Amendments to the "Tasneef Rules for the Classification of Ships"

Effective from 1/1/2024

Reasons of the amendments

Part A – Classification and Surveys

Chapter/Section/Paragraph amended	Reason
Ch 1, Sec 2, [6.7.2], Tab 3 Ch 5, Sec 1, Tab 1 Ch 5, Sec 12, [1.1.1], 21(Title),	to introduce the new **COMF-NOISE-PLUS** additional class notation for passenger ships having noise levels complying with requirements on tonal noise in passenger cabins and acoustic insulation of discotheques and lounges more stringent than those for the COMF-NOISE notation (Prop. 237)
Ch 1, Sec 2, [6.14.60]	to specify that the **ENHANCED MAINTENANCE** additional class notation can be assigned only to ESP ships of 20 years old and above as it is specifically targeted to these types of ships (Prop. 220)

Part B - Hull and Stability

Chapter/Section/Paragraph amended	Reason
Ch 2, Sec 2, [3.1.1]	to align the requirements for double bottom quoted from the SOLAS Convention to the currently in force text of SOLAS regulation II-1/9, as amended by IMO Resolution MSC.421(98) (Prop. 239)
Ch 4, Sec 4, [4.7.2]	to make reference, for vertical extension of bilge wells, to the requirements for double bottom quoted from SOLAS regulation II-1/9 in Ch 2, Sec 1, [3.1.1] instead of requiring a fixed minimum distance from the shall plating (Prop. 239)
Ch 6, App 1, [2.3.4], [2.3.5], [2.3.6], [2.3.7]	to correct typos in formulas for beam column buckling; torsional buckling; web local buckling of stiffeners made of flanged profiles and flat bars
Ch 12, Sec 3, [1.1.1], [1.1.4], [1.1.5](new), [1.2.15](new), [2.2.1], [2.2.3], [2.2.4](new), [2.4.1], Tab 1, Tab 2	to introduce **IACS S14** (Rev.7 - Dec 2022) "Testing Procedures of Watertight Compartments"

Part C - Machinery, Systems and Fire Protection

Chapter/Section/Paragraph amended	Reason
Ch 1, Sec 2, [4.7.8], Tab 6	to introduce **IACS UR M63** (Rev.1 - Jan 2023) "Alarms and safeguards for emergency diesel reciprocating I.C. engines"
Ch 1, Sec 10, [20.6.1](divided into 2.6.1 and 2.6.2(new)), [2.6.2](renumbered as 2.6.3)	to introduce **IACS UR M77** (Rev.4 - Feb 2023) "Storage and use of SCR reductants"
Ch 4, Sec 1, [8.2.4]	to restore the text of the paragraph stating when the requirements for inert gas systems need not be applied, in line with SOLAS regulation II-2/4.5.5.2.1, as it was inadvertently erroneously modified when introducing a previous rule variation

Part E – Service Notations

Chapter/Section/Paragraph amended	Reason
Ch 9, Sec 5, [4.2.2](new) Ch 9, App 2, [4.2.2](new)	to introduce **IACS UR G5** (New - Dec 2022) "Fail-close action of Emergency Shut Down (ESD) valve"
Ch 9, App 1, [1.1.1], [16.4](New)	to introduce the following additional service features for LNG bunker ships: • **NH3 Tank Ready** where the LNG bunker ship is fitted with LNG cargo tanks designed also for ammonia storage. • **NH3 Tank** where the LNG bunker ship is fitted with LNG cargo tanks designed, built and tested also for ammonia storage. (Prop. 238)

Part F – Additional Class Notations

Chapter/Section/Paragraph amended	Reason
Ch 6, Sec 5(New)	to introduce the requirements for the assignment of the new **COMF-NOISE-PLUS** additional class notation (Prop. 237)
Ch 13, Sec 40, [1.1.1], [1.1.2], [1.2.1], [1.2.2], [1.3](deleted), [2.1.1], [2.2.2], [2.3.1], [2.3.2], [2.4.1], [3.1.3], [3.3.1], [3.3.2], [3.3.3], [3.3.4], [3.5](deleted), [4.1.1], Tab 2(deleted), [4.2.1], Tab 3(deleted), Fig 1, [6.1.2], [6.2.1], [6.2.2], [6.3.1], [6.4.1], [6.4.2], [6.4.3], [6.5.2]	to modify the requirements for the assignment of the **ENHANCED MAINTENANCE** additional class notation to: • limit the application of the notation to ESP ships of 20 years old and above as the notation is specifically targeted to these types of ships; • improve and simplify the survey requirements for the assignment of the notation; • introduce simplifications in information recording and reporting procedures; and • make some corrections to improve clarity. (Prop. 220)

SECTION 2 CLASSIFICATION NOTATIONS

1 General

1.1 Purpose of the classification notations

1.1.1 The classification notations give the scope according to which the class of the ship has been based and refer to the specific rule requirements which are to be complied with for their assignment. In particular, the classification notations are assigned according to the type, service and navigation of the ship and other criteria which have been provided by the Interested Party, when applying for classification.

The Society may change the classification notations at any time, when the information available shows that the requested or already assigned notations are not suitable for the intended service, navigation and any other criteria taken into account for classification.

Note 1: Reference should be made to Sec 1, [1.3] on the limits of classification and its meaning.

1.1.2 The classification notations assigned to a ship are indicated on the Certificate of Classification, as well as in the Register of Ships published by the Society.

1.1.3 *(1/7/2008)*

Ships and units, other than those covered in Parts B, C, D, E and F, are to comply with specific Rules published by the Society, which also stipulate the relevant classification notations.

1.1.4 The classification notations applicable to existing ships conform to the Rules of the Society in force at the date of assignment of class, as indicated in Ch 2, Sec 1. However, the classification notations of existing ships may be updated according to the current Rules, as far as applicable.

1.2 Types of notations assigned

1.2.1 The types of classification notations assigned to a ship are the following:

a) main class symbol
b) construction marks
c) service notations with additional service features, as applicable
d) navigation notations
e) operating area notations (optional)
f) additional class notations (optional)

The different classification notations and their conditions of assignment are listed in [2] to [6] below, according to their types.

1.2.2 As an example, the classification notations assigned to a ship may be as follows (the kind of notation shown in brackets does not form part of the classification notation indicated in the Register of Ships and on the Certificate of Classification):

C ✠ HULL ✠ MACH

(main class symbol, construction marks)

oil tanker-chemical tanker-ESP-Flash point > 60°C

(service notation and additional service features)

Unrestricted navigation

(navigation notation)

✠SYS - NEQ

(additional class notation).

2 Main class symbol

2.1 Main class symbol

2.1.1 The main class symbol expresses the degree of compliance of the ship with the rule requirements as regards its construction and maintenance. There is one main class symbol, which is compulsory for every classed ship.

2.1.2 *(1/1/2009)*

The main class symbol C is assigned to ships built in accordance with the requirements of the Rules or other rules recognised as equivalent, and maintained in a condition considered satisfactory by the Society. The period of class (or interval between class renewal surveys) assigned to a ship is maximum 5 years; see Ch 2, Sec 2, [4].

Except for special cases, class is assigned to a ship only when the hull, propulsion and auxiliary machinery installations, and equipment providing essential services have all been reviewed in relation to the requirements of the Rules.

Note 1: The symbol **C** with the 5 year class period is to be understood as being the highest class granted by the Society.

Note 2: The symbol **C** may be followed by the additional construction feature **light ship** in case of ships or other units having restricted navigation notations and generally having length not greater than 50 m as well as speed greater than 15 knots, whose hull scantlings and outfitting comply with the applicable requirements of Chapters 3 and 6 of the "Rules for the Classification of High Speed Craft", issued separately by the Society.

3 Construction marks

3.1 General

3.1.1 The construction mark identifies the procedure under which the ship and its main equipment or arrangements have been surveyed for initial assignment of

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The service notation of units operating permanently anchored or moored in a fixed location is competed by the additional class notation "**MOORING**".

The service notation of units provided with at least one crane, fitted with a grab or a bucket, is completed by the additional class notation "**CARGO HANDLING**".

4.12 Miscellaneous units

4.12.1 The service notation **special service** is assigned to ships which, due to the peculiar characteristics of their activity, are not covered by any of the notations mentioned above. The classification requirements of such units are considered by the Society on a case by case basis.

This service notation may apply, for instance, to ships engaged in research, expeditions and survey, ships for training of marine personnel, whale and fish factory ships not engaged in catching, ships processing other living resources of the sea, and other ships with design features and modes of operation which may be referred to the same group of ships.

An additional service feature may be specified after the notation (e.g. **special service - training, special service - ship lift, special service - fish factory**) to identify the particular service in which the ship is intended to trade. The scope and criteria of classification of such units are indicated in an annex to the Certificate of Classification.

5 Navigation and operating area notations

5.1 Navigation notations

5.1.1 Every classed ship is to be assigned one navigation notation as listed in [5.2].

5.1.2 The assignment of a navigation notation, including the reduction of scantlings or specific arrangements for restricted navigation notations, is subject to compliance with the requirements laid down in Part B, Part C, Part D and Part E of the Rules.

5.1.3 The assignment of a navigation notation does not absolve the Interested Party from compliance with any international and national regulations established by the Administrations for a ship operating in national waters, or a specific area, or a navigation zone. Neither does it waive the requirements in Sec 1, [3.3.1].

5.2 List of navigation notations

5.2.1 The navigation notation **unrestricted navigation** is assigned to a ship intended to operate in any area and any period of the year.

5.2.2 The navigation notation **summer zone** is assigned to ships intended to operate only within the geographical limits as defined in ILLC 1966 for the Summer zones.

5.2.3 The navigation notation **tropical zone** is assigned to ships intended to operate only within the geographical limits as defined in ILLC 1966 for the Tropical zones.

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

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

5.2.6 *(1/7/2009)*

The navigation notations defined in these items [5.2.1] to [5.2.5] are those considered as "normal". Where particular cases of navigation are to be assigned which are not included among those so defined, the navigation notation **special** is assigned, followed by specified restrictions (such as the designation of the geographical area, distance from the shore and/or the most unfavourable sea conditions considered).

5.2.7 *(1/7/2009)*

The Society may assign navigation notations provided by the regulations of the flag Administration, which may be different from those defined in [5.2.1] to [5.2.6].

5.3 Operating area notations

5.3.1 The operating area notation expresses the specified area where some service units are likely to operate at sea within specific restrictions which are different from normal navigation conditions.

The operating area notation is, in principle, solely granted to working units, such as dredgers and crane pontoons.

This operating area notation is indicated after the navigation notation.

Example: **unrestricted navigation - "operating area notation"**

5.3.2 The following operating area notations may be assigned:

a) notation **specified operating area**, where the specific operating conditions which have been considered by the Society are described in an annex to the Certificate of Classification (i.e. distance from shore or from port of refuge, weather or sea conditions)

b) notation **operation service within 'x' miles from shore**, where the operating service is limited to a certain distance from the shore.

6 Additional class notations

6.1 General

6.1.1 An additional class notation expresses the classification of additional equipment or specific arrangement, which has been requested by the Interested Party.

