms (for instance at 90% and 95% of filling).

b) The alarm signals are to be given in a suitable station from which bunkering or transfer operations are controlled.

c) On the weather and/or superstructure decks each fuel or lubricating oil tank vent, overflows and fill pipe con-

nection is to be fitted with a fixed container or enclosed deck area with a capacity of:

- 80 litres if the gross tonnage of the ship is between 300 and 1600
- 160 litres if the gross tonnage of the ship is greater than 1600.

d) The oil filtering equipment, requested by MARPOL Annex I, is to be provided with an oil content meter and with a 15 ppm alarm combined with automatic stopping device.

e) The effluent from the 15 ppm filtering equipment is to be capable of being recirculated to a bilge water holding tank. Such tank is to be so arranged as to allow periodical removal of sediments.

f) A holding tank is to be fitted for the pre-separation of bilge water before conveying it to the separating or filtering equipment.

g) The volume V of such a tank, in m^3, is to be at least:

$$V = 1 + 5{,}5P \cdot 10^{-4}$$

where P is the power of the propulsion engine plant, in kW. In any event it is not required that the volume V is greater than 15 m^3.

Particular cases, for instance with regard to the service, range and installed power, will be specially considered.

h) For ships operating with fuel oil having a mass density at 15°C greater than 0,94 kg/dm^3 and viscosity at 50°C greater than 110 centistokes, the possibility of heating such a tank is to be provided.

i) Ships operating with heavy fuel oil are to be provided with tanks for sludge from the fuel oil purifiers without internal structures and with a suitable heating system.

j) The sludge tank is to be so arranged as to allow periodical removal of sediments. Sludge is either to be disposed of on board through the incinerator or discharged ashore and is to be recorded in the oil record book.

Use of boilers for sludge disposal on board is not allowed unless a treatment system or special device is installed to improve emissions generated by sludge incineration, subject to Tasneef approval.

2.1.4 Procedures

a) The lube oil consumption of all systems having an oil to sea interface, such as main and auxiliary engines cooled by sea water, controlled pitch propellers, sterntubes, bow and stern thrusters, stabilisers, PODs etc, is to be recorded at least once a week in an "Oil Systems record book" aimed at detecting, through unusually high consumption, oil leakage through sealing.

The log-book is to contain the list of all systems concerned, the consumption of each system recorded at least every week and corrective actions when carried out.

b) The Ship Environmental Management Plan referred to in [2.8.2] is to include procedures covering the following:

- oily waste management including discharge criteria;
- preparation, filling in and maintenance of the oil record book and of the "Systems oil consumption log-book";
- periodical calibration of the oil content meter referred to in [2.1.3], to be carried out when required by the Manufacturer's instructions or, in the absence of specific indications, at least every six months; documentation is to be kept on board for examination during periodical surveys;
- periodical cleaning of the bilge holding tank and of the sludge tank
- spillage during bunkering;
- periodical checks of the overflow systems/alarms.

2.2 Prevention of sea pollution by noxious liquid substances carried in bulk as cargo

2.2.1 Application

The following requirements apply to all ships.

2.2.2 General

Provided the ship has been granted a valid “NLS” or a valid "ICOF CHE" certificate, as applicable, issued by an Administration or by a recognised organisation on behalf of an Administration, in accordance with MARPOL 73/78 Annex II, as applicable, there are no additional specific requirements to be complied with on this matter for the purpose of the issuance of the **CLEAN-SEA** notation.

2.3 Prevention of sea pollution by harmful substances carried by sea as cargo in packaged form

2.3.1 General

Harmful substances carried as cargo in packaged form are to be properly stowed and secured so as to minimise the hazards to the marine environment, according to MARPOL 73/78 Annex III, as amended.

2.3.2 Stowage

a) Harmful substances are to be properly stowed and secured so as to minimise the hazards to the marine environment without impairing the safety of the ship and persons on board.

b) Certain harmful substances may, for sound scientific and technical reasons, need to be prohibited for carriage or be limited as to the quantity which may be carried aboard any one ship. In limiting the quantity, due consideration is to be given to the size, construction and equipment of the ship, as well as the packaging and the inherent nature of the substances.

c) Each ship carrying harmful substances is to have a special list or manifest setting forth the harmful substances on board and the location thereof. A detailed stowage plan which sets out the location of the harmful sub-

stances on board may be used in place of such special list or manifest.

2.3.3 Empty packages

Empty packages which have been used previously for the carriage of harmful substances are themselves to be treated as harmful substances, unless adequate precautions have been taken to ensure that they contain no residue that is harmful to the marine environment.

2.3.4 Marking

a) Packages containing a harmful substance are to be durably marked with the correct technical name (trade names alone are not to be used) and, additionally, are to be durably marked or labelled to indicate that the substance is a marine pollutant. Such identification is to be supplemented where possible by other means, for example, by use of the relevant United Nations number.

b) The method of marking the correct technical name and of affixing labels on packages containing a harmful substance is to be such that this information will still be identifiable on packages surviving at least three months' immersion in the sea. In considering suitable marking and labelling, account is to be taken of the durability of the materials used and of the surface of the package.

c) Packages containing small quantities of harmful substances may be exempted from the marking requirements.

2.3.5 Leaks

a) Jettisoning of harmful substances carried in packaged form is not permitted, except where necessary for the purpose of securing the safety of the ship or saving life at sea.

b) Appropriate measures based on the physical, chemical and biological properties of harmful substances are to be taken to regulate the washing of leakages overboard, provided that compliance with such measures would not impair the safety of the ship and persons on board.

2.3.6 Procedures

The Ship Environmental Management Plan referred to in [2.8.2] is to include procedures covering the requirements of this item [2.3].

2.4 Prevention of sea pollution by sewage

2.4.1 General

Provided the ship has been granted a valid ISPP Certificate issued by an Administration or by a recognised organisation on behalf of an Administration, in accordance with MARPOL 73/78 Annex IV, as applicable, the additional specific requirements as per [2.4.2] to [2.4.4] apply.

2.4.2 Discharge of sewage at sea

All sewage discharges whether to sea or shore based facilities are to be recorded in the sewage record book with indication of the date, location and quantity of sewage discharged and are to comply with MARPOL Annex IV discharge requirements.

2.4.3 Sewage treatment plant

a) A sewage treatment plant, meeting operational requirements based on the standards and test methods as detailed in Resolution MEPC.2(VI), as amended, is to be installed on board.

b) The ship is to be equipped with holding tank(s) for treated sewage with sufficient capacity to allow storage of treated sewage when in port or in no discharge areas. The minimum total capacity of such tank(s) is to be 2 days based on the maximum number of persons on board and 96 litres/person/day if a conventional (flushometer) system is used and 11 litres/person/day if a vacuum system is used.

   A smaller volume, in any case not lower than 50% of the above capacity, may be accepted provided that:

   - the ship is equipped with a post-treatment system for sewage, able to reduce the volume of the effluent (ex. by recycling part of the treated sewage water for on board use);
   - 2 days retention is ensured;
   - technical documentation, including results of onboard tests, of the system's efficiency and of effluent volume reduction is documented to the satisfaction of the Society.

c) The ship is to be equipped with a pipe leading to the exterior convenient for the discharge of sewage to a reception facility; such pipe is to be fitted with a standard shore connection in compliance with MARPOL Annex IV, and the materials, piping, fittings and equipment are to comply with the applicable requirements of the various Sections of these Rules.

d) Treated sewage holding tanks are to be equipped with high level alarms.

2.4.4 Procedures

The Ship Environmental Management Plan referred to in [2.8.2] is to include procedures covering the following:

- sewage management including discharge criteria and use of holding tanks in port and no discharge areas;
- preparation, filling in and maintenance of the sewage record book;
- disposal of sewage treatment plant residues. If the ship is not in a condition to dispose at sea of sewage treatment plant residues in accordance with international or national regulations, such residues are to be disposed of ashore or by incineration.

2.5 Prevention of sea pollution by garbage

2.5.1 General

The applicable requirements of MARPOL 73/78 Annex V, as amended, are to be complied with, in addition to the following additional specific requirements.

2.5.2 Placards, garbage management plans and garbage record-keeping

a) Placards which notify the crew and persons of the disposal requirements of MARPOL Annex V are to be fitted on board as applicable.

b) The placards are to be written in the official language of the State whose flag the ship is entitled to fly and, for ships engaged in voyages to ports or offshore terminals under the jurisdiction of other States, in English or French.

c) A garbage management plan and record book is to be available on board. This plan is to provide written procedures for collecting, storing, processing and disposing of garbage, including the use of the equipment on board. It is also to designate the person in charge of carrying out the plan. Such plan is to be in accordance with the guidelines in App 3 and written in the working language of the crew.

d) For living quarter barges, special consideration in the garbage management plan is to be given to the following potentially hazardous wastes:

- Dry-cleaning solvents and waste fluids
- Photocopying and laser printer cartridges
- Unused pharmaceuticals and those which are past their use-by date
- Batteries
- Fluorescent and Mercury vapor lamp bulbs.

2.5.3 Waste recycling

For living quarter barges:

a) a strategy of waste recycling is to be foreseen, adopted and documented;

b) the minimum total quantity of wastes landed for recycling (Wr) is to be 50% of recyclable wastes produced on board (Wb), where Wb = 40 Kg/person/year based on the number of persons the ship is certified to carry.

The amount of waste landed for recycling is to be recorded in the garbage record book, and different wastes are to be collected and landed separately.

Fore the purpose of this Rule, recyclable wastes are:

- Plastic
- Aluminum
- Glass
- Paper-Cardboard.

2.5.4 Procedures

The Ship Environmental Management Plan referred to in [2.8.2] is to include procedures covering the Garbage management and waste recycling, according to this item [2.5].

2.6 Prevention of sea pollution by other sources

2.6.1 Antifouling system

a) Antifouling systems for the hull are to be of TBT-free type.

b) The AFS Certificate and documentation of the TBT-free antifouling system are to be kept on board for checking during periodical surveys.

2.6.2 Release of grey water

The requirements of this item apply only to living quarter barges:

a) Ships are to be equipped with holding tank(s) for grey water with sufficient capacity to allow storage of grey water when in port for at least 2 days. The total capacity of grey water holding tanks is to be based on the maximum number of persons on board and 200 litres/person/day.

b) Grey water holding tanks are to be equipped with high level alarms.

c) If the same tanks are used to hold treated sewage and grey water, their capacity is to be at least the sum of the capacities for the treated sewage holding tanks in [2.4.3] and the tanks for grey water.

A smaller volume, in any case not lower than 50% of the above capacity, may be accepted provided that:

- the ship is equipped with a system for treating greywater, able to reduce the volume of the effluent (e.g. by recycling part of the treated greywater for on board use);
- 2 days retention is ensured;
- technical documentation, including results of onboard tests, of the system's efficiency and of effluent volume reduction is documented to the satisfaction of the Society.

d) Grey water is always to be discharged at a distance of more than 4 nautical miles from the nearest land or to a reception facility.

e) The discharging criteria do not apply when the discharge of grey water is necessary for securing the safety of the ship and those on board, or saving life at sea, or when the discharge results from damage to the ship or its equipment.

f) All grey water discharges whether to sea or shore-based facilities are to be recorded in the grey water record book with indication of the date, location and quantity of grey water discharged. If the grey water is discharged to sea, the records are to include information on distance to the nearest land.

2.6.3 Procedures

The Ship Environmental Management Plan referred to in [2.8.2] is to include procedures requested in [2.6] including the grey water discharge criteria and use of holding tanks in ports and in no discharge areas.

2.7 Ship recycling

2.7.1 General

Some of the problems associated with ship recycling might be addressed at the design and construction stage, not only in relation to the ships themselves but also in respect of ships equipment.

The first step is to identify any potentially hazardous materials which might be incorporated, as a matter of routine, in the structure of ships and their equipment and, where practicable, consider using less hazardous alternatives.

2.7.2 Initial stage

The initial stages might include an evaluation of:

a) the type, amount and potential hazard of materials utilised and their location on board a ship;

b) the activities expected during the operation of the ship and any potentially hazardous wastes which might be generated; and

c) the feasibility of addressing the potential for hazardous waste generation by considering:

1) product reformulation - installing components utilising less potentially hazardous materials;

2) cleaner production technologies - which generate less waste;

3) process modification - to generate less waste;

4) input substitution - utilising less potentially hazardous consumables or those which generate less waste; and

5) on-site, closed-loop recycling - systems that recycle wastes on board the ship.

2.7.3 Design stage

When designing and constructing a vessel, due account is to be taken of the ship's ultimate disposal, by:

a) using materials which can be recycled safely and in an environmentally sound manner; and

b) minimising the use of materials known to be potentially hazardous to health and the environment.

2.7.4 Ship recicyling

The Green Passport or the Green Passport Plus is to be developed according to Resolution A.962(23) - IMO Guidelines on Ship Recycling (paragraph 5) or to Resolution MEPC.179(59) - Guidelines for the development of the inventory of hazardous materials, respectively.

2.7.5 Green Passport

In order to contribute towards minimising potential problems related to protection of the environment in the recycling of vessels, guidelines on ship recycling have been adopted by IMO with Resolution A.962(23) to give guidance to all stakeholders in the ship recycling process.

The Green Passport is to be developed according to the above-mentioned Resolution A.962(23) - IMO Guidelines on Ship Recycling, paragraph 5.

The Green Passport for ships is a document facilitating the application of these Guidelines providing information with regard to materials known to be potentially hazardous utilised in the construction of the ship, its equipment and systems.

This is to accompany the ship throughout its operating life. Successive Owners of the ship are to maintain the accuracy of the Green Passport and incorporate into it all relevant design and equipment changes, with the final Owner delivering the document, with the ship, to the recycling facility.

2.7.6 Green Passport Plus

Following Resolution A.962(23), the new Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009, has been adopted by IMO.

In application of the requirements of the new Convention, the Green Passport Plus is an updated version of the Green Passport, providing more detailed information with regard to potentially hazardous materials utilised in the construction of the ship, its equipment and systems, and developed taking into account IMO Resolution MEPC.179(59) "Guidelines for the Development of the Inventory of Hazardous Materials".

This document accompanies the ship throughout its operating life and incorporates all relevant design and equipment changes, with the final Owner delivering the document, with the ship, to the recycling facility.

2.8 Ship Environmental Management

2.8.1 Ship Environmental Manager

A Ship Environmental Manager, as defined in [1.3.8], is to be available on board.

2.8.2 Ship Environmental Management Plan

An Environmental Management Plan, specific to the ship, is to be developed and made available on board.

The Manual is to contain at least the procedures requested in [2.1.4], [2.3.6], [2.4.4], [2.5.4] and [2.6.4], and is to include:

- the indication of person(s) in charge for each procedure to be carried out
- documents and manuals required
- log-books/records to be filled in
- time schedule when applicable (e.g. checking, sampling, etc.)

The Ship Environmental Management Plan is to be submitted to the Society for information.

3 Inspections and tests

3.1 Inspections and testing during construction

3.1.1 Materials

Materials for piping and equipment which are used for the construction of equipment and systems to be installed on board in connection with the requirements of this Section are to be tested in accordance with the Sections of the Rules applicable to similar types of piping or equipment and their class and/or design conditions.

3.1.2 Tests and inspection during fabrication

Piping and equipment relative to the means for preventing sea pollution, as stated in this Section, are to be inspected and tested during fabrication in accordance with the Sections of the Rules applicable to the type of piping or equipment and the relevant class and/or design conditions.

3.2 Inspection and testing after installation on board

3.2.1

After installation on board, the equipment and systems installed in connection with the requirements of this Section are to be tested in the presence of the Surveyor under operating conditions. The control, monitoring and alarm systems are also to be tested in the presence of the Surveyor or their functioning is to be simulated by a procedure agreed with the Society.

3.3 Periodical surveys

3.3.1 During periodical surveys, the checks and inspections requested in Pt A, Ch 5, Sec 5, as applicable, are to be carried out.