6.4.3 Centralised control station (AUT-CCS)

The additional class notation **AUT-CCS** is assigned to ships which are fitted with machinery installations operated and monitored from a centralised control station.

6.4.4 Automated operation in port (AUT-PORT)

The additional class notation **AUT-PORT** is assigned to ships which are 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.

6.5 Integrated ship systems (SYS)

6.5.1 General

The notations dealt with under this heading are relevant to operation of integrated systems regarding navigation, machinery, communication and specific cargo, as applicable.

In compliance with [6.1.3], these notations are assigned a construction mark, as defined in [3].

The requirements for the assignment of these notations are given in Part F, Chapter 4.

6.5.2 Centralised navigation equipment (SYS-NEQ)

The additional class notation **SYS-NEQ** is assigned to ships which are fitted with a centralised navigation control system so laid out and arranged that it enables normal navigation and manoeuvring operation of the ship by two persons in cooperation.

The additional class notation **SYS-NEQ-1** is assigned when, in addition to the above, the installation is so arranged that the navigation and manoeuvring of the ship can be operated under normal conditions by one person, for periodical one man watch. This notation includes specific requirements for prevention of accidents caused by the operator's unfitness.

6.5.3 Integrated bridge system (SYS-IBS)

The additional class notation **SYS-IBS** is assigned to ships which are fitted with an integrated bridge system which allows simplified and centralised bridge operation of all main functions of navigation manoeuvring and communication, as well as monitoring from bridge of other functions related to specific cargoes and pollution ; for passenger ships, heating, ventilation and air conditioning are also included in the monitored functions.

6.5.4 Communication system (SYS-COM) *(1/7/2009)*

The additional class notation **SYS-COM** is assigned to ships which are fitted with a local area network including the alarm, monitoring and control systems and computers used for management operations and external communication devices for reporting ashore navigation, maintenance and operational information.

6.6 Monitoring equipment (MON)

6.6.1 General

The notations dealt with under this heading are relevant to hull and tailshaft monitoring equipment installed on board ships.

The requirements for the assignment of these notations are given in Part F, Chapter 5.

6.6.2 Hull stress monitoring (MON-HULL)

The additional class notation **MON-HULL** is assigned to ships which are fitted with equipment continuously monitoring ship's dynamic loads through measurements of motions in waves and stresses/deformations in the hull structure.

6.6.3 Tailshaft monitoring system (MON-SHAFT)

The additional class notation **MON-SHAFT** is assigned to ships which are fitted with a temperature monitoring system for the tailshaft sterntube bearings. The assignment of this notation allows the ship to be granted a reduced scope for complete tailshaft surveys, see Ch 2, Sec 2, [8.3.1].

6.7 Comfort on board ships and in port area (COMF)

6.7.1 General *(1/1/2020)*

The notations dealt with under this heading are relevant to the assessment of comfort on board ships and in port area with regard to the level of noise, vibration and/or air temperature/humidity.

The parameters which are taken into consideration for the evaluation of the comfort such as the level of noise, the level of vibration and the air temperature and/or humidity will be indicated in the Certificate of Classification.

These parameters are only verified once for all when the ship is classed.

The requirements for the assignment of these notations are given in Part F, Chapter 6.

6.7.2 Comfort with regard to noise on board ships (COMF-NOISE, COMF-NOISE (DP)~~ and~~, COMF-NOISE (MM) and COMF-NOISE-PLUS) *(1/1/2024)*

The additional class notations:

- **COMF-NOISE** - when the ship is in normal seagoing conditions;
- **COMF-NOISE (DP)** - when the ship is in dynamic positioning conditions; and
- **COMF-NOISE (MM)** - when the ship is in maneuvering mode conditions

are assigned to ships satisfying levels of noise defined in Pt F, Ch 6, Sec 1. The assessment of noise levels is only carried out through design review and sea trials.

The notations are completed by a letter **A**, **B** or **C** which represents the merit level achieved for the assignment of the notations, the merit **A** corresponding to the lowest level of acceptable noise. The notations **COMF-NOISE, COMF-NOISE (DP)** and **COMF-NOISE (MM)** are only assigned if at least the merit level **C** is reached.

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

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

When a passenger ship satisfies the more stringent requirements defined in Pt F, Ch 6, Sec 5 on tonal noise in passenger cabins and acoustic insulation of discotheques and lounges, the **COMF-NOISE-PLUS** additional class notation can be assigned independently from the above notations, upon assessment of noise levels carried out through sea trials only.

6.7.3 Comfort with regard to vibration on board ships (COMF-VIB, COMF-VIB (DP) and COMF-VIB (MM) *(15/9/2023)*

The additional class notations:

- **COMF-VIB** - when the ship is in normal seagoing conditions;
- **COMF-VIB (DP)** - when the ship is in dynamic positioning conditions; and
- **COMF-VIB (MM)** - when the ship is in maneuvering mode conditions

are assigned to ships satisfying levels of vibration defined in Pt F, Ch 6, Sec 2. The assessment of vibration levels is only carried out through design review and sea trials.

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

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

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

6.7.4 Comfort with regard to air temperature/humidity on board ships (COMF-AIR) *(1/1/2020)*

The additional class notation **COMF-AIR** is assigned to ships fitted with a combined heating-ventilation-air conditioning system (HVAC) satisfying levels of air temperature and humidity defined in Pt F, Ch 6, Sec 3. The assessment of air temperature/humidity levels is only carried out through design review and sea trials in Winter and Summer conditions.

The notation may be completed by one of the letters **W** or **S** when the HVAC system has been satisfactorily tested only in Winter or in Summer conditions respectively.

6.7.5 Noise emissions in port area outboard (NOISE-PORT-OUT(X)) and inboard (NOISE-PORT-IN(X)) *(1/1/2023)*

The additional class notations **NOISE-PORT-OUT(X)** and **NOISE-PORT-IN(X)** are assigned to ships satisfying levels of noise in port area defined in Pt F, Ch 6, Sec 4. The assessment of noise levels is only carried out through noise measurements in port area either outboard (for **NOISE-PORT-OUT(X)**) or in board (for **NOISE-PORT-IN(X)**).

The notation is completed by a number (1-100) which represents the merit level achieved for the assignment of the notation, the merit 100 corresponding to the lowest level of noise.

The notations **NOISE-PORT-OUT(X)** and **NOISE-PORT-IN(X)** are only assigned if at least merit level 1 is reached.

6.8 Pollution prevention

6.8.1 General *(1/7/2023)*

The notations dealt with under this heading are assigned to ships fitted with equipment and arrangements enabling them to reduce the pollution of the sea and/or air caused by release of solid waste and liquid and/or gaseous effluents.

The requirements for the assignment of these notations are given in Part F, Chapter 7 or in IMO documents (i.e. MARPOL Convention and MEPC Resolutions).

6.8.2 Sea pollution prevention (CLEAN-SEA) *(1/7/2006)*

The additional class notation **CLEAN-SEA** is assigned to ships provided with construction and procedural means to prevent pollution of the sea.

This is achieved by compliance with the applicable requirements of Annex I, Annex II, Annex III, Annex IV and Annex V of MARPOL Convention, relevant to ship's liquid and solid releases, as well as additional requirements related to prevention of sea pollution as follows:

- prevention of accidental pollution by means of location of fuel and lube oil tanks above the double bottom and away from ship sides
- prevention of operational pollution by means of bilge water separation and filtering, holding tanks for treated sewage and grey water
- prevention of transfer of harmful organisms and pathogens in the ballast water
- prevention of pollution by tributyltin by means of TBT free antifouling paints
- prevention of pollution by solid garbage (resulting from the compacting device and incinerators) by means of proper storage of such waste
- ship recycling.

6.8.3 Air pollution prevention (CLEAN-AIR) *(1/7/2009)*

The additional class notation **CLEAN-AIR** is assigned to ships provided with construction and procedural means to prevent pollution of the air. This is achieved by compliance with the applicable requirements of Annex VI of MARPOL

6.13.2 PMS *(1/7/2009)*

Where a Planned Maintenance Scheme is approved by the Society the additional class notation **PMS** is assigned. An implementation survey is to be carried out to confirm the validity of the additional class notation.

The requirements for the assignment of this notation are given in Pt F, Ch 12, Sec 1.

6.13.3 PMS-CM(PROP) *(1/7/2009)*

Where a Planned Maintenance Scheme approved by the Society is implemented and Condition Based Maintenance complying with the requirements of Pt F, Ch 12, Sec 2 relevant to the propulsion system is applied, the additional class notation **PMS-CM(PROP)** is assigned.

6.13.4 PMS-CM(HVAC) *(1/7/2009)*

Where a Planned Maintenance Scheme approved by the Society is implemented, and Condition Based Maintenance complying with the requirements of Pt F, Ch 12, Sec 3 relevant to the heating, ventilation and air conditioning (HVAC) system is applied, the additional class notation **PMS-CM(HVAC)** is assigned.

6.13.5 PMS-CM(CARGO) *(1/7/2009)*

Where a Planned Maintenance Scheme approved by the Society is implemented, and Condition Based Maintenance complying with the requirements of Pt F, Ch 12, Sec 4 relevant to the cargo system is applied, the additional class notation **PMS-CM(CARGO)** is assigned.

6.13.6 PMS-CM(ELE) *(1/7/2009)*

Where a Planned Maintenance Scheme approved by the Society is implemented, and Condition Based Maintenance complying with the requirements of Pt F, Ch 12, Sec 5 relevant to electrical switchboards is applied, the additional class notation **PMS-CM(ELE)** is assigned.

6.13.7 PMS-CM(FDS) *(1/7/2009)*

Where a Planned Maintenance Scheme approved by the Society is implemented, and Condition Based Maintenance complying with the requirements of Pt F, Ch 12, Sec 6 relevant to the fire detection system is applied, the additional class notation **PMS-CM(FDS)** is assigned.

6.13.8 PMS-CM *(1/1/2020)*

Where a Planned Maintenance Scheme approved by the Society is implemented, and Condition Based Maintenance complying with the requirements of Pt F, Ch 12, Sec 7 relevant to individual items selected by the Owner is applied, the additional class notation **PMS-CM** is assigned.

6.14 Other additional class notations

6.14.1 Strengthened bottom - Not always afloat but safe aground (NAABSA) *(15/10/2019)*

The additional class notation **STRENGTHBOTTOM-NAABSA** may be assigned to ships built with specially strengthened bottom structures so as to be able to be loaded and/or unloaded when properly stranded.

The requirements for the assignment of this notation are given in Pt F, Ch 13, Sec 1.

6.14.2 Loading by grabs *(1/4/2006)*

a) The additional class notation **GRABLOADING** may be assigned to ships with hold tank tops specially reinforced for loading/unloading cargoes by means of grabs or buckets.

   The requirements for the assignment of this notation are given in Pt F, Ch 13, Sec 2.

   However, this does not preclude ships not assigned with this notation from being loaded/unloaded with grabs.

b) The additional class notation **GRAB [X]** may be assigned to ships with hold tank tops designed for loading/unloading cargoes by means of grabs having a maximum mass of [X] tonnes.

   The requirements for the assignment of this notation are given in Pt F, Ch 13, Sec 2 (see also Note 2).