SECTION 5 LOW SULPHUR FUELS (LSF)

1 General

1.1 Application

1.1.1 The additional class notation LSF is assigned to ships for which evidence has been provided to the Society, in accordance with [3], that Low Sulphur Fuels (LSF) may be used by some or all on board fuel oil consumers to be recorded in the ship's status, together with the relevant percentage, in weight, of the fuel sulphur content (e.g. 1%, 0,5%, 0,1%).

Upon request, a statement may be issued to ships complying with the requirements of this Section.

It is to be noted that responsibility for ensuring that the ship is suitable for safe operation using the fuels required by the applicable national or international legislation remains with the operator.

2 Documentation to be submitted

2.1

2.1.1 The list of documents to be submitted is given in Tab 1. The Society reserves the right to request the submission of additional documents in the case of non-conventional design or if it is deemed necessary to evaluate the systems and components.

3 Requisites

3.1 General

3.1.1 A documented analysis aimed at identifying possible risks associated with the use of LSF, including changeover procedures, is to be made available to the Society.

The analysis is to be carried out by means of a methodology for identifying and dealing with potential problems, particularly those which could create a hazardous situation or severe consequences on propulsion and auxiliary engines or boilers.

3.2 Fuel oil consumers

3.2.1 Any fuel oil consumer (engine, boiler, etc.) is not to be negatively affected by the LSF or by the fuel change.

3.2.2 Suitability of the consumers, as they are, is to be stated by the relevant manufacturers; alternatively modifications are to be carried out following the manufacturer's recommendations or, in the absence of the original manufacturer, those issued by other competent parties (e.g. operators or technical consultants) capable of providing a final suitability statement.

3.2.3 The impact of the modifications referred to in [3.2.2] on engines already type approved and/or certified according to MARPOL Annex VI is to be evaluated.

3.3 Fuel oil system

3.3.1 Any modification of the fuel oil system is to be documented and submitted for approval.

3.3.2 Appropriate LSF storage conditions are to be chosen in respect of heating sources; the piping system is to be suitable for the use of LSF in particular to avoid possible leakages.

3.3.3 When LSF is used, correct parameters (e.g. pressure, flow, temperature, etc.) are to be maintained in the system within the limits and specifications given by the manufacturer of each fuel oil consumer.

3.3.4 Fuel changeover on each fuel oil consumer is to be carried out in an easy, safe and reliable manner, following the relevant changeover procedure, which is to be available on board.

3.3.5 Where operational risks are identified in the analysis referred to in [3.1], the relevant risk mitigations are to be correctly implemented.

4 Surveys

4.1 Survey for assignment of the notation

4.1.1 The survey is to include:

a) verification of the availability of the documents relevant to the analysis carried out by the owner on the risks associated with the use of LSF and procedures for fuel changeover

b) verification of the availability of the statements relevant to equipment being able to use LSF without risk, issued by the manufacturers of each fuel handling equipment (e.g. pumps, coolers etc..) and fuel consumers (e.g. aux boilers and auxiliary engines) or, in the absence of the original manufacturer, by other competent parties (e.g. operators or technical consultants) capable of providing a final suitability statement

c) verification of the availability of approved drawings in the case of modifications of existing fuel systems, as per manufacturer's requirements or, in the absence of the original manufacturer, by other competent parties (e.g. operators or technical consultants) capable of providing a final suitability statement

d) survey/tests of the modifications as per the applicable rules (e.g. Pt C, Ch 1, Sec 8), including appropriate location [3.3.2], absence of leakages [3.3.2], functional

tests [3.3.3], and fuel changeover tests [3.3.4], correct implementation of risk mitigation, if any [3.3.4].

4.2 Annual Survey

4.2.1 The survey is to include:

a) verification of the availability of the owner's declaration stating that no modifications to the LSF System, procedures and consumers have been carried out since the last survey

b) verification of on-board availability of the procedures for fuel changeover.

4.3 Class Renewal Survey

4.3.1 The survey is to include:

a) verification of the availability of the owner's declaration stating that no modifications to the LSF System, procedures and consumers have been carried out since the last survey

b) verification of on-board availability of the procedures for fuel changeover

c) testing of the fuel changeover during the dock trials for each fuel oil consumer.

Table 1 : Documents to be submitted

No.	A/I **(1)**	Document
1	I	Documents relevant to the analysis carried out on the risks associated with the use of LSF fuels
2	A	Tank general arrangement plan showing the tanks for LSF storage
3	A	Drawings of fuel oil system
4	I	Arrangements and procedures for use of separate fuel oil

(1) A = to be submitted for approval in quadruplicate;
I = to be submitted for information in duplicate.

APPENDIX 1 DEFINITIONS RELEVANT THE GREEN PLUS NOTATION

1 General

1.1 MARPOL 73/78

1.1.1 MARPOL 73/78 is the IMO "International Convention for the Prevention of Pollution from Ships, 1973/78, including the Annexes from I to VI as amended.

1.2 Ship Environmental Manager

1.2.1 The Ship Environmental Manager is an officer in service on board, in charge of the management and control of the procedures and activities relevant to the requirements of this Chapter.

1.3 Ship recycling

1.3.1 The terms regarding ship recycling used in this Chapter have the meaning provided in the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships 2009, MEPC.179(59) (Guidelines for the development of the inventory of hazardous materials), and IMO Resolution A.962(23).

2 Definitions in connection with prevention of sea pollution

2.1 Discharge

2.1.1 Discharge, in relation to harmful substances or effluents containing such substances, means any release, howsoever caused, from a ship and includes any escape, disposal, spillage, leakage, pumping, emitting or emptying.

Discharge does not include:

- dumping, within the meaning of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, London 13 November 1972, or
- release of harmful substances directly arising from the exploration, exploitation and associated offshore processing of seabed mineral resources, or
- release of harmful substances for purposes of legitimate scientific research into pollution abatement or control.

2.2 Grey water

2.2.1 Grey water means drainage from dishwasher, galley, shower, laundry, bath, washbasin drains and toilette scuppers.

2.3 Grey water - Maximum number of persons

2.3.1 Maximum number of persons on board, for the purpose of calculating grey water retention capacity for living quarter barges, means the maximum number of persons that can be accommodated in cabins plus the crew.

2.4 Harmful substance

2.4.1 Harmful substance means any substance which, if introduced into the sea, is liable to create hazards to human health, harm living resources and marine life, damage amenities or interfere with other legitimate uses of the sea, and includes any substance subject to control by MARPOL 73/78.

2.5 Harmful substances carried in packaged form

2.5.1 Harmful substances are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code) as amended. Packaged form is the form of containment specified for harmful substances in the IMDG Code.

2.6 Oily wastes

2.6.1 Oily wastes means the water removed from machinery space bilges, used lube and hydraulic oils, sludge from fuel oil and from lube oil treatment systems.

2.7 Sludge oil

2.7.1 Sludge oil means sludge from fuel and lubricating oil separators, waste lubricating oil from main and auxiliary machinery and waste oil from bilge water separators, drip trays, etc.

2.8 TBT free antifouling system

2.8.1 Antifouling system means a coating, paint, surface treatment or device used to control or prevent attachment of organisms.

TBT-free antifouling system means an antifouling system in compliance with the IMO Resolution MEPC.102(48) as amended.

2.9 Treated sewage holding tank

2.9.1 Treated sewage holding tank means a tank used for the collection and storage of the effluent of the sewage treatment plant.

2.10 AFS Certificate

2.10.1 AFS Certificate means "International Antifouling System Certificate" or statement of compliance, issued in accordance with IMO Resolution MEPC.104(48), as amended.

3 Definitions in connection with prevention of air pollution

3.1 Cold Ironing

3.1.1 Cold Ironing is the process of providing shore-side electrical power by means of a high-voltage shore connection system designed to supply the ship when operational and lying in port while its main and auxiliary engines are turned off.

3.2 Gas to liquid fuels (GTL)

3.2.1 Gas to liquid fuels are those fuels obtained according a refinery process which converts natural gas or other gaseous hydrocarbons into longer-chain hydrocarbons.

3.3 Global Warming Potential (GWP)

3.3.1 Global Warming Potential is the potential global warming effect of a gas compared with CO2 on a time horizon of 100 years.

3.4 Green House Gases (GHGs)

3.4.1 A Green House Gas is any gas, such as carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), chloro fluoro carbon compounds (CFCs) that contribute to the greenhouse effect when released into the atmosphere.

3.5 Liquefied Natural Gas (LNG)

3.5.1 Liquefied natural gas or LNG is natural gas (primarily methane, CH4) that has been converted to liquid form for ease of storage or transport.

3.6 Low energy consumption lights

3.6.1 Low energy consumption lights are lights other than incandescent light bulbs, halogen lamps and those having similar lum/W ratio, recognized by appropriate national or international standards.

3.7 Ozone Depleting Potential (ODP)

3.7.1 Ozone Depleting Potential is the potential of ozone depletion compared to CFC 11. Values of ODP for ozone depleting gases are provided in the "Montreal Protocol on Substances that Deplete the Ozone Layer".

3.8 Particulates (PMs)

3.8.1 Particulates, alternatively referred to as particulate matter (PM) or fine particles, are tiny particles of solid or liquid suspended in a gas.

3.9 Second generation bio-fuels

3.9.1 Second generation bio-fuels are those produced sustainably by using biomass comprised of the residual non-food parts of current crops, such as stems, leaves and husks that are left behind once the food crop has been extracted, as well as other crops that are not used for food purposes, such as switch grass and cereals that bear little grain, and also industry waste such as wood chips, skins and pulp from fruit pressing etc., whereby the complete cycle from production to consumption, allows to obtain, with equal total power generated, a reduction in CO2 emissions of over 85% compared to fossil fuels.

APPENDIX 2 BASIC AND ADDITIONAL SYSTEMS, COMPONENTS AND PROCEDURAL MEANS TO EVALUATE THE SHIP'S ENVIRONMENTAL INDEX AS PER THE GREEN PLUS NOTATION

1 Prevention of sea pollution

1.1 Oil from machinery spaces

1.1.1 Compliance with Annex I to MARPOL 73/78 as amended

Compliance with Annex I to MARPOL 73/78 as amended is to be assured.

1.1.2 Bilge Water Treatment (15 ppm with alarm and automatic stop)

The oil filtering equipment is to grant maximum oil content in the effluent up to 15 ppm, be provided with an oil content meter and with a 15 ppm alarm in a manned position, combined with automatic stopping device.

The effluent from the 15 ppm filtering equipment is to be capable of being re-circulated to the bilge water holding tank, see [1.1.5].

1.1.3 Bilge Water Treatment (5 ppm with alarm and automatic stop)

The oil filtering equipment is to grant maximum oil content in the effluent up to 5 ppm, be provided with an oil content meter and with a 5 ppm alarm in a manned position, combined with automatic stopping device.

If additional equipment is installed to ensure the above performance, it is to be approved by the Society.

If the performance of 5 ppm is ensured by a system type approved according to applicable MARPOL regulations, such performance is to be verified by the Society.

The effluent from the 5 ppm filtering equipment is to be capable of being re-circulated to the bilge water holding tank, see [1.1.5].

1.1.4 Bilge Water Treatment (5 ppm with alarm, automatic stop and recorder)

In addition to [1.1.3] the following is to be provided with:

a) a monitoring and control system, supervising the overboard discharge of the treated bilge water and including a fuel oil grease monitor, a flow meter, control means, valves and fittings, capable of:
   1) providing a fail-safe system for discharging treated bilge water overboard including immediate shutdown of Bilge Water Separator in the event of
      - high oil content
      - insufficient flow of sampling water through the Oil monitor
      - the rinse/sampling valves (inlet and outlet) of the Oil monitor are not closed
   2) measuring the flow of the water and the oil content value
   3) giving alarm signals
   4) controlling the position of the overboard discharge three-way valve

   The open command of remote controlled overboard discharge valve is to be authorised from the bridge and indication of the status of manually operated overboard discharge valves is to be available on the bridge.
b) a recorder capable of recording
   1) ship's time
   2) run stop time of bilge water separator
   3) all the data from the monitoring and control system as described in a).

1.1.5 Bilge oil tank

All machinery space bilges are to be drained into a holding tank for pre-separation upstream of the oil separation and filtering equipment.

Alternative installations may be considered on a case-by-case basis.

The volume V of the holding tank, in m^3, is to be at least:

$V = 1 + 5{,}5\ P \cdot 10^{-4}$

where P is the power of the propulsion engine plant, in kW.

In any event, it is not required that the volume V is greater than 15 m^3.

Taking into account the ship service, navigation and installed power, a smaller volume V may be accepted on a case-by-case basis.

The tank is to be so arranged as to allow periodical removal of sediments.

For ships operating with fuel oil having a mass density at 15°C greater than 0,94 kg/dm^3 and viscosity at 50°C greater than 110 centistokes, this tank is to be provided with heating arrangements.

A high level alarm is to be given in a manned position.

1.1.6 Sludge tank

The sludge tank is to be so arranged as to allow periodical removal of sediments.

Sludge is to be disposed of on board through the incinerator or discharged ashore and is to be recorded in the oil record book.

Use of boilers for sludge disposal on board is not allowed.

However when a treatment system or special device is installed to improve emissions generated by sludge incineration, subject to Society's approval, use of boiler for sludge disposal may be permitted.

Ships operating with heavy fuel oil are to be provided with tanks for sludge from the fuel oil purifiers without internal structures and with a suitable heating system.

A high level alarm is to be given in a manned position.

1.1.7 Restrictions in the use of ship's tanks for ballast

The use of tanks intended for fuel oil as ballast tanks is not allowed, irrespective of their volume.

1.1.8 Fuel oil tank protection by means of tank boundary distance from the ship side and bottom

The protection of the tanks is to be achieved applying the criteria of MARPOL Annex I Reg. 12A based on the distance of the fuel oil tank boundary from the ship side and bottom.

If the adoption of fuel oil tank protection criteria is compulsory for the ship concerned, no contribution to the ship's environmental index will be considered for fuel oil tank protection.

1.1.9 Fuel oil tank protection by means of outflow calculation

The protection of the tanks is to be achieved applying the criteria of MARPOL Annex I Reg. 12A based upon outflow calculation.

In case the adoption of fuel oil tank protection criteria is compulsory for the concerned ship, no contribution to the ship's environmental index will be considered for fuel oil tank protection.

1.1.10 Lubricating oil and sludge tank protection by means of tank boundary distance from the ship side and bottom

The protection of the tanks (having a capacity of 20 m^3 and above) is to be achieved applying the criteria of MARPOL, Annex I, Reg. 12A (independently from their total aggregate capacity) based upon the distance of fuel oil tanks boundary from the ship side and bottom.

The requirement is not applicable to the double bottom for lubricating oil located under the main engine.

1.1.11 Lubricating oil and sludge tank protection by means of outflow calculation

The protection of the tanks (having a capacity of 20 m3 and above) is to be achieved applying the criteria of MARPOL Annex I Reg. 12A (independently from their total aggregate capacity) based upon outflow calculation.

The requirement is not applicable to the double bottom for lubricating oil located under the main engine.

1.1.12 Oil tank overflow

a) All fuel oil and lubricating oil tanks of capacity greater than 10 m^3 are to be fitted with an overflow system and a high level alarm.

   Acceptable alternatives are:

   - an overflow system and a flow alarm in the overflow main
   - no overflow system and two high level alarms (for instance at 90% and 95% of filling).

b) The alarm signals are to be given in a suitable position from which bunkering or transfer operations are controlled.

1.1.13 Gutters

On the weather and/or superstructure decks each fuel or lubricating oil tank vent, overflow and fill pipe connection is to be fitted with a fixed container or enclosed deck area with a capacity of:

- 80 litres if the gross tonnage of the ship is between 300 and 1600
- 160 litres if the gross tonnage of the ship is greater than 1600.

1.1.14 Dry bilge concept

An adequate number of tanks of 1 m^3 minimum each is to be installed to collect drainage water from one or more equipment (e.g. diesel engine scavenging air coolers, potable water analyzers, low temperature heat exchangers) within the same compartment which have drainage water with similar characteristics. Such tanks have the function to drastically reduce water drainage to bilge spaces and so reduce the oily water, emulsified bilge water and other contaminated water collecting in bilge wells.

Each tank is to be equipped with automatic transfer means, level indicator for local control and high level alarm given in a manned position.

1.1.15 Sludge oil collection and handling facilities

An adequate number of tanks of 100 l approximate capacity each is to be installed to collect oily liquids from drains, vents, seals and glands of all equipment in machinery spaces and bunker stations connected to a fuel oil and lubricating oil system.

The tanks are to be installed outside the double bottom. Drain lines must not pass through watertight bulkheads or tank tops.

The tanks are to be in addition to the drain tanks dedicated to each purifier module for the collection of generated sludge.

The tanks are to be equipped with automatic transfer means, level indicator for local control and high level alarm given in a manned position connected to the automation system.

A hand pump is to be additionally provided which levers are to be located at floor level to facilitate operations; where this is not possible, a platform with a vertical ladder is provided for access to the pump.

Drain tanks of purifier modules are to be provided for each purifier skid, equipped with a high level alarm given to a

manned position, connected to the Control and Monitoring Panel of each purifier.

Drain tanks are to be discharged to the Sludge Tank in [1.1.6] by means of a power operated pump. All discharge lines are sized to allow pumping without the need to heat the sludge.

1.1.16 Water-lubricated stern tube bearings

Stern tube bearings are to be water lubricated according to Pt C, Ch 1, Sec 5, [2.4.3] to Pt C, Ch 1, Sec 5, [2.4.7].

1.1.17 Magnetic coupling on oil pumps

Magnetic couplings are to be used to connect fuel oil and lubricating oil pumps and relevant drivers.

These couplings are to be approved by the Society.

1.1.18 Biodegradable lube oil

Biodegradable oils are to be used for the lubrication of machineries, apart from diesel engines, and for hydraulic systems. The oil biodegradability characteristic is to be according to a recognized standard.

1.1.19 Restrictions in the use of hydraulic plants

All manoeuvring systems (steering gear, watertight doors, hatches, valves etc) apart from the controllable pitch propeller actuating systems are not to be of hydraulic type.

1.1.20 Procedures

a) The lube oil consumption of all systems having an oil to sea interface, such as main and auxiliary engines cooled by sea water, controlled pitch propellers, sterntubes, bow and stern thrusters, stabilisers, PODs etc, is to be recorded at least once a week in an "Oil Systems record book" aimed at detecting, through unusually high consumption, oil leakage through sealings.

   The log-book is to contain the list of all systems concerned, the consumption of each system recorded at least every week and corrective actions when carried out.

b) The Ship Environmental Management Plan, referred to in Sec 1, [4.1.2], is to include procedures covering the following:

   - oily waste management including discharge criteria;
   - preparation, filling in and maintenance of the oil record book;
   - periodical calibration of the oil content meters, when required by the Manufacturer's instructions or, in the absence of specific indications, at least every six months; documentation is to be kept on board for examination during periodical surveys;
   - periodical cleaning of the bilge holding tank and of the sludge tank
   - spillage during bunkering;
   - periodical checks of the overflow systems/alarms.

1.2 Oil from cargo area

1.2.1 Compliance with Annex I to MARPOL 73/78 as amended

Compliance with Annex I to MARPOL 73/78 as amended is to be assured.

1.3 Noxious substances carried in bulk

1.3.1 Compliance with Annex II to MARPOL 73/78 as amended

Compliance with Annex II to MARPOL 73/78 as amended is to be assured

1.4 Harmful substances carried in packaged form

1.4.1 Compliance with Annex III to MARPOL 73/78 as amended

Compliance with Annex III to MARPOL 73/78 as amended is to be assured.

The carriage of harmful substances in packaged form has to comply with the requirements of MARPOL 73/78, Annex III as amended.

1.4.2 Procedures

The Ship Environmental Management Plan, referred to in Sec 1, [4.1.2], is to include procedures covering the following:

a) Stowage

   1) Harmful substances are to be properly stowed and secured so as to minimise the hazards to the marine environment without impairing the safety of the ship and persons on board.

   2) Certain harmful substances, for sound scientific and technical reasons, may need to be prohibited for carriage or be limited as to the quantity which may be carried aboard any one ship. In limiting the quantity, due consideration is to be given to the size, construction and equipment of the ship, as well as the packaging and the inherent nature of the substances.

   3) Each ship carrying harmful substances is to have a special list or manifest setting forth the harmful substances on board and the location thereof. A detailed stowage plan which sets out the location of the harmful substances on board may be used in place of such special list or manifest.

b) Empty packages

   Empty packages which have been used previously for the carriage of harmful substances are themselves to be treated as harmful substances, unless adequate precautions have been taken to ensure that they contain no residue that is harmful to the marine environment.

c) Marking

   1) Packages containing a harmful substance are to be durably marked with the correct technical name (trade names alone are not to be used) and, additionally, are to be durably marked or labelled to indicate that the substance is a marine pollutant. Such identification is to be supplemented where possible by other means, for example, by use of the relevant United Nations number.

   2) The method of marking the correct technical name and of affixing labels on packages containing a harmful substance is to be such that this information will still be identifiable on packages surviving at

least three months' immersion in the sea. In considering suitable marking and labelling, account is to be taken of the durability of the materials used and of the surface of the package.

3) Packages containing small quantities of harmful substances may be exempted from the marking requirements.

d) Leaks

1) Jettisoning of harmful substances carried in packaged form is not permitted, except where necessary for the purpose of securing the safety of the ship or saving life at sea.

2) Appropriate measures based on the physical, chemical and biological properties of harmful substances are to be taken to regulate the washing of leakages overboard, provided that compliance with such measures would not impair the safety of the ship and persons on board.

1.5 Sewage

1.5.1 Treatment plant: effluent quality as per IMO MEPC.2(VI)

A sewage treatment plant, meeting operational requirements based on the standards and test methods as detailed in Resolution MEPC.2(VI), as amended, is to be installed on board.

1.5.2 Treatment plant: effluent quality as per IMO MEPC.159(55)

A sewage treatment plant, meeting operational requirements based on the standards and test methods as detailed in Resolution MEPC.159(55) is to be installed on board.

The system performance is to be certified.

1.5.3 Advanced treatment plant or additional polishing stage: effluent quality as per ADEC Title XIV (33 CFR Part 159 Subpart E)

A sewage treatment plant, meeting operational requirements based on the standards and test methods as detailed in ADEC Title XIV (33 CFR Part 159 Subpart E) is to be installed on board.

The system performance is to be certified.

1.5.4 Holding tank

The ship is to be equipped with holding tank(s) for treated sewage with sufficient capacity to allow storage of treated sewage when in port or in no discharge areas.

The minimum total capacity of such tank(s) is to be 2 days based on the maximum number of persons on board and 96 litres/person/day if a conventional (flush-meter) system is used and 11 litres/person/day if a vacuum system is used.

A high level alarm is to be given in a manned position.

1.5.5 Sewage record book

All sewage discharges whether to sea or shore reception facilities are to be recorded in the sewage record book with indication of the date, location and quantity of sewage discharged, and are to comply with Annex IV to MARPOL 73/78 as amended.

1.5.6 Procedures

The Ship Environmental Management Plan, referred to in Sec 1, [4.1.2], is to include procedures covering the following:

- sewage management including discharge criteria and use of holding tanks in port and no discharge areas;
- preparation, filling in and maintenance of the sewage record book;
- disposal of sewage treatment plant residues. If the ship is not in a condition to dispose at sea of sewage treatment plant residues in accordance with international or national regulations, such residues are to be disposed ashore or by incineration.

1.6 Grey water

1.6.1 Treatment plant: effluent quality as per IMO MEPC.2(VI)

A grey water treatment plant, granting an effluent quality meeting the limits as detailed in Resolution MEPC.2(VI), as amended, is to be installed on board.

1.6.2 Treatment plant: effluent quality as per IMO MEPC.159(55)

A grey water treatment plant granting an effluent quality meeting the limits as detailed in Resolution MEPC.159(55) is to be installed on board.

The system performance is to be certified.

1.6.3 Advanced treatment plant or additional polishing stage: effluent quality as per ADEC Title XIV (33 CFR Part 159 Subpart E)

A grey water treatment plant granting an effluent quality meeting the limits as detailed in ADEC Title XIV (33 CFR Part 159 Subpart E) is to be installed on board.

The system performance is to be certified.

1.6.4 Holding tank

Ships are to be equipped with holding tank(s) for grey water with sufficient capacity to allow storage of grey water when in port for at least 2 days. The total capacity of grey water holding tanks is to be based on the maximum number of persons (see App 1, [2.3]) on board and 200 litres/person/day.

A high level alarm is to be given in a manned position.

If the same tanks are used to hold treated sewage and grey water, their capacity is to be at least the sum of the capacities for the treated sewage holding tanks in [1.5.4] and the tanks for grey water.

A smaller volume, in any case not lower than 50% of the above capacity, may be accepted provided that:

- the ship is equipped with a system for treating grey water, able to reduce the volume of the effluent (e.g. by reusing part of the treated grey water for on board use);
- 2 days' retention is ensured;
- technical documentation, including results of onboard tests, of the system's efficiency and of effluent volume reduction is documented to the satisfaction of the Society.

Grey water is always to be discharged at a distance of more than 4 nautical miles from the nearest land or to a reception facility.

The discharging criteria do not apply when the discharge of grey water is necessary for securing the safety of the ship and those on board, or saving life at sea, or when the discharge results from damage to the ship or its equipment.

1.6.5 Grey water record book

All grey water discharges whether to sea or shore reception facilities are to be recorded in the grey water record book with indication of the date, location and quantity of grey water discharged. If the grey water is discharged to sea, the records are to include information on distance to the nearest land.

1.6.6 Procedures

The Ship Environmental Management Plan, referred to in Sec 1, [4.1.2], is to include procedures for the grey water discharge criteria and use of holding tanks in ports and in no discharge areas.

1.7 Garbage

1.7.1 Garbage Management Plan

For living quarter barges, special consideration in the garbage management plan is to be given to the following potentially hazardous wastes, such as:

- dry-cleaning solvent wastes
- photocopying and printer cartridges
- unused pharmaceuticals
- batteries
- lamp bulbs.

1.7.2 Recycling

For living quarter barges:

a) a strategy of waste recycling is to be foreseen, adopted and documented;

b) the minimum total quantity of wastes landed for recycling (Wr) is to be 50% of recyclable wastes produced on board (Wb), where Wb = 40 Kg/person/year based on the number of persons the ship is certified to carry.

The amount of waste landed for recycling is to be recorded in the garbage record book, and different wastes are to be collected and landed separately.

For the purpose of this Rule, recyclable wastes include but are not limited to:

- Plastic
- Aluminium
- Glass
- Paper-Cardboard.

1.7.3 Advanced recycling

The garbage collection systems are to be designed and installed to facilitate the efficient collection of all wet waste and dry waste generated onboard and to treat such waste in the most effective and environmentally-friendly manner. All recyclable wastes are to be separated for type and treated to reduce volume and consent offloading ashore for recycling. As far as the technology allows, all processes are to be fully automatic and continuous.

1.7.4 Procedures

The Ship Environmental Management Plan, referred to in Sec 1, [4.1.2], is to include procedures covering the Garbage management and waste recycling, according to this item.

1.8 Other sources

1.8.1 Marine growth prevention systems

Antifouling systems for pipings are to be based on environmentally friendly technologies, not discharging harmful products and approved by the Society.

2 Prevention of air pollution

2.1 Ozone depleting substances

2.1.1 Compliance with Annex VI to MARPOL 73/78 as amended

Compliance with Annex VI to MARPOL 73/78 as amended is to be assured.

2.1.2 Refrigerating facilities

The following requirements apply to ships with refrigerating facilities, such as refrigerated cargo ships, liquefied gas carriers with reliquefaction plants, and other ships with centralised cargo refrigeration systems.

They also apply to:

- centralised refrigeration systems for provision stores
- centralised air conditioning plants.

They do not apply to domestic type stand-alone refrigerators and air conditioning units.

Means are to be provided to limit leaks to the atmosphere of refrigerants or their vapours in the event of failure of the plant, as well as in the case of discharge of refrigerant to an onshore reception facility.

Annual refrigerant leakage is to be less than 10% of the total refrigerant charge of each system.

The system is be fitted with evacuation (e.g. compressors) and retention facilities having the capacity to retain all the refrigerants, should the need to evacuate the whole plant arise in an emergency.

The plant is to be designed in such a way as to minimise the risk of medium release in the case of maintenance, repair or servicing; i.e. it is to be designed considering the possibility of isolating those sections which are to be serviced by a system of valves and bypasses, in such a way as not to stop the operation of the plant while in service, preventing the risk of release of the medium outside of the plant.

Materials for piping and equipment specifically designed to limit the emission of refrigerants are to be tested in accordance with the applicable requirements for testing materials intended to be used for the construction of similar types of piping and equipment and their classes and/or design conditions.

Piping and equipment specifically designed to limit the emission of refrigerants are to be inspected and tested during fabrication in accordance with the requirements applicable to similar types of piping or equipment and their classes and/or design conditions.

After installation on board, the plant acceptance trials are to include the operation of the evacuation of the entire refrigerant from the plant to the reception facilities without any release of refrigerant and/or refrigerant vapours. The control, monitoring and alarm systems are also to be tested in the presence of the Surveyor, or their functioning is to be simulated by a procedure agreed with the Society.

2.1.3 Restrictions in the use of GWP substances

Two alternatives may be chosen:

a) avoid the use of refrigerants having GWP > 2000 in refrigeration or air conditioning plant systems;

b) design refrigeration or air conditioning plant systems minimising piping systems carrying the refrigerant (e.g. systems that utilise an intermediate cooling medium for refrigerated cargo spaces/provision plants/AC Ventilation Units).

The requirement does not apply to domestic type, standalone, refrigerators and air conditioning units.

The environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = (P_{TOT} - P_{GWP}>2000) / P_{TOT}$

where

P_{GWP} = Refrigerating capacity at - 10 °C evaporating temperature and + 25°C condensing temperature of refrigerating plant utilizing HFC [kcal/h]

P_{TOT} = Refrigerating capacity at - 10 °C evaporating temperature and + 25°C condensing temperature of any refrigerating plant independently from the utilized medium [kcal/h]

The environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = (P_{TOT} - P_{HFC}) / P_{TOT}$

where

P_{GWP} = Refrigerating capacity at - 10 °C evaporating temperature and + 25°C condensing temperature of refrigerating plant utilizing HFC [kcal/h]

P_{TOT} = Refrigerating capacity at - 10 °C evaporating temperature and + 25°C condensing temperature of any refrigerating plant independently from the utilized medium [kcal/h]

2.1.4 Procedures

The Ship Environmental Management Plan, referred to in Sec 1, [4.1.2], is to contain the following:

a) procedures to be followed to minimise the risk of depleting the refrigerant or the refrigerant vapours in all operative and emergency conditions

b) procedures for corrective actions to be undertaken in the event the annual leakage exceeds 10%

c) procedures for preparing, filling and updating the refrigerant log-book. The leakage is to be documented by consumption figures recorded in a refrigerant log-book to be kept on board and made available during periodical surveys.

2.2 Green House Gases and Pollutants

2.2.1 Non fossil fuels

Where power on board is partially or totally produced with systems which do not use fossil fuels (e.g. sails, fuel cells, etc.), the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{non\ fossil}$ fuels $/ \Sigma P_{TOT}$

Where

$P_{non\ fossil\ fuels}$ = Nominal power of each power source not using fossil fuel [kW]

P_{TOT} = Nominal power of each power source independently from the utilized fuel [kW]

2.2.2 Second generation of bio-fuelss

Where second generation bio-fuels are partially or totally used on board, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{sgbf} / \Sigma P_{TOT}$

Where

P_{sgbf} = Nominal power of each user which utilizes second generation bio-fuel [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW]

2.2.3 Cold ironing

The ship is to be provided with an installation allowing the ship to be electrically fed from shore.