Note 1: These additional class notations may only be assigned to ships with the service notation **general cargo ship** (intended to carry dry bulk cargoes), **bulk carrier**, **ore carrier**, **combination carrier/OBO** or **combination carrier/OOC**.

Note 2: The specific requirements for the assignment of the notation **GRAB [X]** to bulk carriers with the service feature **CSR** are given in the Common Structural Rules (Ch 1, Sec 1, [3]).

6.14.3 In-water survey

The additional class notation **INWATERSURVEY** may be assigned to ships provided with suitable arrangements to facilitate the in-water surveys as provided in Ch 2, Sec 2, [7.1.4].

The requirements for the assignment of this notation are given in Pt F, Ch 13, Sec 3.

6.14.4 Single point mooring

The additional class notation **SPM** (Single Point Mooring) may be assigned to ships fitted with a specific mooring installation.

The requirements for the assignment of this notation are given in Pt F, Ch 13, Sec 4.

These requirements reproduce the provisions of "Recommendations for Equipment Employed in the Mooring of Ships at Single Point Mooring" (3rd edition 1993), issued by OCIMF (Oil Companies International Marine Forum).

6.14.5 Container lashing equipment *(1/7/2017)*

The additional class notation **LASHING** is assigned to ships initially fitted with mobile container lashing equipment that is documented, tested and checked.

The notation **ROUTE DEPENDENT LASHING (start date - end date)** is assigned to ships initially fitted with mobile container lashing equipment that is documented, tested and checked for specific routes and for the period of year defined by the specification start date - end date.

These notation are assigned only to ships having the service notation **container ship** or the additional service feature **equipped for carriage of containers**.

The requirements for the assignment of the notations are given in Pt F, Ch 13, Sec 5.

This equipment, however, will not be verified any longer at the periodical class surveys to which the ship is submitted.

general, the environment (reference is made to **GREEN PLUS** additional class notation)

b) underwater noise limitation (reference is made to **DOLPHIN** additional class notations)

c) noise and vibration limitation on board (reference is made to **COMF-NOISE** and **COMF-VIB** additional class notations)

d) compliance with **NOISE-PORT-OUT(X) or NOISE-PORT-IN(X)** additional class notations

e) compliance with **MLCDESIGN** additional class notation

f) compliance with **BIOSAFE SHIP** additional class notation

g) achievement of EEDI and EEXI values 40% lower than those in Phase 0 EEDI reference lines (see Note 1) in MARPOL Annex VI, according to the 2030 target in Initial IMO strategy on reduction of GHG emissions from ships (Res. MEPC.304(72)).

Note 1: For ro-ro cargo ships and ro-ro passenger ships, reference is made to Phase 2 EEDI reference lines

6.14.55 Maritime Autonomous Surface Ship (MASS) *(1/10/2021)*

The additional class notations **MASS** are assigned to ships having one of the following degrees of autonomy:

- **MASS-ADS**: ship with Automated processes and Decision Support: seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control.
- **MASS-RCM**: Remotely Controlled Manned ship: the ship is controlled and operated from another location. Seafarers are available on board to take control and to operate the shipboard systems and functions.
- **MASS-RCU**: Remotely Controlled Unmanned ship: the ship is controlled and operated from another location. There are no seafarers on board.
- **MASS-FAS**: Fully Autonomous Ship: the operating system of the ship can make decisions and determine actions by itself.

For the assignment of the additional class notations **MASS**, in its variants, the ship is to comply with the requirements given in Pt F, Ch 13, Sec 37.

6.14.56 H2 FUELLED *(1/10/2021)*

The additional class notation **H2 FUELLED** is assigned to ships using hydrogen as fuel, complying with the design and constructional requirements of Pt C, Ch 1, App 14.

6.14.57 H2 FUELLED READY (X1, X2, X3) *(1/10/2021)*

The additional class notation **H2 FUELLED READY (X1, X2, X3…)** is assigned to ships whose design is in compliance with Pt C, Ch 1, App 14, and the relevant systems and arrangement are partially installed on board, thus easing a future ship conversion into a H2 FUELLED ship.

The requirements for the assignment of this additional class notation are given in Pt F, Ch 13, Sec 38.

6.14.58 METHYL/ETHYL ALCOHOL FUELLED *(1/1/2022)*

The additional class notation **METHYL/ETHYL ALCOHOL FUELLED** is assigned to ships using methyl/ethyl alcohol as fuel, complying with the design and constructional requirements of Pt C, Ch 1, App 15.

6.14.59 METHYL/ETHYL ALCOHOL FUELLED READY (X1, X2, X3) *(1/1/2022)*

The additional class notation **METHYL/ETHYL ALCOHOL FUELLED READY (X1, X2, X3…)** is assigned to ships whose design is in compliance with Pt C, Ch 1, App 15, and the relevant systems and arrangement are partially installed on board, thus easing a future ship conversion into a METHYL/ETHYL ALCOHOL FUELLED ship.

The requirements for the assignment of this additional class notation are given in Pt F, Ch 13, Sec 39.

6.14.60 ENHANCED MAINTENANCE (EM) *(1/1/2024)*

The additional class notation **ENHANCED MAINTENANCE (EM)** is assigned to ships of 20 years old and above, having the additional service feature **ESP** and subject to enhanced maintenance including:

- a three-dimensional model structural analysis ~~performed for the hull~~,
- a Planned Maintenance Scheme (PMS) approved by the Society enhanced by a risk analysis of the essential systems, and
- periodical and corrective maintenance, as well as periodical and occasional surveys of hull structures and equipment performed according to approved procedures included in the Inspection and Maintenance Plan (IMP), together with audits at the Owner's office.

The requirements for the assignment of this additional class notation are given in Pt F, Ch 13, Sec 40.

6.14.61 FUEL CELL POWERED SHIP *(1/1/2023)*

The additional class notation **FUEL CELL POWERED SHIP** is assigned to ships where fuel cells are installed to supply essential or not-essential services, in compliance with the design and constructional requirements of Pt C, Ch 2, App 3, as follows:

- **FUEL CELL POWERED SHIP (E)** when fuel cell is used to power at least one of the essential services defined in Pt C, Ch 2, Sec 1, [3.2.1] and contributes to the compliance of the main source of electrical power to the requirements in Pt C, Ch 2, Sec 3, [2.2.3]
- **FUEL CELL POWERED SHIP (NE)** when fuel cell is used to power only services not falling under the definition of essential services in Pt C, Ch 2, Sec 1, [3.2.1].

6.14.62 Reduced Weight of anchor (RW) and Super Reduced Weight of anchor (SRW) *(1/1/2023)*

The additional class notations **RW** or **SRW** may be assigned to ships using high holding power (HHP) anchors or super high holding power (SHHP) anchors as defined in Pt B, Ch 10, Sec 4, [3.2.3], respectively.

The reduction in the weight of anchors is to comply with the requirements in Pt B, Ch 10, Sec 4, [3.2.3].

6.14.69 BIOFUEL *(1/7/2023)*

The additional class notation **BIOFUEL** is assigned to ships operating with biofuel as fuel for their internal combustion engines, boilers, fuel cell or other consumers complying with the requirements of Pt C, Ch 1, App 16. Depending on the type of fuel (e.g. diesel, methanol, ammonia, hydrogen etc..), the notation **BIOFUEL** may be completed with the following features:

- BIODIESEL (FAME)
- BIODIESEL (BTL)
- BIODIESEL (HVO/HDRD)
- BIODIESEL (SVO/PPO)
- BIOMETHANOL
- BIOETHANOL
- BIOLNG
- BIOAMMONIA
- BIOHYDROGEN

For biofuels considered as low flashpoints fuels - i.e those based on LNG, LPG, NH3, methyl/ethyl alcohol and hydrogen - the ship is to additionally comply with the following requirements, as applicable:

- Pt C, Ch 1, App 7 (LNG or CNG Fuelled Ships)
- Pt C, Ch 1, App 13 (LPG or NH3 Fuelled Ships)
- Pt C, Ch 1, App 14 (Hydrogen Fuelled Ships)
- Pt C, Ch 1, App 15 (Methyl/Ethyl Alcohol Fuelled Ships).

The biofuels based on biodiesel considered as low flash point fuel are subject to acceptance by the Society on case-by-case basis.

7 Other notations

7.1

7.1.1 The Society may also define other notations by means of provisional requirements and guidelines, which may then be published in the form of tentative rules.

Table 3 : List of additional class notations *(1/1/2024)*

Additional class notation	Reference for definition	Reference	Remarks
ADVANCED WASTEWATER TREATMENT PLANT (AWTP)	[6.8.12]	NA	
AIR LUBRICATION SYSTEM (AIR LUB)	[6.14.47]	Pt F, Ch 13, Sec 31	
AIR-MON	[6.14.33]	Pt F, Ch 13, Sec 22	
AUT-CCS	[6.4.3]	Pt F, Ch 3, Sec 2	**(1)**
AUT-PORT	[6.4.4]	Pt F, Ch 3, Sec 3	**(1)**
AUT-UMS	[6.4.2]	Pt F, Ch 3, Sec 1	**(1)**
AVM-APS or AVM-APS-NS	[6.3.2]	Pt F, Ch 2, Sec 1	**(1)**
AVM-IAPS	[6.3.3]	Pt F, Ch 2, Sec 2	**(1)**
AVM-DPS or AVM-DPS-NS	[6.3.4]	Pt F, Ch 2, Sec 3	**(1)**
AVM-IPS	[6.3.5]	Pt F, Ch 2, Sec 4	**(1)**
BATTERY POWERED SHIPS	[6.14.42]	Pt C, Ch 2, App 2	
BIOFUEL	[6.14.69]	Pt C, Ch 1, App 16	
BIOSAFE SHIP	[6.14.49]	Pt F, Ch 13, Sec 33	
BWM-E	[6.14.15]	Pt C, Ch 1, Sec 10, [7]	**(5)**
BWM-T	[6.14.15]	Pt C, Ch 1, App 8	
CARGOCONTROL	[6.14.9]	Pt F, Ch 13, Sec 9	
CARGO HANDLING (H), **CARGO HANDLING (O)**, **CARGO HANDLING (T)**, **CARGO HANDLING (S)**, **CARGO HANDLING (SW)**	[6.14.30]	Tasneef Rules for loading and unloading arrangements and for other lifting appliances on board ships	

(1) A construction mark is added to this notation.
(2) This notation may be completed by the specific notations **-PRECOOLING**, **-QUICKFREEZE** and/or **-AIRCONT** (see [6.9.5]).
(3) This notation may be completed by the specific notations **-MIDSHIP** and **-TRANSFER** (see [6.14.7]).
(4) 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** (see [6.8.4]).
(5) This notation may be completed by the specific features: **sequential, flow-through, dilution**.
(6) This notation may be completed by the specific notation **-HULL** (see [6.10.4]).
(7) This notation may be completed by the specific notation **Icebreaker** (see [6.11.1]).