2.2.4 Tool to manage handling and consumption of fuels

The ship is to be provided with a system to monitor and record:

a) fuel supplies to the ship and

b) fuel consumption of the ship.

Data may be inserted manually.

2.2.5 Energy saving and energy conservation

The ship is to be provided with an operational manual, acceptable to the Society, indicating the procedures used

on board to comply with energy saving and energy conservation criteria.

At least the following areas are to be considered in the manual:

- propulsion
- electric production
- electric users for propulsion
- electric users for hull services (steering, thrusters, bilge, ballast)
- electric users for navigation
- electric users for hotel/accommodation services (galley, laundries, lighting and A/C etc)
- steam production and users.

2.2.6 Monitoring of fuel consumption

Engine room automation system or an independent computerised tool has to include means for continuous monitoring the fuel consumption at least of the following users:

- propulsion engines
- diesel generators
- oil fired boilers
- other oil fired users (e.g. inert gas generators).

2.2.7 Optimization of Air Conditioning (AC) plant

Means are to be provided to optimize AC plant, including the use of passive means to decrease AC demand (e.g. reflective glazing).

2.2.8 Low energy consumption lights

At least 80% in power of the lighting fittings is to be of low consumption type.

2.2.9 Hull transom design

Means are to be adopted to increase propulsion efficiency by minimum 0.5% at design speed and relevant calculations or evidence are to be submitted.

2.2.10 Stabilizer openings

Openings in way of fin stabilizers are to be fitted with suitable means to restore the hull boundary continuity when fins are not in operation.

2.2.11 Silicone-based antifouling paint

A silicone-based paint, which decreases the hull frictional resistance, is to be used as hull antifouling system.

2.2.12 Fluor-polymer antifouling paint

A fluor-polymer-based paint, which decreases the frictional resistance, is to be used as hull antifouling system.

2.2.13 Fins on propeller boss cups

Suitable propeller boss fins are to be fitted on the propeller to guide the water stream in order to reduce vortex and increase the propeller efficiency.

2.2.14 High-performing propellers

The ship is to be fitted with high performing propellers (capable to increase propulsion efficiency by minimum 1% at design speed) characterized by a double-side or a single-side arc brim provided at the tip of each blade. Relevant calculations or evidence are to be submitted.

2.2.15 Support tool to assist the Master in keeping most efficient sailing draft and trim

The ship is to be fitted with means capable to support the Master in keeping most efficient sailing draft and trim.

2.3 Nitrogen Oxides

2.3.1 Compliance with limits as per Annex VI to MARPOL 73/78 as amended

Compliance with limits as per reg. 13 of Annex VI to MARPOL 73/78 as amended is to be assured.

2.3.2 Gas to liquids (GTL) fuels

Where GTL fuels are partially or totally used on board, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{GTL} / \Sigma P_{TOT}$

Where

P_{sgbf} = Nominal power of each user which utilizes GTL fuel [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW]

Diesel engines, which are not subject to reg. 13 of MARPOL Annex VI, are not to be taken into account.

2.3.3 Fossil fuel pre-treatment (e.g. water emulsion), or water injection into combustion chamber, or scavenging air, or combination of these

Where fossil fuel pre-treatment (e.g. water emulsion), or water injection into combustion chamber, or scavenging air, or combination of these are partially used on board, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{FT} / \Sigma P_{TOT}$

Where

P_{FT} = Nominal power of each user which utilizes fuel treatment [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW]

Diesel engines, which are not subject to Regulation 13 of MARPOL Annex VI, are not to be taken into account.

2.3.4 Dual-fuel engines running with LNG

The fuel used on board is to be LNG (gasoil only used as back-up in emergency).

Diesel engines, which are not subject to Regulation 13 of MARPOL Annex VI, are not to be taken into account.

Depending on installation a weighted index may be necessary.

2.3.5 Exhaust gas treatment

Each diesel engine subject to Regulation 13 of MARPOL Annex VI is to be fitted with an exhaust gas treatment system which abates not less than 85% the total generated NOx and which does not increase total fuel consumption at

the engine maximum continuous rating by more than an averaged 2%.

The system is to be acceptable to the Society in compliance with Sec 1, [8] as applicable.

Depending on installation a weighted index may be necessary.

2.3.6 NOx emissions monitoring and recording The ship is to be fitted with system for monitoring and recording the NOx emissions from diesel engines and boilers.

Diesel engines, which are not subject to Regulation 13 of MARPOL Annex VI, are not to be taken into account.

The system is to be acceptable to the Society in compliance with Sec 1, [8] as applicable.

2.4 Sulphur Oxides

2.4.1 SOx limits (global 3,0 % and SECA as required by MARPOL 73/78 Annex VI)

The sulphur content of fuel used on board ships (average percentage calculated on a yearly basis) is not to exceed 3,0 % by mass. In any case, the sulphur content of any fuel oil used on board ships is not to exceed the percentage by mass as required by MARPOL 73/78 Annex VI.

2.4.2 SOx limits (1,0 %)

The sulphur content of fuel oil used on board ships (average percentage calculated on a yearly basis) is not to exceed 1,0 % by mass. In any case, the sulphur content of any fuel oil used on board ships is not to exceed the percentage by mass as required by MARPOL 73/78 Annex VI.

2.4.3 SOx limits (0,1 %)

The sulphur content of fuel oil used on board ships (average percentage calculated on a yearly basis) is not to exceed 0,1 % by mass. In any case, the sulphur content of any fuel oil used on board ships is not to exceed the percentage by mass as required by MARPOL 73/78 Annex VI.

2.4.4 Gas to liquids (GTL) fuels

Where GTL fuels are partially or totally used on board, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{GTL} / \Sigma P_{TOT}$

Where

P_{GTL} = Nominal power of each user which utilizes GTL fuel [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW].

2.4.5 Blending fossil fuel with second-generation bio-fuels

Where blending (of fossil fuel with second generation bio-fuels), ensuring a sulphur content not exceeding 1,0% by mass, are partially or totally used on board, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{sgbf} / \Sigma P_{TOT}$

Where

P_{sgbf} = Nominal power of each user which utilizes blending [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel[kW]

2.4.6 Dual-fuel engines running with LNG

The fuel used on board is to be LNG (gas oil only used as back-up in emergency).

Diesel engines, which are not subject to Regulation 13 of MARPOL Annex VI, are not to be taken into account.

Depending on installation a weighted index may be necessary.

2.4.7 Exhaust gas treatment

Each diesel engine subject to Regulation 13 of MARPOL Annex VI is to be fitted with an exhaust gas treatment system which abates not less than 85% the total generated SOx and which does not increase total fuel consumption at the engine maximum continuous rating by more than an averaged 2%.

The system is to be acceptable to the Society in compliance with Sec 1, [8] as applicable.

Depending on installation a weighted index may be necessary.

2.4.8 SOx emissions monitoring and recording

The ship is to be fitted with system for monitoring and recording the SOx emissions from diesel engines and boilers.

Diesel engines, which are not subject to Regulation 13 of MARPOL Annex VI, are not to be taken into account.

The system is to be acceptable to the Society in compliance with Sec 1, [8] as applicable.

2.5 Particulates

2.5.1 Gas to liquids (GTL) fuels

Where GTL fuels are partially or totally used on board the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{GTL} / \Sigma P_{TOT}$

Where

P_{GTL} = Nominal power of each user which utilizes GTL fuel [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW]

Diesel engines, which are not subject to Regulation 13 of MARPOL Annex VI, are not to be taken into account.

2.5.2 Fuel treatment

Where fossil fuel pre-treatment (e.g. water emulsion), or water injection into combustion chamber, or scavenging air, or blending of pre-treated fossil fuel with second-generation bio-fuels or combination of these are partially used on

board, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{FT} / \Sigma P_{TOT}$

Where

P_{FT} = Nominal power of each user which utilizes fuel treatment [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW]

Diesel engines, which are not subject to Regulation 13 of MARPOL Annex VI, are not to be taken into account.

2.5.3 Lower PMs emission achieved by modifications in prime movers (e.g. common rail) that do not increase other pollutants and GHGs emissions

Where modification in prime movers are carried out, to achieve lower PMs emission without increasing other pollutant and GHG emissions, only partially, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{mpm} / \Sigma P_{TOT}$

Where

P_{mpm} = Nominal power of modified prime movers [kW]

P_{TOT} = Nominal power of each prime mover independently if modified or not [kW]

Diesel engines, which are not subject to Regulation 13 of MARPOL Annex VI, are not to be taken into account.

2.5.4 Dual-fuel engines running with LNG

The fuel used on board is to be LNG (gasoil only used as back-up in emergency).

Diesel engines, which are not subject to Regulation 13 of MARPOL Annex VI, are not to be taken into account.

Depending on installation a weighted index may be necessary.

2.5.5 Exhaust gas treatment

Each diesel engine subject to Regulation 13 of MARPOL Annex VI is to be fitted with an exhaust gas treatment system which abates not less than 85% the total generated PMs, as determined according to ISO 8178 Standard or equivalent, and which does not increase total fuel consumption at the engine maximum continuous rating by more than an averaged 2%.

The system is to be acceptable to the Society in compliance with Sec 1, [8] as applicable.

Depending on installation a weighted index may be necessary.

2.6 Carbon Dioxide (CO_2)

2.6.1 Gas to liquids (GTL) fuels

Where GTL fuels are partially or totally used on board for CO_2 reduction, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{GTL} / \Sigma P_{TOT}$

Where

P_{GTL} = Nominal power of each user which utilizes GTL fuel [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW]

Diesel engines, which are not subject to Regulation 13 of MARPOL Annex VI, are not to be taken into account.

2.6.2 Blending fossil fuel with second-generation bio-fuels

Where blending (of fossil fuel and second generation biofuels) are partially or totally used on board for CO_2 reduction, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{sgbf} / \Sigma P_{TOT}$

Where

P_{FT} = Nominal power of each user which utilizes blending [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW]

2.6.3 Dual-fuel engines running with LNG

The fuel used on board is to be LNG (gas oil only used as back-up in emergency).

Diesel engines, which are not subject to Regulation 13 of MARPOL Annex VI, are not to be taken into account.

Depending on installation a weighted index may be necessary.

2.6.4 CO_2 emissions monitoring and recording

The ship is to be fitted with system for monitoring and recording the CO_2 emissions from diesel engines and boilers.

Diesel engines, which are not subject to Regulation 13 of MARPOL Annex VI, are not to be taken into account.

The system is to be acceptable to the Society in compliance with Sec 1, [8] as applicable.

2.6.5 Energy Efficiency Design Index (EEDI)

The ship is to be provided with an index measuring ship's CO_2 eefficiency at the design stage, expressed in the form of CO_2 emitted per unit of transport work ("attained EEDI").

Taking into account the need to substantiate all data used in the EEDI formula, these requirements are mainly applicable to new buildings.

The "attained EEDI" is to be not greater than a "required EEDI" as described in Table 1, Regulation 21 of MEPC62/6/3.

The "attained EEDI" is to be calculated according to the "Interim Guidelines on the Method of Calculation of the Energy Efficiency Design Index for New Ships" as per IMO Circular MEPC.1/Circ.681.

The "required EEDI" is to be calculated according to Regulation 20 of MEPC62/6/3.

Reference lines to be used for the calculation of the "required EEDI" are those contained in document MEPC 62/6/4.

For the calculation of the "attained EEDI", only the types of ships having the reference lines in document MEPC 62/6/4 can be considered. Ships having diesel-electric propulsion, turbine propulsion or hybrid propulsion systems are excluded.

2.6.6 Ship Energy Efficiency Management Plan (EEDI)

The ship is to be provided with a specific Ship Energy Efficiency Management Plan (SEEMP) describing a possible approach for monitoring ship and fleet efficiency performance over time and some options to be considered when seeking to optimise the performance of the ship. This plan may form part of the ship's Safety Management System (SMS).

The SEEMP is to be developed taking into account the "Guidance for the development of a ship Energy Efficiency Management Plan (SEEMP)" as per IMO Circular MEPC.1/Circ.683.

2.7 Ship Recycling

2.7.1 Green Passport

The ship has to comply with requirements of Sec 4, [2.7] and is to be provided with a Green Passport as per Sec 4, [2.7.5]

2.7.2 Green Passport Plus

The ship has to comply with requirements of Sec 4, [2.7] and is to be provided with a Green Passport Plus as per Sec 4, [2.7.6].

APPENDIX 3 GUIDELINES FOR IMPLEMENTATION OF ANNEX V OF MARPOL 73/78

1 Preamble

1.1 IMO Guidelines for implementation of Annex V of MARPOL 73/78

1.1.1 The content of this Appendix has been taken from the IMO "Guidelines for the implementation of MARPOL 73/78" and is to be used as guidance for compliance with the requirements of Sec 4, [2.5].

1.2 Operational requirements

1.2.1 The IMO "Guidelines for the implementation of MARPOL 73/78" contain a number of operational requirements, as well as duties for Governments, reception facilities and other parties. Some of these operational requirements, in particular those related to the obligations of Governments and reception facilities, have not been included in this Appendix. However, some operational requirements have been left in this Appendix, where it is felt that they could be useful to clarify the content of these regulations. Compliance with the operational requirements is not a requisite for the issuance of the **CLEAN-SEA** notation, unless equipment, systems, manuals, facilities, etc. are necessary for complying with such operational requirements. In this case such equipment, systems, manuals, facilities, etc. are to be considered as part of the requirements for granting the notation, while their actual operation is considered outside the scope of these regulations.

2 Introduction and definitions

2.1 Introduction

2.1.1 Purpose of the Guidelines

The Guidelines are divided into seven categories that provide a general framework to formulate programs for education and training of seafarers and others to comply with the regulations:

- methods of reducing shipboard generation of garbage;
- shipboard garbage handling and storage procedures;
- shipboard equipment for processing garbage;
- estimation of the amounts of ship-generated garbage delivered to port;
- and actions to ensure compliance with the regulations.

2.1.2 Waste management options

Recognising that Annex V regulations promote waste management systems for ships, and that ships vary tremendously in size, mission, complement and capability, these Guidelines include a range of waste management options that may be combined in many ways to facilitate compliance with Annex V.

2.1.3 Discharge of garbage into the sea

Although Annex V permits the discharge of a range of garbage into the sea, it is recommended that whenever practicable ships use, as a primary means, port reception facilities.

2.2 Definitions

2.2.1 General

The following definitions integrate those given in Sec 4, [1.3.6].

2.2.2 Regulations

Regulations means the regulations contained in the Annexes to MARPOL 73/78.

2.2.3 Harmful substance

Harmful substance means any substance which, if introduced into the sea, is liable to create hazards to human health, harm living resources and marine life, damage amenities or interfere with other legitimate uses of the sea, and includes any substance subject to control by MARPOL 73/78.

2.2.4 Discharge

Discharge, in relation to harmful substances or effluents containing such substances, means any release, howsoever caused, from a ship and includes any escape, disposal, spilling, leaking, pumping, emitting or emptying.

Discharge does not include:

- dumping, within the meaning of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, London 13 November 1972, or
- release of harmful substances directly arising from the exploration, exploitation and associated offshore processing of seabed mineral resources, or
- release of harmful substances for purposes of legitimate scientific research into pollution abatement or control.

2.2.5 Incident

Incident means an event involving the actual or probable discharge into the sea of a harmful substance, or effluents containing such a substance.

2.2.6 Organisation

Organisation means the International Maritime Organisation.

2.2.7 Wastes

Wastes means useless, unneeded or superfluous matter which is to be discarded.

2.2.8 Food wastes

Food wastes are any spoiled or unspoiled victual substances, such as fruits, vegetables, dairy products, poultry, meat products, food scraps, food particles, and all other materials contaminated by such wastes, generated aboard ship, principally in the galley and dining areas.

2.2.9 Plastic

Plastic means a solid material which contains as an essential ingredient one or more synthetic organic high polymers and which is formed (shaped) during either manufacture of the polymer or the fabrication into a finished product by heat and/or pressure. Plastics have material properties ranging from hard and brittle to soft and elastic. Plastics are used for a variety of marine purposes including, but not limited to, packaging (vapour-proof barriers, bottles, containers, liners), ship construction (fibreglass and laminated structures, siding, piping, insulation, flooring, carpets, fabrics, paints and finishes, adhesives, electrical and electronic components), disposable eating utensils and cups, bags, sheeting, floats, fishing nets, strapping bands, rope and line.

2.2.10 Domestic waste

Domestic waste means all types of food wastes and wastes generated in the living spaces on board the ship.

2.2.11 Cargo-associated waste

Cargo-associated waste means all materials which have become wastes as a result of use on board a ship for cargo stowage and handling. Cargo-associated waste includes but is not limited to dunnage, shoring, pallets, lining and packing materials, plywood, paper, cardboard, wire, and steel strapping.

2.2.12 Maintenance waste

Maintenance waste means materials collected by the engine department and the deck department while maintaining and operating the vessel, such as soot, machinery deposits, scraped paint, deck sweeping, wiping wastes, and rags, etc.

2.2.13 Operational wastes

Operational wastes means all cargo-associated waste and maintenance waste, and cargo residues defined as garbage in Sec 4, [1.3.6].

2.2.14 Dishwater

Dishwater is the residue from the manual or automatic washing of dishes and cooking utensils which have been pre-cleaned to the extent that any food particles adhering to them would not normally interfere with the operation of automatic dishwashers.

2.2.15 Greywater

Greywater is drainage from dishwater, shower, laundry, bath and washbasin drains and does not include drainage from toilets, urinals, hospitals, and animal spaces as well as drainage from cargo spaces.

2.2.16 Oily rags and contaminated rags

Oily rags are rags which have been saturated with oil as provided for in Annex I to MARPOL 73/78. Contaminated rags are rags which have been saturated with a substance defined as a harmful substance in the other annexes to MARPOL 73/78.

2.2.17 Cargo residues

Cargo residues for the purposes of these Guidelines are defined as the remnants of any cargo material on board that cannot be placed in proper cargo holds (loading excess and spillage) or which remain in cargo holds and elsewhere after unloading procedures are completed (unloading residual and spillage). However, cargo residues are expected to be in small quantities.

Cargo material contained in the cargo hold bilge water is not treated as cargo residues provided that the cargo material is not classified as a marine pollutant in the IMO IMDG Code and the bilge water is discharged from a loaded hold through the vessel's fixed piping bilge drainage system.

2.2.18 Fishing gear

Fishing gear is defined as any physical device or part thereof or combination of items that may be placed on or in the water with the intended purpose of capturing, or controlling for subsequent capture, living marine or freshwater organisms.

2.2.19 Seafarers

Seafarers for the purposes of these Guidelines means anyone who goes to sea in a ship for any purpose including, but not limited to, transport of goods and services, exploration, exploitation and associated offshore processing of seabed mineral resources, fishing and recreation.

2.3 Application

2.3.1 Exclusion

Dishwater and greywater are not included as garbage in the context of Annex V.

2.3.2 Ash and clinkers

Ash and clinkers from shipboard incinerators and coal-burning boilers except ashes from plastic products which may contain toxic or heavy metal residues, disposal of which is prohibited by regulation 3(1)(a) of Annex 5 are operational wastes in the meaning of Annex V, regulation 1(1), and therefore are included in the term "all other garbage", in the meaning of Annex V, regulations 3(1)(b)(ii) and 5(2)(a)(ii), notwithstanding regulation 3(2) and item [5.4.7.6] of this Appendix.

2.3.3 Cargo residues

Cargo residues are to be treated as garbage under Annex V except when such residues are substances defined or listed under the other annexes to MARPOL 73/78.

2.3.4 Cargo residues that might pose harm to the marine environment

Cargo residues of all other substances are not explicitly excluded from disposal as garbage under the overall definition of garbage in Annex V. However, certain of these substances may pose harm to the marine environment and may not be suitable for disposal at reception facilities equipped to handle general garbage because of their possible safety hazards. The disposal of such cargo residues is to be based on the physical, chemical and biological properties of the substance and may require special handling not normally provided by garbage reception facilities.

2.3.5 Release of food for fish

The release of small quantities of food wastes for the specific purpose of fish feeding in connection with fishing or tourist operations is not included as garbage in the context of Annex V.

3 Minimising the amount of potential garbage

3.1 Domestic wastes

3.1.1 Domestic wastes may be minimised through proper provisioning practices. Options available to decrease the amount of domestic waste generated aboard ship include the following:

a) Bulk packaging of consumable items may result in less waste being created. However, factors such as inadequate shelf-life once a container is open must be considered to avoid increasing wastes.

b) Reusable packaging and containers can decrease the amount of garbage being generated. Use of disposable cups, utensils, dishes, towels and rags and other convenience items should be limited and replaced by washable items when possible.

c) Where practical options exist, provisions packaged in materials other than disposable plastic should be selected to replenish ship supplies unless a reusable plastic alternative is available.

3.2 Operational waste

3.2.1 Operational waste generation is specific to individual ship activities and cargoes. It is recommended that Manufacturers, shippers, ship operators and Governments consider the garbage associated with various categories of cargoes and take action as needed to minimise their generation. Suggested actions are listed below:

a) consider replacing disposable plastic sheeting used for cargo protection with permanent, reusable covering material

b) consider stowage systems and methods that reuse coverings, dunnage, shoring, lining and packing materials

c) dunnage, lining and packaging materials generated in port during cargo discharge should preferably be disposed of to the port reception facilities and not retained on board for discharge at sea.

3.3 Cargo residues

3.3.1 Cargo residues are created through inefficiencies in loading, unloading and handling on board.

a) As cargo residues fall under the scope of these Guidelines, it may in certain cases be difficult for port reception facilities to handle such residues. It is therefore recommended that cargo should be unloaded as efficiently as possible in order to avoid or minimise cargo residues.

b) Spillage of the cargo during transfer operations is to be carefully controlled, both on board and from the dockside. Since this spillage typically occurs in port, it is to be completely cleaned up prior to sailing and either delivered into the intended cargo space or into the port reception facility. Shipboard areas where spillage is most common are to be protected such that the residues are easily recovered.

3.4 Fishing gear

3.4.1 Fishing gear, once discharged, becomes a harmful substance. It is recommended that fishing vessel operators record and report the loss and recovery of fishing gear. Techniques both to minimise the amount of fishing gear lost in the ocean and to maximise its recovery are listed below.

a) Operators and associations of fishing vessels using untended, fixed or drifting gear are encouraged to develop information exchanges with such other ship traffic as may be necessary to minimise accidental encounters between ships and gear.

b) Fishery managers are encouraged to consider the probability of encounters between ship traffic and fishing gear when establishing seasons, areas and gear-type regulations.

c) Fishery managers, fishing vessel operators and associations are encouraged to utilise gear identification systems which provide information such as vessel name, registration number and nationality, etc. Such systems may be useful to promote reporting, recovery and return of lost gear.

d) Fishing vessel operators are encouraged to document positions and reasons for loss of their gear. To reduce the potential of entanglement and "ghost fishing" (capture of marine life by discharged fishing gear), benthic traps, trawl and gill-nets could be designed to have degradable panels or sections made of natural fibre twine, wood or wire.

4 Shipboard garbage handling and storage procedures

4.1 General

4.1.1 Limitation on the discharge of garbage from ships

Limitations on the discharge of garbage from ships as specified in Annex V are summarised in Tab 1. Although, except in special areas, discharge at sea of a wide range of ship-generated garbage is permitted outside specified distances

from the nearest land, preference should be given to disposal at shore reception facilities.

Table 1 : Summary of at-sea garbage disposal

Garbage type	All ships except those in the adjacent column		Ships associated with offshore platforms **(3)**
	Outside special areas	Inside special areas **(2)**	
Plastics, including synthetic ropes and fishing nets and plastic garbage bags	Disposal prohibited	Disposal prohibited	Disposal prohibited
Floating dunnage, lining and packing material	> 25 miles offshore	Disposal prohibited	Disposal prohibited
Paper, rags, glass, metal, bottles, crockery and similar refuse	> 12 miles	Disposal prohibited	Disposal prohibited
All other garbage including paper, rags, etc. comminuted or ground	> 3 miles	Disposal prohibited	Disposal prohibited
Food waste not comminuted or ground	> 12 miles	> 12 miles	Disposal prohibited
Food waste comminuted or ground **(1)**	> 3 miles	> 12 miles	> 12 miles
Mixed refuse types	**(4)**	**(4)**	**(4)**

(1) Comminuted or ground garbage must be able to pass through a screen with mesh size no larger than 25 mm.
(2) Garbage disposal in special areas is to be effected in accordance with Regulation 5(4)(b) of Annex V.
(3) All ships alongside or within 500 m from fixed or floating platforms engaged in exploration of seabed mineral resources.
(4) When garbage is mixed with other harmful substances having different disposal or discharge requirements, the more stringent disposal requirements are to apply.

4.1.2 Means to comply with garbage disposal requirements

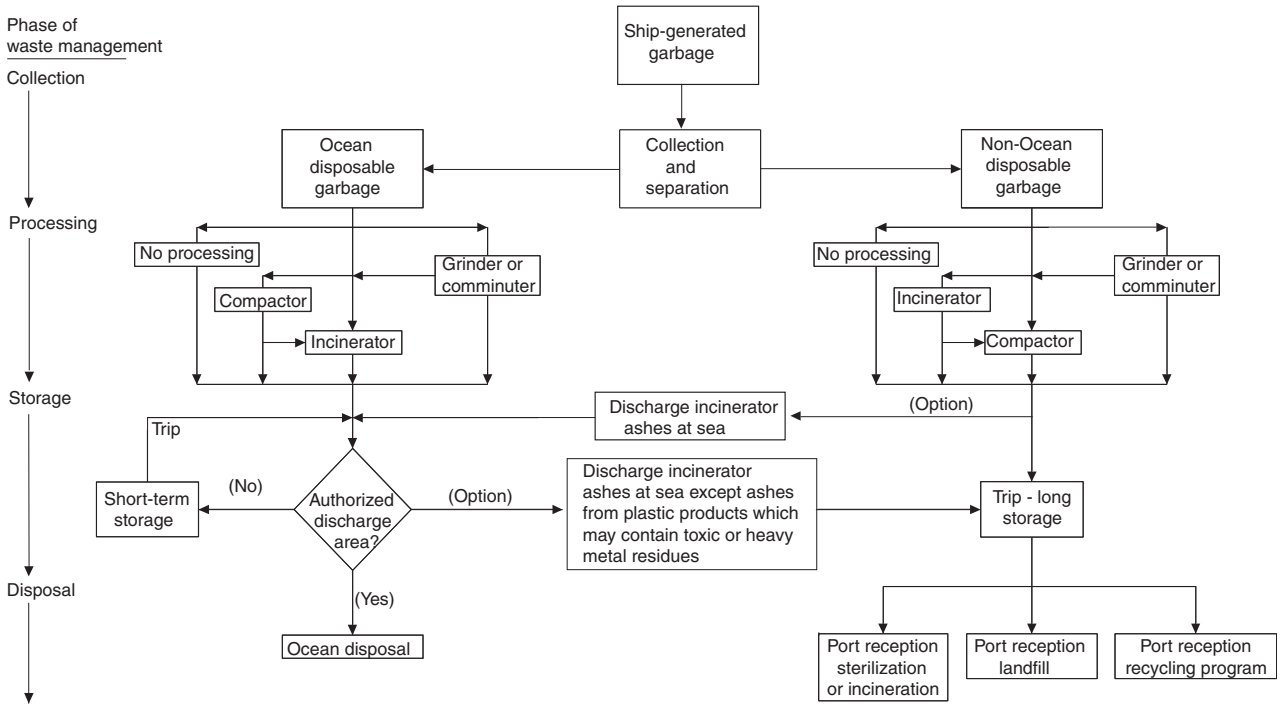
a) Compliance with the limitations in [4.1.1] requires personnel, equipment and procedures for collecting, sorting, processing, storing and disposing of garbage. Economic and procedural considerations associated with these activities include storage space requirements, sanitation, equipment and personnel costs and in-port garbage service charges.

b) Compliance with the provisions of Annex V will require careful planning by the ship operator and proper execution by crew members as well as other seafarers. The most appropriate procedures for handling and storing garbage on ship will vary depending on factors such as the type and size of the ship, the area of operation (e.g. distance from nearest land), shipboard garbage processing equipment and storage space, crew size, duration of voyage, and regulations and reception facilities at ports of call. However, in view of the cost involved with the different ultimate disposal techniques, it may also be economically advantageous to keep garbage requiring special handling separate from other garbage. Proper handling and storage will minimise shipboard storage space requirements and enable efficient transfer of retained garbage to port reception facilities.

4.2 Waste management plan

4.2.1 To ensure that the most effective and efficient handling and storage procedures are followed, it is recommended that vessel operators develop waste management plans that can be incorporated into crew and vessel operating manuals. Such manuals should identify crew responsibilities (including an environmental control officer) and procedures for all aspects of handling and storing garbage aboard the ship. Procedures for handling ship-generated garbage can be divided into four phases: collection, processing, storage, and disposal. A generalised waste management plan for handling and storing ship-generated garbage is presented in Fig 1. Specific procedures for each phase are discussed in the following requirements.

Figure 1 : Options for shipboard handling and disposal of garbage



4.3 Collection

4.3.1 General

a) Procedures for collecting garbage generated aboard ship are to be based on consideration of what can and cannot be discarded overboard while en route.

b) To reduce or avoid the need for sorting after collection, it is recommended that three categories of distinctively marked garbage receptacles should be provided to receive garbage as it is generated. These separate receptacles (e.g. cans, bags, or bins) would receive:

1) plastics and plastics mixed with non-plastic garbage;

2) food wastes (which includes materials contaminated by such wastes);

3) other garbage which can be disposed of at sea.

c) Receptacles for each of the three categories of garbage are to be clearly marked and distinguishable by colour, graphics, shape, size or location. These receptacles are to be provided in appropriate spaces throughout the ship (e.g. the engine room, mess deck, wardroom, galley, and other living or working spaces) and all crew members and passengers are to be advised of what garbage is and is not to be discarded in them.

d) Crew responsibilities are to be assigned for collecting or emptying these receptacles and taking the garbage to the appropriate processing or storage location. Use of such a system will facilitate subsequent shipboard processing and minimise the amount of garbage which must be stored aboard ship for return to port.

4.3.2 Plastics and plastics mixed with non-plastic garbage

Plastic garbage is to be retained aboard ship for discharge at port reception facilities unless reduced to ash by incineration. When plastic garbage is not separated from other garbage, the mixture is to be treated as if it were all plastic.

4.3.3 Food wastes

a) Some Governments have regulations for controlling human, plant and animal diseases that may be carried by foreign food wastes and materials that have been associated with them (e.g. food packaging and disposable eating utensils). These regulations may require incinerating, sterilising or other special treatment of garbage to destroy possible pest and disease organisms. Such garbage is to be kept separate from other garbage and preferably retained for disposal in port in accordance with the laws of the receiving country.

b) Precautions are to be taken to ensure that plastics contaminated by food wastes (e.g. plastic food wrappers) are not discharged at sea with other food wastes.

4.3.4 Other garbage

Garbage in this category includes, but is not limited to, paper products, rags, glass, metal, bottles, crockery, dunnage, lining and packing materials. Vessels may find it desirable to separate dunnage, lining and packing material which will float since this material is subject to a different discharge limit than other garbage in this category (see Table 1). Such garbage is to be kept separate from other garbage and preferably retained for disposal in port.

4.3.5 Additional receptacles which may be useful

a) Separate cans or bags could be provided for receiving and storing glass, metal, plastics, paper or other items which can be recycled.

b) Synthetic fishing net and line scraps generated by the repair or operation of fishing gear may not be discarded at sea and are to be collected in a manner that avoids its loss overboard. Such material may be incinerated, compacted or stored along with other plastic waste or it may be preferable to keep it separate from other types of garbage if it has strong odour or great volume.