Additional class notation	Reference for definition	Reference	Remarks
CARGO PIPING PROTECTED (CPP)	[6.14.63]	Pt F, Ch 13, Sec 41	
CLEAN-AIR	[6.8.3]	Pt F, Ch 7, Sec 3	**(4)**
CLEAN-SEA	[6.8.2]	Pt F, Ch 7, Sec 4	**(4)**
COAT-WBT	[6.14.12]	Pt F, Ch 13, Sec 12	
COATING PERFORMANCE STANDARD IN CARGO OIL TANKS (CPS-COT)	[6.14.64]	Pt F, Ch 13, Sec 42	
COMF-AIR	[6.7.4]	Pt F, Ch 6, Sec 3	
COMF-NOISE, **COMF-NOISE (DP)** and **COMF-NOISE (MM)**	[6.7.2]	Pt F, Ch 6, Sec 1	
COMF-NOISE-PLUS	[6.7.2]	Pt F, Ch 6, Sec 5	
COMF-VIB, **COMF-VIB (DP)** and **COMF-VIB (MM)**	[6.7.3]	Pt F, Ch 6, Sec 2	
COVENT	[6.14.8]	Pt F, Ch 13, Sec 8	
CYBER RESILIENCE (CYR, CYR-OT and CYR-IT)	[6.14.45]	Pt F, Ch 13, Sec 29	
DANGEROUS GOODS	[6.14.34]	NA	
DIGITAL SHIP (ADC)	[6.14.46]	Pt F, Ch 13, Sec 30	
DIGITAL SHIP (D)	[6.14.46]	Pt F, Ch 13, Sec 43	
DIVINGSUPPORT	[6.14.17]	Pt F, Ch 13, Sec 14	
DOLPHIN QUIET SHIP or DOLPHIN TRANSIT SHIP	[6.14.39]	Pt F, Ch 13, Sec 25	
DORS	[6.14.36]	Pt F, Ch 13, Sec 23	
DMS	[6.14.11]	Pt F, Ch 13, Sec 11	
DYNAPOS	[6.14.6] a)	Pt F, Ch 13, Sec 6	**(1)**
DP PLUS	[6.14.6] b)	Pt F, Ch 13, Sec 6	
EEDI-Ph3	[6.8.8]	NA	
EGCS-SOX and/or EGCS-NOX	[6.14.41]	Pt F, Ch 13, Sec 26	
EFFICIENT SHIP (S, DWT)	[6.14.28]	Pt F, Ch 13, Sec 19	
ENHANCED MAINTENANCE (EM)	[6.14.60]	Pt F, Ch 13, Sec 40	
FATIGUELIFE (Y)	[6.14.13]	NA	
FIRE	[6.14.22]	Pt F, Ch 13, Sec 17	
FIRE-AS	[6.14.22]	Pt F, Ch 13, Sec 17	
FIRE-MS	[6.14.22]	Pt F, Ch 13, Sec 17	
FIRE-MS (hot-spots)	[6.14.22]	Pt F, Ch 13, Sec 17	
FIRE-CS	[6.14.22]	Pt F, Ch 13, Sec 17	
FUEL CELL POWERED SHIP (E) **FUEL CELL POWERED SHIP (NE)**	[6.14.61]	Pt C, Ch 2, App 3	
FUEL SAMPLING	[6.14.65]	Pt F, Ch 13, Sec 44	
GRABLOADING and GRAB (X)	[6.14.2]	Pt F, Ch 13, Sec 2	

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

(2) This notation may be completed by the specific notations **-PRECOOLING**, **-QUICKFREEZE** and/or **-AIRCONT** (see [6.9.5]).

(3) This notation may be completed by the specific notations **-MIDSHIP** and **-TRANSFER** (see [6.14.7]).

(4) 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** (see [6.8.4]).

(5) This notation may be completed by the specific features: **sequential, flow-through, dilution**.

(6) This notation may be completed by the specific notation **-HULL** (see [6.10.4]).

(7) This notation may be completed by the specific notation **Icebreaker** (see [6.11.1]).

SECTION 1 GENERAL

1 General

1.1

1.1.1 The purpose of this Chapter is to give details on the scope of surveys of specific equipment and systems fitted on board the ship, which are covered by an additional class notation. Unless otherwise specified in Ch 1, Sec 2, [6], the scope of these surveys provides the requirements to be complied with for the maintenance of the relevant additional class notation.

1.1.2 These specific requirements are additional to those laid down in Chapter 3 and Chapter 4. These surveys are to be carried out at intervals as described in Ch 2, Sec 2, as far as possible concurrently with the surveys of the same type, i.e. annual, intermediate or class renewal survey.

1.1.3 The equipment and systems are also to be submitted to occasional survey whenever one of the cases indicated in Ch 2, Sec 2, [11] occurs.

1.1.4 Where specific requirements are given in this Chapter for the class renewal survey, they are additional to the applicable requirements for the annual survey.

1.1.5 For the assignment of the additional class notations, ships are to be submitted to an admission to class survey as described in Ch 2, Sec 1, [2] and Ch 2, Sec 1, [3] for new and existing installations, respectively, as applicable.

2 Additional class notations subject to additional surveys

2.1

2.1.1 The specific requirements detailed in this Chapter are linked to the additional class notation(s) assigned to the ship. Where a ship has more than one additional class notation, the specific requirements linked to each additional class notation are applicable as long as they are not contradictory.

2.1.2 Tab 1 indicates which additional class notations are subject to specific requirements, and in which Section and/or Article they are specified.

Table 1 : Additional class notations for which specific survey requirements are applicable *(1/1/2024)*

Additional class notation	Section or Article applicable in this Chapter	Type of surveys affected by these specific requirements	Remarks
STAR **STAR-HULL** **STAR-MACH**	Sec 2	See Remarks	The scope and periodicity of surveys are stipulated by specific requirements given in Pt F, Ch 1, Sec 1, [5] and Pt F, Ch 1, Sec 2, [4]
Availability of machinery: **AVM-APS** **AVM-IAPS** **AVM-DPS** **AVM-IPS**	Sec 3	annual survey class renewal survey	
Automated machinery systems: **AUT-UMS** **AUT-CCS** **AUT-PORT**	Sec 4	annual survey class renewal survey	
Integrated ship systems: **SYS-NEQ** **SYS-NEQ-1** **SYS-COM** **SYS-IBS**	Sec 5	annual survey class renewal survey	
Monitoring equipment: **MON-HULL** **MON-SHAFT**	Sec 6	annual survey class renewal survey tailshaft survey	

Additional class notation	Section or Article applicable in this Chapter	Type of surveys affected by these specific requirements	Remarks
HELIDECK **HELIDECK H**	Sec 11	annual survey class renewal survey	
Other notations **STRENGTHBOTTOM-NAABSA** **GRABLOADING - GRAB [X]** **SPM** **LASHING** and **ROUTE DEPENDENT LASHING** **DYNAPOS** **DP PLUS** **VCS** **COVENT** **CARGOCONTROL** **COAT-WBT** **DIVINGSUPPORT** **HVSC** **HVSC-NB** **FIRE** **SELF-UNLOADING** **TAS** **EFFICIENT SHIP (S,DWT)** **MOORING** **CARGO HANDLING (H), CARGO HANDLING (O), CARGO HANDLING (T), CARGO HANDLING (S), CARGO HANDLING (SW) AND PERSONNEL LIFTING, PERSONNEL LIFTING ADV, PERSONNEL LIFTING ADV PLUS** **G· SAHARA, SAHARA** **COMF-NOISE, COMF-VIB, COMF-NOISE (DP), COMF-VIB (DP), COMF- NOISE (MM), COMF-VIB (MM), COMF-NOISE-PLUS,** **DOLPHIN QUIET SHIP,** **DOLPHIN TRANSIT SHIP** **RISK MITIGATION (...)** **AIR MON** **DANGEROUS GOODS** **INF 1, INF 2, INF 3** **INERTGAS A, INERTGAS B, INERTGAS C** **LNG FUELLED, CNG FUELLED** **LNG FUELLED (Main), CNG FUELLED (Main)** **LNG FUELLED (Aux), CNG FUELLED (Aux)** **MAN OVERBOARD DETECTION SYSTEM** **CYBER RESILIENCE** **DIGITAL SHIP (ADC)** **AIR LUBRICATION SYSTEM** **PERSONS WITH REDUCED MOBILITY (PMR-ITA)** **BIOSAFE SHIP** **REMOTE SURVEYABLE SHIP (REMOTE)** **SUSTAINABLE SHIP** **MARITIME AUTONOMOUS SURFACE SHIPS (MASS)** **ENHANCED MAINTENANCE (EM)** **CARGO PIPING PROTECTED (CPP)** **NOISE-PORT-OUT(X)** **NOISE-PORT-IN(X)** **COATING PERFORMANCE STANDARD IN CARGO OIL TANKS (CPS-COT)** **DIGITAL SHIP (D)** **FUEL SAMPLING** **WIND ASSISTED** **PROPULSION SYSTEM (WAPS)** **LOADINT-LAS** **ULTRA LOW EMISSION VESSEL (ULEV)**	Sec 12	As applicable in accordance with the related Articles in Sec 12	

SECTION 12 OTHER NOTATIONS

1 General

1.1

1.1.1 *(1/1/2024)*

The requirements of this Section apply to ships which have been assigned one of the following additional class notations described in Ch 1, Sec 2, [6.14]:

STRENGTHBOTTOM-NAABSA

GRABLOADING

GRAB [X]

SPM

LASHING and ROUTE DEPENDENT LASHING

DYNAPOS

DP PLUS

VCS

COVENT

CARGOCONTROL

COAT-WBT

DIVINGSUPPORT

HVSC-NB, HVSC

FIRE

SELF-UNLOADING

TAS

EFFICIENT SHIP (S, DWT)

MOORING

CARGO HANDLING (H), CARGO HANDLING (O), CARGO HANDLING (T), CARGO HANDLING (S), CARGO HANDLING (SW) AND PERSONNEL LIFTING, PERSONNEL LIFTING ADV, PERSONNEL LIFTING ADV PLUS

SAHARA, SAHARA

COMF-NOISE, COMF-VIB, COMF-NOISE (DP), COMF-VIB (DP), COMF-NOISE (MM), COMF-VIB (MM), COMF-NOISE-PLUS, DOLPHIN QUIET SHIP, DOLPHIN TRANSIT SHIP

RISK MITIGATION

AIR MON

DANGEROUS GOODS

INF 1, INF 2, INF 3

INERTGAS A, INERTGAS B, INERTGAS C

LNG FUELLED, LNG FUELLED (Main), LNG FUELLED (Aux)

CNG FUELLED, CNG FUELLED (Main), CNG FUELLED (Aux)

MAN OVERBOARD DETECTION SYSTEM

CYBER RESILIENCE

DIGITAL SHIP (ADC)

AIR LUBRICATION SYSTEM

PERSONS WITH REDUCED MOBILITY (PMR-ITA)

BIOSAFE SHIP

REMOTE

SUSTAINABLE SHIP

MARITIME AUTONOMOUS SURFACE SHIPS (MASS)

ENHANCED MAINTENANCE (EM)

CARGO PIPING PROTECTED (CPP)

NOISE-PORT-OUT(X), NOISE-PORT-IN(X)

COATING PERFORMANCE STANDARD IN CARGO OIL TANKS (CPS-COT)

DIGITAL SHIP (D)

FUEL SAMPLING

WIND ASSISTED PROPULSION SYSTEM (WAPS)

LOADINT-LAS

ULTRA LOW EMISSION VESSEL (ULEV)

2 STRENGTHBOTTOM-NAABSA

2.1 Dry-docking survey

2.1.1 The reinforced area of bottom plating and internal associated structures are to be visually examined for possible deformations, fractures or other damage. If deemed necessary, thickness measurements may be required.

3 GRABLOADING and GRAB [X]

3.1 Class renewal survey

3.1.1 The reinforced area of double bottom plating and adjacent associated structures are to be visually examined for possible deformations, fractures or other damage. If deemed necessary, thickness measurements may be required.

4 SPM

4.1 Annual survey

4.1.1 The Owner or his representative is to declare to the attending Surveyor that no significant alterations have been made without the prior approval of the Society.

4.1.2 The annual survey is to include:

- a general examination of all components of the installation (bow chain stoppers, bow fairleads, pedestal

20 ↻ SAHARA and SAHARA

20.1 Annual survey

20.1.1 *(1/7/2014)*

The Owner or his representative is to declare to the attending Surveyor that no significant alterations have been made without the prior approval of the Society.

The annual survey is to include:

- examination, where fitted, of the wooden sheathing protecting the cargo deck
- verification from the on-board records that performance of the fresh water generator(s) is regularly monitored
- visual examination of mechanical components used for cooling and maintaining an ambient temperature, including the test of the audible and visual alarms fitted, at a continually manned control station, to indicate any malfunction of the cooling units.

20.2 Renewal survey

20.2.1 *(1/7/2014)*

The requirements for annual surveys in [20.1.1] are to be complied with.

20.2.2 *(1/7/2014)*

Internal examination and working test of fresh water generator (s).

21 COMF-NOISE, COMF-VIB, COMF-NOISE (DP), COMF-VIB (DP), COMF-NOISE (MM), COMF-VIB (MM), COMF-NOISE-PLUS, DOLPHIN QUIET SHIP, DOLPHIN TRANSIT SHIP

21.1 Renewal survey

21.1.1 *(1/7/2014)*

Verification that the ship has not been subjected to modifications, refitting or major repairs that may affect its level of comfort.

In particular, the following items have to be verified:

- main engine(s)
- propulsion shafting and its components such as reduction gear (if fitted), intermediate bearings, etc.
- propeller(s)
- air-conditioning System(s) and Ventilation System(s), including their intake and delivery ducts or plenum.

22 RISK MITIGATION (…)

22.1 Annual and renewal survey

22.1.1 *(1/7/2015)*

The verifications to be carried out at periodical surveys are established on a case by case basis according to the measures adopted in order to reduce the risk of failures of the specific technical matters indicated between brackets in the notation itself.

23 AIR MON

23.1 Annual and renewal survey

23.1.1 *(1/7/2015)*

The survey is to include:

a) verification that the maintenance and inspection of the HVAC system are carried out according to the makers recommendations and internal procedures;

b) checking that the monitoring plan is available, updated and implemented;

c) checking the reports of the required analysis and their review for compliance as evidence of monitoring plan implementation.

In addition, a record of extraordinary maintenance, repairs, equipment modifications (if any) and the results of relevant tests carried out is to be available.

24 DANGEROUS GOODS

24.1 Annual and renewal survey

24.1.1 *(1/7/2015)*

The survey is to include:

a) verification that the "Record for the Carriage of Dangerous Goods in Packaged Form and Dangerous Solid Cargoes in Bulk" is present on board;

b) verification, when appropriate, that there is a special list, manifest or stowage plan for the carriage of dangerous goods;

c) verification, as applicable, that the approved Cargo Securing Manual, according to (SOLAS 74/2011 Reg.VII/5) is present on board (applicable only to dangerous goods in package form)

d) verification of the consistency and efficiency of the specific constructional and carriage requirements imposed for the carriage of the goods listed in the "Record for the Carriage of Dangerous Goods in Packaged Form and Dangerous Solid Cargoes in Bulk".

25 INF 1, INF 2, INF 3

25.1 Annual and renewal survey

25.1.1 *(1/7/2015)*

The survey is to include:

a) verification that the "Damage Stability booklet", related to the carriage of INF materials, is present on board;

b) verification that the "shipboard emergency plan", related to the carriage of INF materials, is present on board;

c) verification of additional arrangements, if any, for radiological protection related to the carriage of INF materials;

d) verification of additional equipment, if any, for radiological protection related to the carriage of INF materials;

e) verification of the permanent securing devices provided to prevent movement of the packages within the cargo spaces;

SECTION 2 COMPARTMENT ARRANGEMENT

1 Definitions

1.1 Cofferdam

1.1.1 A cofferdam means an empty space arranged so that compartments on each side have no common boundary; a cofferdam may be located vertically or horizontally. As a rule, a cofferdam is to be properly ventilated and of sufficient size to allow for inspection.

1.2 Machinery spaces of category A

1.2.1 *Machinery spaces of category A are those spaces or trunks to such spaces which contain:*

- *internal combustion machinery used for main propulsion; or*
- *internal combustion machinery used for purposes other than propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or*
- *any oil fired boiler or fuel oil unit.*

2 Cofferdams

2.1 Cofferdam arrangement

2.1.1 Cofferdams are to be provided between compartments intended for liquid hydrocarbons (fuel oil, lubricating oil) and those intended for fresh water (drinking water, water for propelling machinery and boilers) as well as tanks intended for the carriage of liquid foam for fire extinguishing.

2.1.2 Cofferdams separating fuel oil tanks from lubricating oil tanks and the latter from those intended for the carriage of liquid foam for fire extinguishing or fresh water or boiler feed water may not be required when deemed impracticable or unreasonable by the Society in relation to the characteristics and dimensions of the spaces containing such tanks, provided that:

- the thickness of common boundary plates of adjacent tanks is increased, with respect to the thickness obtained according to Ch 7, Sec 1, by 2 mm in the case of tanks carrying fresh water or boiler feed water, and by 1 mm in all other cases
- the sum of the throats of the weld fillets at the edges of these plates is not less than the thickness of the plates themselves
- the structural test is carried out with a head increased by 1 m with respect to Ch 12, Sec 3, [2].

2.1.3 *(1/7/2021)*

Spaces intended for the carriage of flammable liquids are to be separated from accommodation and service spaces by means of a cofferdam. Where accommodation and service spaces are arranged immediately above such spaces, the cofferdam may be omitted only where the deck is not provided with access openings and is coated with a layer of material which will not give rise to smoke or toxic or explosive hazards at elevated temperatures. These properties shall be determined in accordance with the Fire Test Procedure Code for the type of coating, either primary deck covering or paint, provided.

The cofferdam may also be omitted where such spaces are adjacent to a passageway, subject to the conditions stated in [2.1.2] for fuel oil or lubricating oil tanks.

2.1.4 Cofferdams are only required between fuel oil double bottoms and tanks immediately above where the inner bottom plating is subjected to the head of fuel oil contained therein, as in the case of a double bottom with its top raised at the sides.

Where a corner to corner situation occurs, tanks are not be considered to be adjacent.

Adjacent tanks not separated by cofferdams are to have adequate dimensions to ensure easy inspection.

3 Double bottoms

3.1 General

3.1.1 Double bottom *(1/1/2024)*

a) *A double bottom shall be fitted extending from the collision bulkhead to the afterpeak bulkhead, as far as this is practicable and compatible with the design and proper working of the ship.*

b) *Where a double bottom is required to be fitted the inner bottom shall be continued out to the ship's sides in such a manner as to protect the bottom to the turn of the bilge. Such protection will be deemed satisfactory if the inner bottom is not lower at any part than a plane parallel with the keel line and which is located not less than a vertical distance h measured from the keel line, as calculated by the formula:*

h = B / 20

However, in no case is the value of h to be less than 760 mm, and need not be taken as more than 2,000 mm.

c) *Small wells constructed in the double bottom in connection with drainage arrangements ~~of holds, etc.~~, shall not extend downward more than necessary. ~~A well extending to the outer bottom is, however, permitted at the after end of the shaft tunnel. Other wells (e.g., for lubricating oil under main engines) may be permitted by the Society if satisfied that the arrangements give~~*

~~protection equivalent to that afforded by a double bottom complying with this regulation. In no case shall~~ ~~t~~The vertical distance from the bottom of such a well to a plane coinciding with the keel line shall not be less than h/2 or 500 mm, whichever is greater, or compliance with paragraph k) of this article shall be shown for that part of the ship.

d) Other wells (e.g. for lubricating oil under main engines) may be permitted by the Society if satisfied that the arrangements give protection equivalent to that afforded by a double bottom complying with this article.

e) For a cargo ship of 80 m in length and upwards or for a passenger ship, proof of equivalent protection is to be shown by demonstrating that the ship is capable of withstanding bottom damages as specified in paragraph k). Alternatively, wells for lubricating oil below main engines may protrude into the double bottom below the boundary line defined by the distance h provided that the vertical distance between the well bottom and a plane coinciding with the keel line is not less than h/2 or 500 mm, whichever is greater.

f) For cargo ships of less than 80 m in length the arrangements shall provide a level of safety to the satisfaction of the Society.

g) A double bottom need not be fitted in way of watertight tanks, including dry tanks of moderate size, provided the safety of the ship is not impaired in the event of bottom or side damage.

h) In the case of passenger ships to which the provisions of SOLAS regulation II-1/1.5 apply and which are engaged on regular service within the limits of a short international voyage as defined in SOLAS regulation III/3.22, the ~~Administration~~Society may permit a double bottom to be dispensed with if satisfied that the fitting of a double bottom in that part would not be compatible with the design and proper working of the ship.

i) Any part of ~~a passenger ship or~~ a cargo ship of 80 m in length and upwards or of a passenger ship that is not fitted with a double bottom in accordance with paragraphs a), ~~d~~g) or ~~e~~h), as specified in paragraph b) shall be capable of withstanding bottom damages, as specified in paragraph h), in that part of the ship. For cargo ships of less than 80 m in length the alternative arrangements shall provide a level of safety to the satisfaction of the Society.

j) In the case of unusual bottom arrangements in ~~a passenger ship or~~ a cargo ship of 80 m in length and upwards or a passenger ship, it shall be demonstrated that the ship is capable of withstanding bottom damages as specified in paragraph ~~h~~k). For cargo ships of less than 80 m in length the alternative arrangements shall provide a level of safety to the satisfaction of the Society.

k) Compliance with paragraphs ~~f)~~c), e), i) or ~~g~~i) is to be achieved by demonstrating that si, when calculated in accordance with SOLAS ~~R~~reg.ulation II-1/7-2 ~~of SOLAS Convention~~, is not less than 1 for all service conditions when subject to a bottom damage assumed at any position along the ship's bottom and with an extent specified in ~~item~~ 2) below for any position in the affected part of the ship:

1) Flooding of such spaces shall not render emergency power and lighting, internal communication, signals or other emergency devices inoperable in other parts of the ship.

2) Assumed extent of damage shall be as ~~follows~~in Tab 1.