4.3.6 Recovery of garbage at sea

a) Fishermen and other seafarers who recover derelict fishing gear and other persistent garbage during routine operations are encouraged to retain this material for disposal on shore. If lost pots or traps are recovered and space is not available for storage, fishermen and other seafarers are encouraged to remove and transport any line and webbing to port for disposal and return the bare frames to the water, or at least to cut open the traps to keep them from continuing to trap marine life.

b) Seafarers are further encouraged to recover other persistent garbage from the sea as opportunities arise and prudent practice permits.

4.3.7 Oily rags and contaminated rags

Oily rags and contaminated rags are to be kept on board and discharged to a port reception facility or incinerated.

4.4 Processing

4.4.1 General

Depending on factors such as the type of ship, area of operation, size of crew, etc., ships may be equipped with incinerators, compactors, comminuters or other devices for shipboard garbage processing (see [5]). Appropriate members of the crew should be assigned responsibility for operating this equipment on a schedule commensurate with ship needs. In selecting appropriate processing procedures, the following requirements are to be considered.

4.4.2 Use of compactors, incinerators and comminuters

Use of compactors, incinerators, comminuters and other such devices has a number of advantages, such as making it possible to discharge certain garbage at sea which otherwise might not be permitted, reducing shipboard space requirements for storing garbage, making it easier to offload garbage in port and enhancing assimilation of garbage discharged into the marine environment.

4.4.3 Special precautions related to the use of incinerators

It is to be noted that special rules on incineration may be established by authorities in some ports and may exist in some special areas. Incineration of the following items requires special precaution due to the potential environmental and health effects from combustion of by-products: hazardous materials (e.g. scraped paint, impregnated wood) and certain types of plastics (e.g. PVC-based plastics).

4.4.4 Ships operating in special areas

Ships operating primarily in special areas or within 3 nautical miles from the nearest land should choose between storage of either compacted or uncompacted material for offloading at port reception facilities or incineration with retention of ash and clinkers. This is the most restrictive situation in that no discharge is permitted. The type of ship and the expected volume and type of garbage generated will determine the suitability of compaction, incineration or storage options.

4.4.5 Compactors

Compactors make garbage easier to store, to transfer to port reception facilities and to dispose of at sea when discharge limitations permit. In the latter case, compacted garbage may also aid in sinking, which would reduce aesthetic impacts in coastal waters and along beaches, and perhaps reduce the likelihood of marine life ingesting or otherwise interacting with discharged materials.

4.4.6 Comminuters

Ships operating primarily beyond 3 nautical miles from the nearest land are encouraged to install and use comminuters to grind food wastes to a particle size capable of passing through a screen with openings no larger than 25 mm. Although larger food scraps may be discharged beyond 12 nautical miles, it is recommended that comminuters be used even outside this limit because they hasten assimilation into the marine environment. Because food wastes comminuted with plastics cannot be discharged at sea, all plastic materials are to be removed before food wastes are ground up.

4.5 Storage

4.5.1 General

Garbage collected from living and working areas throughout the ship is to be delivered to designated processing or storage locations. Garbage that must be returned to port for disposal may require long-term storage depending on the length of the voyage or arrangements for off-loading (e.g. transferring garbage to an offshore vessel for incineration or subsequent transfer ashore). Garbage which may be discarded overboard may require short-term or no storage. In all cases, garbage is to be stored in a manner which avoids health and safety hazards. The points in the following requirements are to be considered when selecting procedures for storing garbage.

4.5.2 Containers for garbage

Ships are to use separate cans, drums, boxes, bags or other containers for short-term (disposable garbage) and trip-long (non-disposable garbage) storage. Short-term storage would be appropriate for holding otherwise disposable garbage while a ship is passing through a restricted discharge area.

4.5.3 Container capacity

Sufficient storage space and equipment (e.g. cans, drums, bags or other containers) are to be provided. Where space is limited, vessel operators are encouraged to install compactors or incinerators. To the extent possible, all processed and unprocessed garbage which must be stored for any length of time is to be in tight, securely covered containers.

4.5.4 Wastes which may carry diseases

Food wastes and associated garbage which are returned to port and which may carry diseases or pests are to be stored in tightly covered containers and kept separate from garbage which does not contain such food wastes. Both types of garbage are to be stored in separate clearly marked containers to avoid incorrect disposal and treatment on land.

4.5.5 Waste fishing gear

Storage of waste fishing gear on deck may be appropriate if materials have strong odours or if their size is too great to permit storage elsewhere on the ship. In cases where gear is fouled with marine growth or dead organisms, it may be reasonable to tow gear behind the vessel for a time to wash it out before storing.

4.5.6 Disinfection

Disinfection and both preventative and remedial pest control methods are to be applied regularly in garbage storage areas.

4.6 Disposal

4.6.1 General

Although disposal is possible under Annex V, discharge of garbage to port reception facilities is to be given first priority. Disposal of ship-generated garbage is to be effected in a manner consistent with the regulations summarised in Table 1. When disposing of garbage, the points in the following requirements are to be considered:

4.6.2 Discharge at sea

Garbage which may be disposed of at sea can simply be discharged overboard. Disposal of uncompacted garbage is convenient, but results in a maximum number of floating objects which may reach shore even when discharged beyond 25 nautical miles from the nearest land. Compacted garbage is more likely to sink and thus less likely to pose aesthetic problems. If necessary and possible, weights are to be added to promote sinking. Compacted bales of garbage are to be discharged over deep water (50 m or more) to prevent rapid loss of their structural integrity due to wave action and currents.

4.6.3 Floating cargo-associated waste

Floating cargo-associated waste that is not plastic or otherwise regulated under other MARPOL annexes may be discharged beyond 25 nautical miles from the nearest land. Cargo-associated waste that will sink and is not plastic or otherwise regulated may be discharged beyond 12 nautical miles from the nearest land. Most cargo-associated waste may be generated during the loading and unloading process, usually at dock side. It is recommended that every effort should be made to deliver these wastes to the nearest port reception facility system prior to the ship's departure.

4.6.4 Maintenance waste

Maintenance wastes are generated more or less steadily during the course of routine ship operations. In some cases, maintenance wastes may be contaminated with substances, such as oil or toxic chemicals, controlled under other annexes or other pollution control laws. In such cases, the more stringent disposal requirements take precedence.

4.6.5 Arrangements for garbage discharge into onshore garbage reception facilities

To ensure timely transfer of large quantities of ship-generated garbage to port reception facilities, it is essential for ships or their agents to make arrangements well in advance for garbage reception. At the same time, disposal needs are to be identified in order to make provision for garbage requiring special handling or other necessary arrangements. Special disposal needs might include off-loading food wastes and associated garbage which may carry certain disease or pest organisms, or unusually large, heavy or odorous derelict fishing gear.

5 Shipboard equipment for processing garbage

5.1 General

5.1.1 The range of options for garbage handling aboard ships depends largely upon costs, personnel limitations, generation rate, capacity, vessel configuration and traffic patterns. The types of equipment available to address the various facets of shipboard garbage handling include incinerators, compactors, comminuters and their associated hardware.

5.2 Grinding or comminution

5.2.1 Discharge of ground or comminuted food waste

a) When not in a special area, the discharge of comminuted food wastes and all other comminuted garbage (except plastics and floatable dunnage, lining and packing materials) is permitted beyond 3 nautical miles from the nearest land.

b) Such comminuted or ground garbage is to be capable of passing through a screen with openings no greater than 25 mm unless such comminuters or grinders comply with accepted international standards which effectively accomplish this.

c) It is recommended that garbage should not be discharged into a ship's sewage treatment system unless it is approved for treating such garbage.

d) Furthermore, garbage is not to be stored in bottoms or tanks containing oily wastes. Such action can result in faulty operation of sewage treatment or oily-water separator equipment and can cause sanitary problems for crew members and passengers.

Table 2 : Compaction options for shipboard generated garbage

Typical examples	Special handling by vessel personal before compacting	Compaction characteristics			On-board storage space
		Rate of alteration	Retainment of compact form	Density of compacted form	
Metal, food and beverage, glass, small wood pieces	None	Very rapid	Almost 100%	High	Minimum
Comminuted plastics, fibre and paper board	Minor - reduce material to size for feed, minimum manual labour	Rapid	Approximately 80%	Medium	Minimum
Small metal drums, uncomminuted cargo packing, large pieces of wood	Moderate - longer manual labour time required to size material for feed	Slow	Approximately 50%	Relatively low	Moderate
Uncomminuted plastics	Major - very long manual labour time to size material for feed; usually impractical	Very slow	Less than 10%	Very low	Maximum
Bulky metal cargo containers, thick metal items	Impracticable for shipboard compaction: not feasible	Not applicable	Not applicable	Not applicable	Maximum

5.2.2 Food waste grinders

A wide variety of food waste grinders are available on the market and are commonly fitted in most modern ships' galleys. These food waste grinders produce a slurry of food particles and water that washes easily through the required 25 mm screen. Output ranges from 10 to 250 litres per minute. It is recommended that the discharge from shipboard comminuters should be directed into a holding tank when the vessel is operating within an area where discharge is prohibited.

5.2.3 Use of shredding or crushing equipment

Size reduction of certain other garbage items can be achieved by shredding or crushing and machines for carrying out this process are available for use on board ships.

5.3 Compaction

5.3.1 Compaction options

Tab 2 shows compaction options for various types of garbage.

5.3.2 Garbage that cannot be compacted

Most garbage can be compacted; exceptions include unground plastics, fibre and paper board, bulky cargo containers and thick metal items. Pressurised containers are not to be compacted since they present an explosion hazard.

5.3.3 Reduction of volume by compaction

Compaction can reduce the volume of garbage into bags, boxes or briquettes. When these compacted slugs are equally formed and structurally strong, they can be piled up in building block form; this permits the most efficient use of space in the storage compartments. The compaction ratio for normal mixed shipboard garbage may range as high as 12:1.

5.3.4 Options of compactors

Some of the available compactors have options such as sanitising, deodorising, adjustable compaction ratios, bagging in plastic or paper, boxing in cardboard (with or without plastic or wax paper lining), baling, etc. Paper or cardboard tends to become soaked and weakened by moisture in the garbage during long periods of storage on board. There have also been problems due to the generation of gas and pressure which can explode tight plastic bags.

5.3.5 Use of grinding machines before compaction

If grinding machines are used prior to compaction, the compaction ratio can be increased and the storage space decreased.

5.3.6 Installation of compactors

A compactor is to be installed in a compartment with adequate room for operating and maintaining the unit and storing garbage to be processed. The compartment is to be located adjacent to the areas of food processing and commissary storerooms. If not already required by regulations it is recommended that the space should have freshwater washdown service, coamings, deck drains, adequate ventilation and hand or automatic fixed fire-fighting equipment.

Table 3 : Incineration options for shipboard generated garbage

Typical examples	Special handling by vessel personal before incineration	Incineration characteristics				On-board storage space
		Combustibility	Reduction of volume	Residual	Exhaust	
Paper, packaging, food and beverage containers	Minor - easy to feed into hopper	High	Over 95%	Powder ash	Possibly smoky and not hazardous	Minimum
Fibre and paper board	Minor - reduce material to size for feed, minimum manual labour	High	Over 95%	Powder ash	Possibly smoky and not hazardous	Minimum
Plastic packaging, food and beverage containers, etc.	Minor - easy to feed into hopper	High	Over 95%	Powder ash	Possibly smoky and hazardous based on incinerator design	Minimum
Plastic sheeting, netting, rope and bulk material	Moderate manual labour time for size reduction	High	Over 95%	Powder ash	Possibly smoky and hazardous based on incinerator design	Minimum
Rubber hoses and bulk pieces	Major manual labour time for size reduction	High	Over 95%	Powder ash	Possibly smoky and hazardous based on incinerator design	Minimum
Metal food and beverage containers, etc.	Minor - easy to feed into hopper	Low	Less than 10%	Slag	Possibly smoky and not hazardous	Moderate
Metal cargo, bulky containers, thick metal items	Major manual labour time for size reduction (not easily incinerated)	Very low	Less than 5%	Large metal fragments and slag	Possibly smoky and not hazardous	Maximum
Glass food and beverage containers, etc.	Minor - easy to feed into hopper	Low	Less than 10%	Slag	Possibly smoky and not hazardous	Moderate
Wood cargo containers and large wood straps	Moderate manual labour time for size reduction	High	Over 95%	Powder ash	Possibly smoky and not hazardous	Minimum

5.4 Incinerators

5.4.1 General

In comparison with the technology of land-based incineration, the state of the art in marine incinerators is not highly advanced, primarily because the technology has not yet been subject to constraints on air emissions nor to the types of materials that could be incinerated. Marine incinerators in current use are predominantly designed for intermittent operation and hand stoking and typically do not include any provisions for air pollution control. Control of air pollution is normally required in many ports in the world. Prior to using an incinerator while in port, permission may be required from the port authority concerned. In general, the use of shipboard garbage incinerators in ports in or near urban areas is to be discouraged as their use will add to possible air pollution in these areas. Special considerations for incinerators are listed in the following requirements.

5.4.2 Incinerating options

Tab 3 presents options for incineration of garbage, including considerations for special handling by vessel personnel, combustibility, reduction of volume, residual materials, exhaust, and shipboard storage space. Most garbage is amenable to incineration with the exception of metal and glass.

5.4.3 Shipboard incinerators design

In contrast to land-based incinerators, shipboard incinerators are to be as compact as practicable; automatic operation is desirable. Most shipboard incinerators are designed for intermittent operation: the waste is charged to the incinerator, firing is started, and combustion typically lasts for three to six hours.

5.4.4 Commercial marine incinerators

Commercial marine incinerators currently available vary greatly in size, have natural or induced draught, and are hand fired. It is to be noted that incinerator ratings are usually quoted on the basis of heat input rate rather than on a mass charged basis because of the variability of the heat content in the wastes. Some modern incinerators are designed for continuous firing, and can handle simultaneous disposal of nearly all shipboard waste.

5.4.5 Advantages of shipboard incinerators

Some of the advantages of the most advanced incinerators may include that they operate under negative pressure, they are highly reliable since they have few moving parts, they require minimal operator skill, they are low in weight, and they have low exhaust and external skin temperatures.

5.4.6 Disadvantages of shipboard incinerators

Some of the disadvantages of incinerators may include the possible hazardous nature of the ash or vapour, dirty operation, excessive labour required for charging, stoking and ash removal, and the fact that they may not meet air pollution regulations imposed in certain harbours. Some of these disadvantages can be remedied by automatic equipment for charging, stoking and ash discharge into the sea outside areas where such discharge is prohibited. The additional equipment to perform these automatic functions requires more installation space.

5.4.7 Incineration of predominately plastic wastes

The incineration of predominantly plastic wastes, as might be considered under some circumstances in complying with Annex V, requires more air and much higher temperatures for complete destruction. If plastics are to be burnt in a safe manner, the incinerator is to be suitable for the purpose; otherwise, the following problems can result:

a) Depending on the type of plastic and conditions of combustion, some toxic gases can be generated in the exhaust stream, including vaporised hydrochloric (HCl) and hydrocyanic (HCN) acids. These and other intermediary products of plastic combustion can be extremely dangerous.

b) The ash from the combustion of some plastic products may contain heavy metal or other residues which can be toxic and are therefore not to be discharged into the sea. Such ashes are to be retained on board and discharged at port reception facilities.

c) The temperatures generated during incineration of primarily plastic wastes are high enough to possibly damage some garbage incinerators.

d) Plastic incineration requires three to ten times more combustion air than average municipal refuse. If the proper level of oxygen is not supplied, high levels of soot will be formed in the exhaust stream.

5.4.8 Further requirements

Shipboard incinerators are to be designed, constructed, operated and maintained in accordance with the specification for shipboard incinerators set out in Ch 4, Sec 2, [5] and App 4.

6 Guidelines for the development of a garbage management plan

6.1 Introduction

6.1.1 IMO Resolution Guidelines

These Guidelines, which are an abstract of IMO MEPC.71(38) (adopted on 10 July 1996) "Guidelines for the development of a garbage management plan", provide direction on complying with the mandatory requirements for the development of a ship's garbage management plan.