3) If any damage of a lesser extent than the maximum damage specified in ~~item~~ 2) would result in a more severe condition, such damage should be considered.

l) In case of large lower holds in passenger ships, the Administration may require an increased double bottom height of not more than B/10 or 3 m, whichever is less, measured from the keel line. Alternatively, bottom damages may be calculated for these areas, in accordance with paragraph ~~h~~k), but assuming an increased vertical extent.

For ships not subject to SOLAS Convention the requirements of this item [3.1.1] will be specially considered by the Society in each single case.

3.1.2 *(1/1/2011)*

Special requirements for tankers are specified in Part E.

Table 1 *(1/1/2011)*

	For 0,3 L from the forward perpendicular of the ship	Any other part of the ship
Longitudinal extent	1/3 $L^{2/3}$ or 14.5 m, whichever is less	1/3 $L^{2/3}$ or 14.5 m, whichever is less
Transverse extent	B/6 or 10 m, whichever is less	B/6 or 5 m, whichever is less
Vertical extent, measured from the keel line	B/20 or 2 m, whichever is less	B/20 or 2 m, whichever is less

4 Compartments forward of the collision bulkhead

4.1 General

4.1.1 The fore peak and other compartments located forward of the collision bulkhead may not be arranged for the carriage of fuel oil or other flammable products.

This requirement does not apply to ships of less than 400 tons gross tonnage, except for those where the fore peak is the forward cofferdam of tanks arranged for the carriage of flammable liquid products having a flash point not exceeding 60°C.

SECTION 4 BOTTOM STRUCTURE

1 General

1.1 Application

1.1.1 The requirements of this Section apply to longitudinally or transversely framed single and double bottom structures.

1.2 General arrangement

1.2.1 In ships greater than 120 m in length, the bottom is, in general, to be longitudinally framed.

1.2.2 *(1/7/2002)*
The bottom is to be checked by the Designer to ascertain that it withstands the loads resulting from the dry-docking of the ship.

1.2.3 The bottom is to be locally stiffened where concentrated loads are envisaged.

1.2.4 Girders or floors are to be fitted under each line of pillars, when deemed necessary by the Society on the basis of the loads carried by the pillars.

1.2.5 Adequate tapering is to be provided between double bottom and adjacent single bottom structures. Similarly, adequate continuity is to be provided in the case of height variation in the double bottom. Where such a height variation occurs within 0,6 L amidships, the inner bottom is generally to be maintained continuous by means of inclined plating.

1.2.6 Provision is to be made for the free passage of water from all parts of the bottom to the suctions, taking into account the pumping rate required.

1.2.7 When solid ballast is fitted, it is to be securely positioned. If necessary, intermediate floors may be required for this purpose.

1.3 Keel

1.3.1 The width of the keel is to be not less than the value obtained, in m, from the following formula:

$$b = 0,8 + 0,5\frac{L}{100}$$

1.4 Drainage and openings for air passage

1.4.1 Holes are to be cut into floors and girders to ensure the free passage of air and liquids from all parts of the double bottom.

1.4.2 Air holes are to be cut as near to the inner bottom and draining holes as near to the bottom shell as practicable.

2 Longitudinally framed single bottom

2.1 General

2.1.1 Single bottom ships are to be fitted with a centre girder formed by a vertical continuous or intercostal web plate and a horizontal face plate continuous over the floors. Intercostal web plates are to be aligned and welded to floors.

2.1.2 In general, girders are to be fitted spaced not more than 2,5 m apart and formed by a vertical intercostal web plate and a horizontal face plate continuous over the floors. Intercostal web plates are to be aligned and welded to floors.

2.1.3 Centre and side girders are to be extended as far aft and forward as practicable.

2.1.4 Where side girders are fitted in lieu of the centre girder, the scarfing is to be adequately extended and additional stiffening of the centre bottom may be required.

2.1.5 Longitudinal girders are to be fitted in way of each line of pillars.

2.1.6 Floors are to be made with a welded face plate between the collision bulkhead and 0,25L from the fore end.

2.2 Floors

2.2.1 In general, the floor spacing is to be not greater than 5 frame spacings.

2.3 Longitudinal ordinary stiffeners

2.3.1 Longitudinal ordinary stiffeners are generally to be continuous when crossing primary members.

3 Transversely framed single bottom

3.1 General

3.1.1 The requirements in [2.1] apply also to transversely framed single bottoms.

3.2 Floors

3.2.1 Floors are to be fitted at every frame.

3.2.2 The height, in m, of floors at the centreline is to be not less than B/16. In the case of ships with considerable rise of floor, this height may be required to be increased so as to assure a satisfactory connection to the frames.

4 Longitudinally framed double bottom

4.1 General

4.1.1 The centre girder is to be continuous and extended over the full length of ship and the spacing of adjacent longitudinal girders is generally to be not greater than 6,5 m.

4.2 Double bottom height

4.2.1 The double bottom height is to be sufficient to ensure access to all parts and, in way of the centre girder, is to be not less than the greater value obtained, in m, from the following formulae:

$$h_{DB} = 3\frac{B + T + 10}{100}$$

$$h_{DB} = 0,7$$

4.2.2 Where the height of the double bottom varies, the variation is generally to be made gradually and over an adequate length; the knuckles of inner bottom plating are to be located in way of plate floors.

Where this is impossible, suitable longitudinal structures such as partial girders, longitudinal brackets etc., fitted across the knuckle are to be arranged.

4.2.3 In ships without a flat bottom, the height of double bottom specified in [4.2.1] may be required to be adequately increased such as to ensure sufficient access to the areas towards the sides.

4.3 Floors

4.3.1 The spacing of plate floors, in m, is generally to be not greater than 0,05L or 3,8 m, whichever is the lesser.

Additional plate floors are to be fitted in way of transverse watertight bulkheads.

4.3.2 Plate floors are generally to be provided with stiffeners in way of longitudinal ordinary stiffeners.

4.3.3 Where the double bottom height exceeds 0,9 m, watertight floors are to be fitted with stiffeners having a net section modulus not less than that required for tank bulkhead vertical stiffeners.

4.4 Bottom and inner bottom longitudinal ordinary stiffeners

4.4.1 Bottom and inner bottom longitudinal ordinary stiffeners are generally to be continuous through the floors.

4.5 Brackets to centreline girder and margin plate

4.5.1 In general, intermediate brackets are to be fitted connecting either the margin plate or the centre girder to the nearest bottom and inner bottom ordinary stiffeners.

4.5.2 Such brackets are to be stiffened at the edge with a flange having a width not less than 1/10 of the local double bottom height.

If necessary, the Society may require a welded flat bar to be arranged in lieu of the flange.

4.5.3 Where the side shell is transversely stiffened, margin plate brackets are to be fitted at every frame.

4.6 Duct keel

4.6.1 Where a duct keel is arranged, the centre girder may be replaced by two girders conveniently spaced, generally no more than 2 m apart.

4.6.2 The structures in way of the floors are to ensure sufficient continuity of the latter.

4.7 Bilge wells

4.7.1 Bilge wells arranged in the double bottom are to be limited in depth and formed by steel plates having a net thickness not less than the greater of that required for watertight floors and that required for the inner bottom.

4.7.2 *(1/1/2024)*

~~In ships subject to subdivision requirements, such bilge wells are to be fitted so that the distance of their bottom from the shell plating is not less than 460 mm~~Vertical extension of bilge wells is to comply with the requirements given in Ch 2, Sec 2, [3.1.1].

4.7.3 Where there is no margin plate, well arrangement is considered by the Society on a case by case basis.

5 Transversely framed double bottom

5.1 General

5.1.1 The requirements in [4.1], [4.2], [4.5], [4.6] and [4.7] apply also to transversely framed double bottoms.

5.2 Floors

5.2.1 Plate floors are to be fitted at every frame forward of 0,75L from the aft end.

Plate floors are also to be fitted:

- in way of transverse watertight bulkheads
- in way of double bottom steps.

Elsewhere, plate floors may be arranged at a distance not exceeding 3 m.

5.2.2 In general, plate floors are to be continuous between the centre girder and the margin plate.

5.2.3 Open floors are to be fitted in way of intermediate frames.

APPENDIX 1 HULL GIRDER ULTIMATE STRENGTH

Symbols

For symbols not defined in this Appendix, refer to the list at the beginning of this Chapter.

R_{eH_S} : Minimum yield stress, in N/mm^2, of the material of the considered stiffener

R_{eH_p} : Minimum yield stress, in N/mm^2, of the material of the considered plate

I_Y : Moment of inertia, in m^4, of the hull transverse section around its horizontal neutral axis, to be calculated according to Sec 1, [2.4]

Z_{AB} ,Z_{AD} : Section moduli, in cm^3, at bottom and deck, respectively, defined in Sec 1, [2.3.2]

s : Spacing, in m, of ordinary stiffeners

ℓ : Span, in m, of ordinary stiffeners, measured between the supporting members (see Ch 4, Sec 3, Fig 2 to Ch 4, Sec 3, Fig 5)

h_w : Web height, in mm, of an ordinary stiffener

t_w : Web net thickness, in mm, of an ordinary stiffener

b_f : Face plate width, in mm, of an ordinary stiffener

t_f : Face plate net thickness, in mm, of an ordinary stiffener

A_S : Net sectional area, in cm^2, of stiffener, without attached plating

t_p : Net thickness, in mm, of the plating attached to an ordinary stiffener of the plate of an hard corner or of the plate of a stiffened plate as applicable.

1 General

1.1

1.1.1 *(1/7/2016)*

The method for calculating the ultimate hull girder capacity is to identify the critical failure modes of all main longitudinal structural elements.

1.1.2 *(1/7/2016)*

Structures compressed beyond their buckling limit have reduced load carrying capacity. All relevant failure modes for individual structural elements, such as plate buckling, torsional stiffener buckling, stiffener web buckling, lateral or global stiffener buckling and their interactions, are to be considered in order to identify the weakest inter-frame failure mode.

2 Incremental-iterative method

2.1 Assumptions

2.1.1 Procedure *(1/7/2016)*

In applying the incremental-iterative method, the following assumptions are generally to be made:

- the ultimate strength is calculated at hull transverse sections between two adjacent transverse webs;
- the hull girder transverse section remains plane during each curvature increment;
- the hull material has an elasto-plastic behaviour;
- the hull girder transverse section is divided into a set of elements, see [2.2.2], which are considered to act independently.

According to the iterative procedure, the bending moment M_γ acting on the transverse section at each curvature value χ_ι is obtained by summing the contribution given by the stress σ acting on each element. The stress σ correspond to the element strain, ε is to be obtained for each curvature increment from the non-linear load-end shortening curves σ-ε of the element.

These curves are to be calculated, for the failure mechanisms of the element, from the formulae specified in [2.3]. The stress σ is selected as the lowest among the values obtained from each of the considered load-end shortening curves σ-ε.

The procedure is to be repeated for each step, until the value of the imposed curvature reaches the value χ_F, in m^{-1}, in hogging and sagging condition, obtained from the following formula:

$$\chi_F = \pm 0,003\left(\frac{M_\gamma}{EI_\gamma}\right)$$

where:

M_γ : the lesser of the values $M_{\gamma 1}$ and $M_{\gamma 2}$, in kN·m

$M_{\gamma 1}$: $10^{-3}\ R_{eH}\ Z_{AB}$

$M_{\gamma 2}$: $10^{-3}\ R_{eH}\ Z_{AD}$

If the value γ_F is not sufficient to evaluate the peaks of the curve M-γ the procedure is to be repeated until the value of the imposed curvature permits the calculation of the maximum bending moments of the curve.

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Figure 4 : Plating with knuckle point *(1/7/2016)*

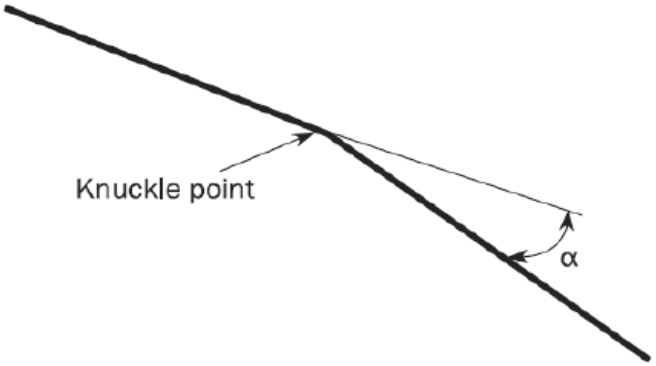
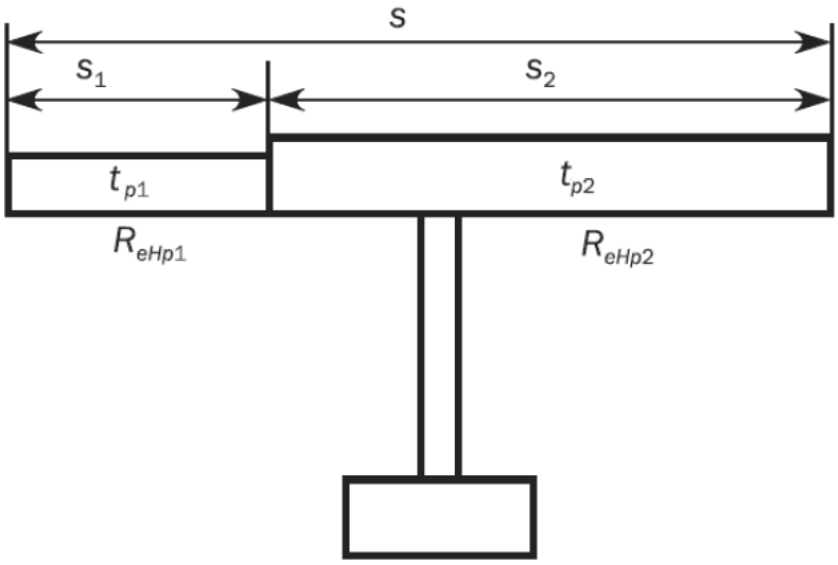


Figure 5 : Element with different thickness and yield strength *(1/7/2016)*



2.3 Load-end shortening curves

2.3.1 Stiffened plate element and stiffeners element *(1/7/2016)*

Stiffened plate element and stiffener element composing the hull girder transverse sections may collapse following one of the modes of failure specified in Tab 1.

- Where the plate members are stiffened by non-continuous longitudinal stiffeners, the stress of the element is to be obtained in accordance with [2.3.3] to [2.3.8], taking into account the non-continuous longitudinal stiffener. In calculating the total forces for checking the hull girder ultimate strength, the area of non-continuous longitudinal stiffener is to be assumed as zero.
- Where the opening is provided in the stiffened plate element, the considered area of the stiffened plate element is to be obtained by deducting the opening area from the plating in calculating the total forces for checking the hull girder ultimate strength.
- For stiffened plate element, the effective width of plate for the load shortening portion of the stress-strain curve is to be taken as full plate width, i.e. to the intersection of other plate or longitudinal stiffener - neither from the end of the hard corner element nor from the attached plating of stiffener element, if any. In calculating the total forces for checking the hull girder ultimate strength, the area of the stiffened plate element is to be taken between the hard corner element and the stiffener element or between the hard corner elements, as applicable.

2.3.2 Hard corners element *(1/7/2016)*

The relevant load-end shortening curve σ-ε is to be obtained for lengthened and shortened hard corners according to [2.3.3].

Table 1 : Modes of failure of plating panels and ordinary stiffeners

Element	Mode of failure	Curve σ-ε defined in
Lengthened transversely framed plating panel or ordinary stiffeners	Elasto-plastic collapse	[2.3.3]
Shortened ordinary stiffeners	Beam column buckling	[2.3.4]
	Torsional buckling	[2.3.5]
	Web local buckling of flanged profiles	[2.3.6]
	Web local buckling of flat bars	[2.3.7]
Shortened transversely framed plating panel	Plate buckling	[2.3.8]

2.3.3 Elasto-plastic collapse of structural elements *(1/7/2016)*

The equation describing the load-end shortening curve σ-ε for the elasto-plastic collapse of structural elements composing the hull girder transverse section is to be obtained from the following formula, valid for both positive (shortening) and negative (lengthening) strains (see Fig 6):

$$\sigma = \Phi R_{eHA}$$

where:

R_{eHA} : Equivalent minimum yield stress, in N/mm², of the considered element, obtained by the following formula:

$$R_{eHA} = \frac{10 b_{E1} t_p l_{pe} R_{EHS} + A_S l_{sE} R_{EHS}}{R_{EHS} + A_S l_{sE}}$$

Φ : Edge function:

$\Phi = -1$ for $\varepsilon < -1$

$\Phi = \varepsilon$ for $-1 < \varepsilon < 1$

$\Phi = 1$ for $\varepsilon > 1$

ε : Relative strain:

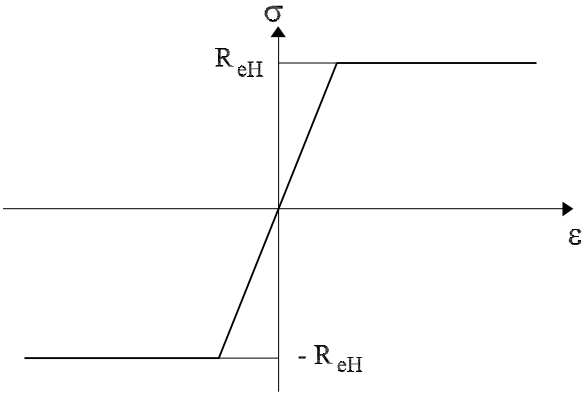
$$\varepsilon = \frac{\varepsilon_E}{\varepsilon_Y}$$

ε_E : Element strain

ε_Y : Strain inducing yield stress in the element:

$$\varepsilon_Y = \frac{R_{eHA}}{E}$$

Figure 6 : Load-end shortening curve σ-ε for elasto-plastic collapse



2.3.4 Beam column buckling *(1/7/2016)*

The positive strain portion of the average stress - average strain curve σ_{CR1}-ε based on beam column buckling of plate-stiffener combinations is described according to the following (see Fig 6).

$$\sigma_{CR1} = \Phi \sigma_{C1} \frac{A_S + 10 b_E t_P}{A_S + 10 s t_P}$$

where:

Φ : Edge function defined in [2.3.3]

σ_{C1} : Critical stress, in N/mm²:

$$\sigma_{C1} = \frac{\sigma_{E1}}{\varepsilon} \quad \text{for} \quad \sigma_{E1} \le \frac{R_{eHB}}{2}\varepsilon$$

$$\sigma_{C1} = R_{eH}\left(1 - \frac{\Phi R_{eH}\varepsilon}{4\sigma_{E1}}\right) \quad \text{for} \quad \sigma_{E1} > \frac{R_{eHB}}{2}\varepsilon$$

$$\sigma_{C1} = \frac{\sigma_{E1}}{\varepsilon} \quad \text{for} \quad \sigma_{E1} \le \frac{R_{eHB}}{2}\varepsilon$$

$$\sigma_{C1} = R_{eH}\left(1 - \frac{R_{eH}\varepsilon}{4\sigma_{E1}}\right) \quad \text{for} \quad \sigma_{E1} > \frac{R_{eHB}}{2}\varepsilon$$

where:

R_{eHB} : Equivalent minimum yield stress, in N/mm², of the considered element, obtained by the following formula:

$$R_{eHB} = \frac{10 b_{E1} t_p l_{pE} R_{EHS} + A_S l_{sE} R_{EHS}}{R_{EHS} + A_S l_{sE}}$$

l_{pE} : Distance, in mm, measured from the neutral axis of the stiffener with attached plate of width b_{E1} to the bottom of the attached plate

l_{sE} : Distance, in mm, measured from the neutral axis of the stiffener with attached plate of width b_{E1} to the top of stiffener

ε : Relative strain defined in [2.3.3]

σ_{E1} : Euler column buckling stress, in N/mm² equal to:

$$\sigma_{E1} = \pi^2 E \frac{I_E}{A_E l^2} 10^4$$

$$\sigma_{E1} = \pi^2 E \frac{I_E}{A_E l^2} 10^{-4}$$

I_E : Net moment of inertia of ordinary stiffeners, in cm^4, with attached shell plating of width b_{E1}

b_{E1} : Effective width, in m, of the attached shell plating, equal to:

$$b_{E1} = \frac{s}{\beta_E} \quad \text{for} \quad \beta_E > 1,0$$

$$b_{E1} = s \quad \text{for} \quad \beta_E \le 1,0$$

$$\beta_E = 10^3 \frac{s}{t_p}\sqrt{\frac{\varepsilon R_{eH}}{E}}$$

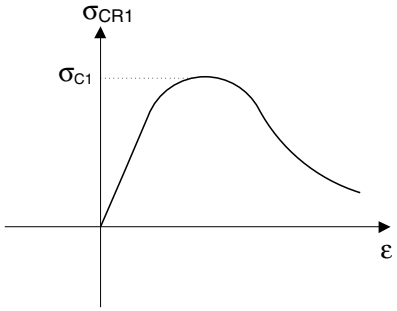
A_E : Net sectional area, in cm^2, of ordinary stiffeners with attached shell plating of width b_E

b_E : Width, in m, of the attached shell plating:

$$b_E = \left(\frac{2,25}{\beta_E} - \frac{1,25}{\beta_E^2}\right) s \quad \text{for} \quad \beta_E > 1,25$$

$$b_E = s \quad \text{for} \quad \beta_E \le 1,25$$

Figure 7 : Load-end shortening curve σ_{CR1}-ε for beam column buckling



2.3.5 Torsional buckling *(1/7/2016)*

The load-end shortening curve σ_{CR2}-ε for the flexural-torsional buckling of stiffeners composing the hull girder transverse section is to be obtained according to the following formula (see Fig 8):

$$\sigma_{CR2} = \Phi \frac{A_S \sigma_{C2} + 10 s t_P \sigma_{CP}}{A_S + 10 s t_P}$$

where:

Φ : Edge function defined in [2.3.3]