6.1.2 Content of the garbage management plan

A ship's garbage management plan is to contain a list of the particular ship's equipment and arrangements for the handling of garbage, and may contain extracts from and/or references to existing company instructions.

6.2 Prevention of pollution by garbage

6.2.1 Combination of techniques

To achieve cost-effective and environmentally sound results, many garbage management planners use a combination of three complementary techniques to manage garbage:

- source reduction
- recycling
- disposal.

6.2.2 Prevention of generation of garbage on board ships

When requisitioning stores and provisions, shipping companies should encourage their suppliers to apply the substitutionary principle in order to reduce, to the greatest possible extent and at an early stage, the generation of garbage on board ships.

6.2.3 Evaluation of garbage components

The ship's garbage is made up of distinct components, some of which are addressed in MARPOL 73/78, whilst others may be addressed locally, nationally or regionally, e.g. domestic, operational, cargo-associated, food and maintenance wastes. Each component is to be evaluated separately to determine the best waste management practice for that waste.

6.3 Matters to be addressed in the garbage management plan

6.3.1 Designated person in charge of carrying out the plan

a) In accordance with the regulation, a person is to be designated in the garbage management plan to be responsible for implementing the procedures within the plan.

b) This person is to be assisted by departmental staff to ensure that the collection, separation and processing of garbage is efficient in all areas of the ship, and that the procedures aboard are carried out in accordance with the garbage management plan.

6.3.2 Procedures for collecting garbage

a) Identify suitable receptacles for collection and separation.

b) Identify locations of receptacles, collection and separation stations.

c) Describe the process of how garbage is transported from the source of generation to the collection and separation stations.

d) Describe how garbage will be handled between primary collection and separation stations and other handling methods commensurate with the following:

   1) needs of reception facilities, taking into account possible local recycling arrangements

   2) shipboard processing

   3) storage

   4) disposal at sea

e) Describe the training or education programs to facilitate collection of garbage.

Note 1: Separation of garbage for the purpose of these Guidelines is considered part of the collection process. Separation may take place at the source or at a separate designated station.

6.3.3 Procedures for processing garbage

a) Identify personnel responsible for the operation of the equipment.

b) Identify available processing devices and their capacities.

c) Identify locations of processing devices and stations.

d) Identify the categories of garbage that will be processed by each of the available processing devices.

e) Describe how garbage will be handled between primary processing stations and the storage or disposal stations.

f) Describe processing procedures used commensurate with the following:

   1) needs of reception facilities, taking into account possible local recycling arrangements

   2) storage

   3) disposal at sea.

g) Describe the training or education programs to facilitate the processing of garbage.

h) Identify available operating and maintenance procedures (this may be done by reference to documents available on board).

6.3.4 Procedures for storing garbage

a) Identify the location, the intended use and the capacity of available storage stations for each category of garbage.

b) Describe how garbage will be handled between storage stations and disposal commensurate with the following:

   1) discharge to reception facilities, taking into account possible local recycling arrangements

   2) disposal at sea

c) Describe the training or education programs to facilitate the storing of garbage.

6.3.5 Procedures for disposing of garbage

Describe the ship's procedures to ensure compliance with the requirements of Annex V of MARPOL 73/78 for disposal of garbage.

APPENDIX 4 STANDARDS SPECIFICATIONS FOR SHIPBOARD INCINERATORS

(IMO RESOLUTION MEPC.76(40) ADOPTED ON 25 SEPTEMBER 1997)

1 General

1.1 Scope

1.1.1 Coverage

This specification covers the design, manufacture, performance, operation and testing of incinerators intended to incinerate garbage and other shipboard wastes generated during the ship's normal service.

1.1.2 Application

This specification applies to those incinerator plants with capacities up to 1500 kW per unit.

1.1.3 Industrial systems

This specification does not apply to systems on special incinerator ships, e.g. for burning industrial wastes such as chemicals, manufacturing residues, etc.

1.1.4 Items not addressed by the specification

This specification does not address the electrical supply to the unit or the foundation connections and stack connections.

1.1.5 Emission requirements

This specification provides emission requirements in Annex A1 and fire protection requirements in Annex A2. Provisions for incinerators integrated with heat recovery units and provisions for flue gas temperature are given in Annex A3 and Annex A4, respectively.

1.1.6 Hazardous materials

This specification may involve hazardous materials, operations and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use, including possible port State limitations.

1.2 Definitions

1.2.1 Ship

Ship means a vessel of any type whatsoever operating in the marine environment and includes hydrofoil boats, air-cushioned vehicles, submersibles, floating craft and fixed or floating platforms.

1.2.2 Incinerator

Incinerator means shipboard facilities for incinerating solid wastes approximating in composition to household waste and liquid wastes arising from the operation of the ship, e.g. domestic waste, cargo-associated waste, maintenance waste, operational waste, cargo residues and fishing gear, etc. These facilities may be designed to use or not to use the heat energy produced.

1.2.3 Garbage

Garbage means all kinds of victual, domestic and operational waste excluding fresh fish and parts thereof, generated during normal operation of the ship as defined in Annex V to MARPOL 73/78.

1.2.4 Waste

Waste means useless, unneeded or superfluous matter which is to be discarded.

1.2.5 Food wastes

Food wastes are any spoiled or unspoiled victual substances, such as fruits, vegetables, dairy products, poultry, meat products, food scraps, food particles, and all other materials contaminated by such wastes, generated aboard ship, principally in the galley and dining areas.

1.2.6 Plastic

Plastic means a solid material which contains as an essential ingredient one or more synthetic organic high polymers and which is formed (shaped) during either manufacture of the polymer or the fabrication into a finished product by heat and/or pressure. Plastics have material properties ranging from hard and brittle to soft and elastic. Plastics are used for a variety of marine purposes including, but not limited to, packaging (vapour-proof barriers, bottles, containers, liners), ship construction (fibreglass and laminated structures, siding, piping, insulation, flooring, carpets, fabrics, paints and finishes, adhesives, electrical and electronic components), disposable eating utensils and cups, bags, sheeting, floats, fishing nets, strapping bands, rope and line.

1.2.7 Domestic waste

Domestic waste means all types of food wastes, sewage and wastes generated in the living spaces on board the ship for the purpose of this specification.

1.2.8 Cargo-associated waste

Cargo-associated waste means all materials which have become wastes as a result of use on board a ship for cargo stowage and handling. Cargo-associated waste includes but is not limited to dunnage, shoring pallets, lining and packing materials, plywood, paper, cardboard, wire, and steel strapping.

1.2.9 Maintenance waste

Maintenance waste means materials collected by the engine department and the deck department while maintaining and operating the vessel, such as soot, machinery deposits, scraped paint, deck sweeping, wiping wastes, oily rags, etc.

1.2.10 Operational waste

Operational wastes means all cargo-associated wastes and maintenance waste (including ash and clinkers), and cargo residues defined as garbage in Sec 4, [1.3.6].

1.2.11 Sludge oil

Sludge oil means sludge from fuel and lubricating oil separators, waste lubricating oil from main and auxiliary machinery and waste oil from bilge water separators, drip trays, etc.

1.2.12 Oily rags

Oily rags are rags which have been saturated with oil as provided for in Annex I to the Convention. Contaminated rags are rags which have been saturated with a substance defined as a harmful substance in the other annexes to MARPOL 73/78.

1.2.13 Cargo residues

Cargo residues for the purposes of this standard are defined as the remnants of any cargo material on board that cannot be placed in proper cargo holds (loading excess and spillage) or which remains in cargo holds and elsewhere after unloading procedures are completed (unloading residual and spillage). However, cargo residues are expected to be in small quantities.

1.2.14 Fishing gear

Fishing gear is defined as any physical device or part thereof or combination of items that may be placed on or in the water with the intended purpose of capturing, or controlling for subsequent capture, living marine or freshwater organisms.

2 Design

2.1 Materials and manufacture

2.1.1 Materials

The materials used in the individual parts of the incinerator are to be suitable for the intended application with respect to heat resistance, mechanical properties, oxidation, corrosion, etc., as in other auxiliary marine equipment.

2.1.2 Piping

Piping for fuel and sludge oil should be seamless steel of adequate strength and to the satisfaction of the Society. Short lengths of steel, or annealed copper nickel, nickel copper, or copper pipe and tubing may be used for the burners. The use of non-metallic materials for fuel lines is prohibited. Valves and fittings may be threaded in sizes up to and including 60 mm O.D. (outside diameter), but threaded unions are not to be used on pressure lines in sizes 33 mm O.D. (outside diameter) and over.

2.1.3 Protection of rotating parts

All rotating or moving mechanical and exposed electrical parts should be protected against accidental contact.

2.1.4 Incinerator wall protection

Incinerator walls are to be protected with insulated fire bricks/refractory and a cooling system. Outside surface temperature of the incinerator casing which may be touched during normal operations should not exceed 20°C above ambient temperature.

2.1.5 Refractory design and material

Refractory should be resistant to thermal shocks and to normal ship's vibration. The refractory design temperature should be equal to the combustion chamber design temperature plus 20%. (See [2.1])

2.1.6 Corrosion minimisation

Incinerating systems should be designed such that corrosion will be minimised on the inside of the systems.

2.1.7 Incinerators equipped to incinerate liquid waste

In systems equipped for incinerating liquid wastes, safe ignition and maintenance of combustion are to be ensured, e.g. by a supplementary burner using gas oil/diesel oil or equivalent.

2.1.8 Combustion chamber design

The combustion chamber(s) should be designed for easy maintenance of all internal parts including the refractory and insulation.

2.1.9 Means to assure negative pressure in the furnace

The combustion process should take place under negative pressure which means that the pressure in the furnace under all circumstances should be lower than the ambient pressure in the room where the incinerator is installed. A flue gas fan may be fitted to secure negative pressure.

2.1.10 Incinerator furnace charging

The incinerating furnace may be charged with solid waste either by hand or automatically. In every case, fire dangers should be avoided and charging should be possible without danger to the operating personnel. For instance, where charging is carried out by hand, a charging lock may be provided which ensures that the charging space is isolated from the fire box as long as the filling hatch is open. Where charging is not effected through a charging lock, an interlock should be installed to prevent the charging door from opening while the incinerator is in operation with burning of garbage in progress or while the furnace temperature is above 220 °C.

2.1.11 Incinerators equipped with feeding sluice

Incinerators equipped with a feeding sluice or system should ensure that the material charged will move to the combustion chamber. Such system should be designed such that both operator and environment are protected from hazardous exposure.

2.1.12 Interlocks

Interlocks should be installed to prevent ash removal doors from opening while burning is in progress or while the furnace temperature is above 220 °C.

2.1.13 Observation ports

The incinerator should be provided with a safe observation port of the combustion chamber in order to provide visual control of the burning process and waste accumulation in the combustion chamber. Neither heat, flame nor particles should be able to pass through the observation port. An example of a safe observation port is high-temperature glass with a metal closure.

2.1.14 Electrical requirements

a) Electrical installation requirements should apply to all electrical equipment, including controls, safety devices, cables, and burners and incinerators.

   1) A disconnecting means capable of being locked in the open position should be installed at an accessible location at the incinerator so that the incinerator can be disconnected from all sources of potential. This disconnecting means should be an integral part of the incinerator or adjacent to it. (See [2.3.1])

   2) All uninsulated live metal parts should be guarded to avoid accidental contact.

   3) The electrical equipment should be arranged so that failure of this equipment will cause the fuel supply to be shut off.

   4) All electrical contacts of every safety device installed in the control circuit should be electrically connected in series. However, special consideration should be given to arrangements when certain devices are wired in parallel.

   5) All electrical components and devices should have a voltage rating commensurate with the supply voltage of the control system.

   6) All electrical devices and electrical equipment exposed to the weather should meet the requirements of international standards acceptable to the Society.

   7) All electrical and mechanical control devices should be of a type tested and accepted by a nationally recognised testing agency, according to international standards.

   8) The design of the control circuits should be such that limit and primary safety controls directly open a circuit that functions to interrupt the supply of fuel to combustion units.

b) Overcurrent protection

   1) Conductors for interconnecting wiring that is smaller than the supply conductors should be provided with overcurrent protection based on the size of the smallest interconnecting conductors external to any control box, in accordance with the requirements of acceptable international standards.

   2) Overcurrent protection for interconnecting wiring should be located at the point where the smaller conductors connect to the larger conductors. However, overall overcurrent protection is acceptable if it is sized on the basis of the smallest conductors of the interconnecting wiring, or in accordance with the requirements of acceptable international standards.

   3) Overcurrent protection devices should be accessible and their function should be identified.

c) Motors

   1) All electric motors should have enclosures corresponding to the environment where they are located, at least IP 44, in accordance with the requirements of international standards acceptable to the Society.

   2) Motors should be provided with a corrosion-resistant nameplate specifying information in accordance with the requirements of acceptable international standards.

   3) Motors should be provided with running protection by means of integral thermal protection, overcurrent devices, or a combination of both in accordance with the Manufacturer's instructions and with the requirements of acceptable international standards.

   4) Motors should be rated for continuous duty and designed for an ambient temperature of 45 °C or higher.

   5) All motors should be provided with terminal leads or terminal screws in terminal boxes integral with, or secured to, the motor frames.

d) Ignition system

   1) When automatic electric ignition is provided, it should be accomplished by means of either a high voltage electric spark, a high energy electric spark, or a glow coil.

   2) Ignition transformers should have an enclosure corresponding to the environment where they are located, at least IP 44, in accordance with the requirements of acceptable international standards.

   3) Ignition cable should meet the requirements of acceptable international standards.

e) Wiring

   1) All wiring for incinerators should be rated and selected in accordance with the requirements of acceptable international standards.

f) Bonding and grounding

   1) Means should be provided for grounding the major metallic frame or assembly of the incinerator.

   2) Non-current carrying enclosures, frames and similar parts of all electrical components and devices should be bonded to the main frame or assembly of the incinerator. Electrical components that are bonded by their installation do not require a separate bonding conductor.

   3) When an insulated conductor is used to bond electrical components and devices, it should show a continuous green colour, with or without a yellow stripe.

2.2 Operating requirements

2.2.1 Design operating conditions

The incinerator system should be designed and constructed for operation with the following conditions, as indicated in Tab 1 and Tab 2:

Table 1

Item	Temperature
Maximum combustion chamber flue gas outlet temperature	1200 °C
Minimum combustion chamber flue gas outlet temperature	850 °C
Preheat temperature of combustion chamber	650 °C

For batch loaded incinerators there are no preheating requirements. However, the incinerator should be designed such that the temperature in the actual combustion space reaches 600°C within 5 minutes after start.

Table 2

Operation	Mode
Prepurge, before ignition	At least 4 air changes in the chamber(s) and stack, but not less than 15 seconds.
Time between restarts	At least 4 air changes in the chamber(s) and stack, but not less than 15 seconds.
Postpurge, after shut-off of fuel oil	Not less than 15 seconds after the closing of the fuel oil valve.
Incinerator discharge gases	Minimum 6% O_2 (measured in dry flue gas)

2.2.2 Shielding of combustion chamber surfaces

The outside surface of combustion chamber(s) should be shielded from contact such that people in normal work situations will not be exposed to extreme heat (20°C above ambient temperature) or direct contact with surface temperatures exceeding 60°C. Examples for alternatives to accomplish this are a double jacket with an air flow in between or an expanded metal jacket.

2.2.3 Operating pressure

Incinerating systems are to be operated with underpressure (negative pressure) in the combustion chamber such that no gases or smoke can leak out to the surrounding areas.

2.2.4 Warning plates

The incinerator should have warning plates attached in a prominent location on the unit, warning against unauthorised opening of doors to combustion chamber(s) during operation and against overloading the incinerator with garbage.

2.2.5 Instruction plate

The incinerator should have instruction plate(s) attached in a prominent location on the unit clearly addressing the following:

a) Cleaning ashes and slag from the combustion chamber(s) and cleaning of combustion air openings before starting the incinerator (where applicable).

b) Operating procedures and instructions. These should include proper start-up procedures, normal shutdown procedures, emergency shutdown procedures and procedures for loading garbage (where applicable).

2.2.6 Prevention of building up of dioxins

To avoid building up of dioxins, the flue gas should be shock-cooled to a maximum 350 °C within 2,5 metres from the combustion chamber flue gas outlet.

2.3 Operating controls

2.3.1 Disconnecting switch

The entire unit should be capable of being disconnected from all sources of electricity by means of one disconnect switch located near the incinerator (see [2.1.14] a) 1)).

2.3.2 Emergency stop

There should be an emergency stop switch located outside the compartment which stops all power to the equipment. The emergency stop switch should also be able to stop all power to the fuel pumps. If the incinerator is equipped with a flue gas fan, the fan should be capable of being restarted independently of the other equipment on the incinerator.

2.3.3 Control equipment design

The control equipment should be so designed that any failure of the following will prevent continued operations and cause the fuel supply to be cut off.

a) Safety thermostat/draft failure

1) A flue gas temperature controller, with a sensor placed in the flue gas duct, should be provided to shut down the burner if the flue gas temperature exceeds the temperature set by the Manufacturer for the specific design.

2) A combustion temperature controller, with a sensor placed in the combustion chamber, should be provided to shut down the burner if the combustion chamber temperature exceeds the maximum temperature.

3) A negative pressure switch should be provided to monitor the draft and the negative pressure in the combustion chamber. The purpose of this negative pressure switch is to ensure that there is sufficient draft/negative pressure in the incinerator during operations. The circuit to the program relay for the burner will be opened and an alarm activated before the negative pressure rises to atmospheric pressure.

b) Flame failure/fuel oil pressure

1) The incinerator should have a flame safeguard control consisting of a flame sensing element and associated equipment for shutdown of the unit in the event of ignition failure and flame failure during the

firing cycle. The flame safeguard control should be so designed that the failure of any component will cause a safety shutdown.

2) The flame safeguard control should be capable of closing the fuel valves in not more than 4 seconds after a flame failure.

3) The flame safeguard control should provide a trial-for-ignition period of not more that 10 seconds during which fuel may be supplied to establish flame. If flame is not established within 10 seconds, the fuel supply to the burners should be immediately shut off automatically.

4) Whenever the flame safeguard control has operated because of failure of ignition, flame failure or failure of any component, only one automatic restart may be provided. If this is not successful, then manual reset of the flame safeguard control should be required for restart.

5) Flame safeguard controls of the thermostatic type, such as stack switches and pyrostats operated by means of an open bimetallic helix, are prohibited.

6) If fuel oil pressure drops below the value set by the Manufacturer, a failure and lock out of the program relay should result. This also applies to a sludge oil burner (where pressure is important for the combustion process or a pump is not an integral part of the burner.)

c) Loss of power

1) If there is a loss of power to the incinerator control/alarm panel (not remote alarm panel), the system should shut down.

2.3.4 Fuel control solenoid valves

Two fuel control solenoid valves should be provided in series in the fuel supply line to each burner. On multiple burner units, a valve on the main fuel supply line and a valve at each burner will satisfy this requirement. The valves should be connected electrically in parallel so that both operate simultaneously.

2.3.5 Alarms

a) An outlet for an audible alarm should be provided for connection to a local alarm system or a central alarm system. When a failure occurs, a visible indicator should show what caused the failure. (The indicator may cover more than one fault condition.)

b) The visible indicator should be designed so that, where failure is a safety related shutdown, manual reset is required.

2.3.6 Cooling after shutdown

After shutdown of the oil burner, provision should be made for the fire box to cool sufficiently. (As an example of how this may be accomplished, the exhaust fan or ejector could be designed to continue to operate. This would not apply in the case of an emergency manual trip).

2.4 Other requirements

2.4.1 Documentation

A complete instruction and maintenance manual with drawings, electrical diagrams, spare parts list, etc. should be furnished with each incinerator.

2.4.2 Installation

All devices and components should, as fitted in the ship, be designed to operate when the ship is upright and when inclined at any angle of list up to and including 15° either way under static conditions and 22,5° under dynamic conditions (rolling) either way and simultaneously inclined dynamically (pitching) 7,5° by bow or stern.

2.4.3 Incinerators

a) Incinerators are to be fitted with an energy source with sufficient energy to ensure a safe ignition and complete combustion. The combustion is to take place at sufficient negative pressure in the combustion chamber(s) to ensure that no gases or smoke leak out to the surrounding areas.

b) A drip tray is to be fitted under each burner and under any pumps, strainers, etc. that require occasional examination.

3 Tests and certification

3.1 Tests

3.1.1 Prototype tests

An operating test for the prototype of each design should be conducted, with a test report completed indicating results of all tests. The tests should be conducted to ensure that all of the control components have been properly installed and that all parts of the incinerator, including controls and safety devices, are in satisfactory operating condition. Tests should include those described in [3.1.3] below.

3.1.2 Factory tests

For each unit, if preassembled, an operating test should be conducted to ensure that all of the control components have been properly installed and that all parts of the incinerator, including controls and safety devices, are in satisfactory operating condition. Tests should include those described in [3.1.3] below.

3.1.3 Shipboard tests

An operating test after installation should be conducted to ensure that all of the control components have been properly installed and that all parts of the incinerator, including controls and safety devices, are in satisfactory operating condition. The requirements for prepurge and time between restarts should be verified at the time of the installation test.

a) Flame safeguard

The operation of the flame safeguard system should be verified by causing flame and ignition failures. Operation of the audible alarm (where applicable) and visible indicator should be verified. The shutdown times should be verified.

b) Limit controls

Shutdown due to the operation of the limit controls should be verified.

1) Oil pressure limit control

The lowering of the fuel oil pressure below the value required for safe combustion should initiate a safety shutdown.

2) Other interlocks

Other interlocks provided should be tested for proper operation as specified by the unit Manufacturer.

c) Combustion controls

The combustion controls should be stable and operate smoothly.

d) Programming controls

Programming controls should be verified as controlling and cycling the unit in the intended manner. Proper prepurge, ignition, postpurge and modulation should be verified. A stopwatch should be used for verifying intervals of time.

e) Fuel supply controls

The satisfactory operation of the two fuel control solenoid valves for all conditions of operation and shutdown should be verified.

f) Low voltage test

A low voltage test should be conducted on the incinerator unit to satisfactorily demonstrate that the fuel supply to the burners will be automatically shut off before an incinerator malfunction results from the reduced voltage.

g) Switches

All switches should be tested to verify proper operation.

3.2 Certification

3.2.1 The Manufacturer's certification that an incinerator has been constructed in accordance with this standard should be provided (by letter, certificate or in the instruction manual).

3.3 Marking

3.3.1 Each incinerator should be permanently marked indicating:

a) Manufacturer's name or trademark

b) Style, type, model or other Manufacturer's designation for the incinerator

c) Capacity - to be indicated by net designed heat release of the incinerator in heat units per timed period; for example, British Thermal Units per hour, megajoules per hour, kilocalories per hour.

3.4 Quality assurance

3.4.1 Incinerators should be designed, manufactured and tested in a manner that ensures they meet the requirements of this standard.

4 ANNEX A1 - Emission standard for shipboard incinerators with capacity of up to 1500 kW - Minimum information to be provided

4.1 IMO Type Approval Certificate

4.1.1 An IMO Type Approval Certificate should be required for each shipboard incinerator. In order to obtain such certificate, the incinerator should be designed and built to an IMO approved standard. Each model should go through a specified type approval test procedure at the factory or an approved test facility, and under the responsibility of the Society.

Note 1: The incinerator is to be of a type approved or accepted by the Society.

4.1.2 Type approval tests should include measuring of the parameters listed in Tab 3:

Table 3

Item	Measure
Max Capacity	kW or kcal/h kg/h of specified waste kg/h per burner
Pilot fuel consumption	kg/h per burner
O_2 Average in combustion chamber/zone	%
CO Average in flue gas	mg/MJ
Soot number average	Bacharach or Ringelman Scale
Combustion chamber flue gas outlet average temperature	°C
Amount of unburned components in ashes	% by weight

4.1.3 Tab 4 indicates the duration of test operations.

Table 4

Operation	Time
For sludge oil burning	6 - 8 hours
For solid waste burning	6 - 8 hours

4.1.4 Fuel test specifications for type approval tests (% by weight) are indicated in Tab 5 and Tab 6.

4.1.5 Tab 7 indicates the required emission standard to be verified by the type approval test.

Flue gas outlet temperature and O_2 content should be measured during the combustion period, and not during the preheating or cooling periods. For a batch loaded incinerator, it is acceptable to carry out the type approval test by means of a single batch.

A high temperature in the actual combustion chamber/zone is an absolute requirement in order to obtain a complete and smoke free incineration, including that of plastic and other synthetic materials, while minimising DIOXINE, VOC (Volatile Organic Compounds) and emissions.

Table 5

Sludge/waste	Specification
Sludge oil consisting of	75% sludge oil from heavy fuel oil 5% waste lubricating oil 20% emulsified water
Solid waste (class 2) consisting of	50% food waste 50% rubbish containing • approx 30% paper • approx 40% cardboard • approx 10% rags • approx 20% plastic The mixture will have up to 50% moisture and 7% incombustible solids
Note 1: Classes of waste Reference: Waste Classification from Incinerator Institute of America (Information for type approval tests only) **Note 2:** Class 2 Refuse, consisting of approximately even mixture of rubbish and garbage by weight. This type of waste is common to passenger ships, consists of up to 50% moisture, 7% incombustible solids and has a heating value of about 10 000 kJ/kg as fired.	

Table 6

Calorific values			Densities	
Sludge	kJ/Kg	kcal/kg Sludge		kg/m^3
Vegetables and putrescibles	5700	1360	Paper (loose)	50
Paper	14300	3415	Refuse (75% wet)	720
Rag	15500	3700	Dry rubbish	110
Plastics	36000	8600	Scrap wood	190
Sludge oil	36000	8600	Wood sawdust	220
Sewage sludge	3000	716		
Note 1: Density of loose general waste generated on board ship will be about 130 kg/m^3.				

Table 7

Emission	Standard
O_2 in combustion chamber	6 - 12%
CO in flue gas maximum average	200 mg/MJ
Soot number maximum average	BACHARACH 3 or RINGELMAN 1 (A higher soot number is acceptable only during very short periods such as starting up)
Unburned components in ash residues	Max 10% by weight
Combustion chamber flue gas outlet temperature range	850-1200 °C

4.2 Fuel related emission

4.2.1

a) Even with good incineration technology the emission from an incinerator will depend on the type of material being incinerated. If for instance a vessel has bunkered a fuel with high sulphur content, then sludge oil from separators which is burned in the incinerator will lead to emission of SO_x. But again, the SO_x emission from the incinerator would only amount to less than one per cent of the SO_x discharged with the exhaust from main and auxiliary engines.

b) Principal organic constituents (POC) cannot be measured on a continuous basis. Specifically, there are no instruments with provision for continuous time telemetry that measure POC, HCI or waste destruction efficiency, to date. These measurements can only be made using grab sample approaches where the sample is returned to a laboratory for analysis. In the case of organic constituents (undestroyed wastes), the laboratory work requires considerable time to complete. Thus, continuous emission control can only be assured by secondary measurements.

c) ON BOARD OPERATION/EMISSSION CONTROL

For a shipboard incinerator with IMO TYPE APPROVAL, emission control/monitoring should be limited to the following:

1) Control/monitor O_2 content in combustion chamber (spot checks only; an O_2 content analyser is not required to be kept on board).

2) Control/monitor temperature in combustion chamber flue gas outlet.

By continuous (auto) control of the incineration process, it is ensured that the two parameters mentioned above are kept within the prescribed limits. This mode of operation will ensure that particulates and ash residue contain only traces of organic constituents.

4.3 Passenger/cruise ships with incinerator installations having a total capacity of more than 1500 kW

4.3.1

a) On board this type of vessel, the following conditions will probably exist:

1) Generation of huge amounts of burnable waste with a high content of plastic and synthetic materials.

2) Incinerating plant with a high capacity operating continuously over long periods.

3) Vessel often operating in very sensitive coastal areas.

b) In view of the fuel related emission from a plant with such a high capacity, installation of a flue gas sea water scrubber should be considered. This installation can perform an efficient after-cleaning of the flue gases, thus minimising the content of:

- HC1
- SO_x
- PARTICULATE MATTER

c) Any restriction on NITROGEN OXIDE (NO_x) should only be considered in connection with possible future regulations governing the vessel's total pollution, i.e. main and auxiliary machinery, boilers, etc.

5 ANNEX A2 - Fire protection requirements for incinerators and waste stowage spaces

5.1 SOLAS requirements to be applied

5.1.1 For the purpose of construction, arrangement and insulation, incinerator spaces and waste stowage spaces should be treated as category A machinery spaces (SOLAS II-2/3.19) and service spaces (SOLAS II-2/3.12), respectively. To minimise the fire hazards these spaces represent, the following SOLAS requirements in Chapter II-2 should be applied:

a) Annex A2.1 - Passenger ships

For passenger vessels carrying more than 36 passengers

1) Regulation 26.2.2(12) should apply to incinerator and combined incinerator/waste stowage spaces, and the flue uptakes from such spaces

2) Regulation 26.2.2(13) should apply to waste stowage spaces and garbage chutes connected thereto.

b) Annex A2.2 - Other ships

For all other vessels, including passenger vessels carrying not more than 36 passengers:

1) Regulation 44.2.2(6) should apply to incinerator and combined incinerator/waste spaces, and the flue uptakes from such spaces

2) Regulation 44.2.2(9) should apply to waste stowage spaces and garbage chutes connected thereto.

c) Annex A2.3 - Incinerators and waste stowage spaces

Incinerators and waste stowage spaces located on weather decks (Regulation II-2/3.(17)) need not meet the above requirements but should be located:

1) as far aft on the vessel as possible;

2) not less than 3 m from entrances, air inlets and openings to accommodation and service spaces and control stations;

3) not less than 5 m measured horizontally from the nearest hazardous area, or vent outlet from a hazardous area; and

4) not less than 2 m from the incinerator and the waste material stowage area, unless physically separated by a structural fire barrier.

d) Annex A2.4 - Fixed fire-extinguishing and fire detection system

A fixed fire detection and fire-extinguishing system should be installed in enclosed spaces containing incinerators, in combined incinerator/waste stowage spaces, and in any waste stowage space in accordance with Tab 8.

e) Annex A2.5 - Incinerator and waste stowage spaces on weather decks

Where an incinerator or waste stowage space is located on weather decks it must be accessible with two means of fire extinguishment: either fire hoses, semi-portable fire extinguishers, fire monitors or a combination of any two of these extinguishing devices. A fixed fire-extinguishing system is acceptable as one means of extinguishment.

f) Annex A2.6 - Flue uptakes

Flue uptake piping/ducting should be led independently to an appropriate terminus via a continuous funnel or trunk.

6 ANNEX A3 - Incinerators integrated with heat recovery units

6.1 Flue gas system

6.1.1 The flue gas system, for incinerators where the flue gas is led through a heat recovery device, should be designed so that the incinerator can continue operation with the economiser coils dry. This may be accomplished with bypass dampers if needed.

6.2 Alarms

6.2.1 The incinerator unit should be equipped with a visual and an audible alarm in case of loss of feed water.

6.3 Cleaning devices

6.3.1 The gas-side of the heat recovery device should have equipment for proper cleaning. Sufficient access should be provided for adequate inspection of external heating surfaces.

7 ANNEX A4 - Flue gas temperature

7.1 General

7.1.1 When deciding upon the type of incinerator, consideration should be given as to what the flue gas temperature will be. The flue gas temperature can be a determining factor in the selection of materials for fabricating the stack. Special high temperature material may be required for use in fabricating the stack when the flue gas temperature exceeds 430 °C.

Table 8

	Automatic sprinkler system	Fixed fire-extinguishing system	Fixed fire detection system
Combined incinerator and waste stowage space	X		
Incinerator space		X	X
Waste stowage space	X		