σ_{C2} : Critical stress, in N/mm^2:

$$\sigma_{C2} = \frac{\sigma_{E2}}{\varepsilon} \quad \text{for} \quad \sigma_{E2} \le \frac{R_{eH}}{2}\varepsilon$$

$$\sigma_{C2} = R_{eH}\left(1 - \frac{\Phi R_{eH}\varepsilon}{4\sigma_{E2}}\right) \quad \text{for} \quad \sigma_{E2} > \frac{R_{eH}}{2}\varepsilon$$

$$\sigma_{C2} = \frac{\sigma_{E2}}{\varepsilon} \quad \text{for} \quad \sigma_{E2} \le \frac{R_{eH}}{2}\varepsilon$$

$$\sigma_{C2} = R_{eH}\left(1 - \frac{R_{eH}\varepsilon}{4\sigma_{E2}}\right) \quad \text{for} \quad \sigma_{E2} > \frac{R_{eH}}{2}\varepsilon$$

σ_{E2} : Euler torsional buckling stress, in N/mm^2, defined in Ch 7, Sec 2, [4.3.3]

ε : Relative strain defined in [2.3.3]

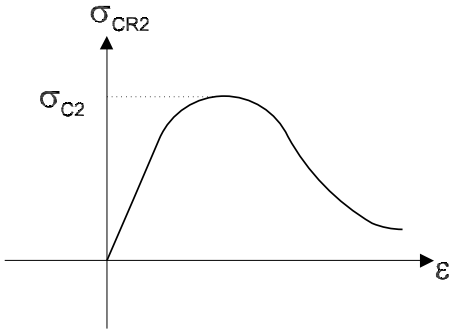
σ_{CP} : Buckling stress of the attached plating, in N/mm^2:

$$\sigma_{CP} = \left(\frac{2,25}{\beta_E} - \frac{1,25}{\beta_E^2}\right) R_{eHp} \quad \text{for} \quad \beta_E > 1,25$$

$$\sigma_{CP} = R_{eHp} \quad \text{for} \quad \beta_E \le 1,25$$

β_E : Coefficient defined in [2.3.4].

Figure 8 : Load-end shortening curve σ_{CR2}-ε for flexural-torsional buckling



2.3.6 Web local buckling of stiffeners made of flanged profiles *(1/7/2016)*

The load-end shortening curve σ_{CR3}-ε for the web local buckling of flanged stiffeners composing the hull girder transverse section is to be obtained from the following formula:

$$\sigma_{CR3} = \Phi \frac{10^3 b_E t_P + R_{eHp} + (h_{WE} t_W + b_F t_F) R_{eHS}}{10^3 s t_P + h_W t_W + b_F t_F}$$

where:

Φ : Edge function defined in [2.3.3]

b_E : Effective width, in m, of the attached shell plating, defined in [2.3.4]

h_{WE} : Effective height, in mm, of the web:

$$h_{WE} = \left(\frac{2,25}{\beta_E} - \frac{1,25}{\beta_E^2}\right) h_W \quad \text{for} \quad \beta_W > 1,25$$

$$h_{WE} = h_W \quad \text{for} \quad \beta_W \le 1,25$$

β_E : Coefficient defined in [2.3.4]

$$\beta_W = 10^3 \frac{h_W}{t_W}\sqrt{\frac{\varepsilon R_{eHS}}{E}}$$

$$\beta_W = \frac{h_W}{t_W}\sqrt{\frac{\varepsilon R_{eHS}}{E}}$$

2.3.7 Web local buckling of stiffeners made of flat bars *(1/7/2016)*

The load-end shortening curve σ_{CR4}-ε for the web local buckling of flat bar stiffeners composing the hull girder transverse section is to be obtained from the following formula (see Fig 9):

$$\sigma_{CR4} = \Phi \frac{10 s t_P \sigma_{CP} + A_S \sigma_{C4}}{A_S + 10 s t_P}$$

where:

Φ : Edge function defined in [2.3.3]

σ_{CP} : Buckling stress of the attached plating, in N/mm^2, defined in [2.3.5]

σ_{C4} : Critical stress, in N/mm^2:

$$\sigma_{C4} = \frac{\sigma_{E4}}{\varepsilon} \quad \text{for} \quad \sigma_{E4} \le \frac{R_{eHS}}{2}\varepsilon$$

$$\sigma_{C4} = R_{eHS}\left(1 - \frac{\Phi R_{eHS}\varepsilon}{4\sigma_{E4}}\right) \quad \text{for} \quad \sigma_{E4} > \frac{R_{eHS}}{2}\varepsilon$$

$$\sigma_{C4} = \frac{\sigma_{E4}}{\varepsilon} \quad \text{for} \quad \sigma_{E4} \le \frac{R_{eHS}}{2}\varepsilon$$

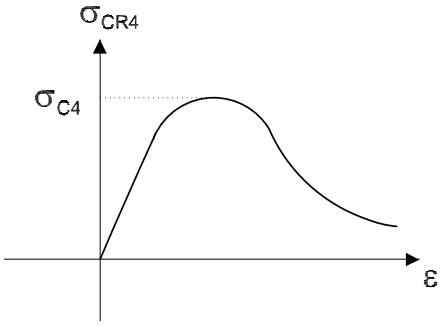
$$\sigma_{C4} = R_{eHS}\left(1 - \frac{R_{eHS}\varepsilon}{4\sigma_{E4}}\right) \quad \text{for} \quad \sigma_{E4} > \frac{R_{eHS}}{2}\varepsilon$$

σ_{E4} : Local Euler buckling stress, in N/mm^2:

$$\sigma_{E4} = 160000\left(\frac{t_W}{h_W}\right)^2$$

ε : Relative strain defined in [2.3.3].

Figure 9 : Load-end shortening curve σ_{CR4}-ε for web local buckling of flat bars



2.3.8 Plate buckling *(1/7/2016)*

The load-end shortening curve σ_{CR5}-ε for the buckling of transversely stiffened panels composing the hull girder transverse section is to be obtained from the following formula:

$$\sigma_{CR5} = \min\left\{\begin{array}{l} R_{eHp}\,\phi \\ \phi R_{eHp}\left[\frac{s}{l}\left(\frac{2{,}25}{\beta_E} - \frac{1{,}25}{\beta_E^2}\right) + 0{,}1\left(1 - \frac{s}{l}\right)\left(1 + \frac{1}{\beta_E^2}\right)^2\right] \end{array}\right.$$

where:

β_E : Coefficient defined in [2.3.4].

ϕ : Edge function defined in [2.3.3].

3 Alternative methods

3.1 Non-linear finite element analysis

3.1.1 *(1/7/2016)*

Advanced non-linear finite element analyses models may be used for the assessment of the hull girder ultimate capacity. Such models are to consider the relevant effects important to the non-linear responses.

3.1.2 *(1/7/2016)*

Particular attention is to be given to modelling the shape and size of geometrical imperfections. It is to be ensured that the shape and size of geometrical imperfections trigger the most critical failure modes.

SECTION 3 TESTING

1 General

1.1 Purpose and application

1.1.1 Purpose *(1/1/2024)*

The test procedures in this Section are to confirm the watertightness of tanks ~~and~~, watertight boundaries and the structural adequacy of tanks which form part of the watertight subdivisions of ships (see Note 1). These procedures may also be applied to verify the weathertightness of structures and shipboard outfitting. The tightness of all tanks and watertight boundaries of ships during new construction and those relevant to major conversions or major repairs (see Note 2) is to be confirmed by these test procedures prior to the delivery of the ship.

Note 1: Watertight subdivision means the transverse and longitudinal subdivisions of the ship required to satisfy the subdivision requirements of SOLAS Chapter II-1.

Note 2: Major repair means a repair affecting structural integrity.

1.1.2 Application *(1/1/2016)*

All gravity tanks (see Note 1) and other boundaries required to be watertight or weathertight are to be tested in accordance with the requirements of this Section and proven to be tight and structurally adequate as follows:

- Gravity Tanks for their tightness and structural adequacy,
- Watertight Boundaries Other Than Tank Boundaries for their watertightness, and
- Weathertight Boundaries for their weathertightness.

The testing of structures not listed in Tab 1 or Tab 2 is to be specially considered.

Note 1: Gravity tank means a tank that is subject to vapour pressure not greater than 70 kPa.

1.1.3 SOLAS Ships *(1/1/2018)*

The testing procedures of watertight compartments reported in [2.2.2] apply to ships subjected to SOLAS Convention, unless:

a) the shipyard provides documentary evidence of the shipowner's agreement to a request to the Flag Administration for an exemption from the application of SOLAS Chapter II-1, Regulation 11, or for an equivalency agreeing that the content of [2.2.3] is equivalent to SOLAS Chapter II-1, Regulation 11; and

b) the above-mentioned exemption/equivalency has been granted by the responsible Flag Administration.

1.1.4 ~~Non-~~SOLAS ~~Ships and SOLAS~~ Exempt~~ion~~/Equivalent Ships *(1/1/2024)*

The testing procedures of watertight compartments reported in [2.2.~~2~~3] apply to ~~ships not subjected to SOLAS Convention and to~~ ships subjected to SOLAS Convention for which:

a) the shipyard provides documentary evidence of the shipowner's agreement to a request to the Flag Administration for an exemption from the application of SOLAS Chapter II-1, Regulation 11, or for an equivalency agreeing that the content of [2.2.3] is equivalent to SOLAS Chapter II-1, Regulation 11; and

b) the above-mentioned exemption/equivalency has been granted by the responsible Flag Administration.

1.1.5 Non-SOLAS Ships *(1/1/2024)*

The testing procedures of watertight compartments reported in [2.2.4] apply to ships not subjected to SOLAS Convention (see SOLAS Chapter I, Regulation 1 and Regulation 3).

1.2 Definitions

1.2.1 Shop primer

Shop primer is a thin coating applied after surface preparation and prior to fabrication as a protection against corrosion during fabrication.

1.2.2 Protective coating

Protective coating is a final coating protecting the structure from corrosion.

1.2.3 Structural test *(1/7/2013)*

A structural test is a test to verify the structural adequacy of tank construction. This may be a hydrostatic test or, where the situation warrants, a hydropneumatic test.

1.2.4 Leak test *(1/1/2016)*

A leak test is a test to verify the tightness of a boundary. Unless a specific test is indicated, this may be a hydrostatic/hydropneumatic test or an air test. A hose test may be considered an acceptable form of leak test for certain boundaries, as indicated in Tab 1, Note 3.

1.2.5 Hydrostatic test (leak and structural) *(1/1/2016)*

A hydrostatic test is a test wherein a space is filled with a liquid to a specified head.

1.2.6 Hydropneumatic test (leak and structural) *(1/1/2016)*

A hydropneumatic test is a test combining a hydrostatic test and an air test, wherein a space is partially filled with liquid and pressurized with air.

1.2.7 Hose test (leak) *(1/1/2016)*

A hose test is a test to verify the tightness of a joint by a jet of water with the joint visible from the opposite side.

1.2.8 Air test (leak) *(1/1/2016)*

An air test is a test to verify the tightness by means of air pressure differential and leak indicating solution. It includes tank air test and joint air tests, such as compressed air fillet weld tests and vacuum box tests.

1.2.9 Compressed air fillet weld test (leak) *(1/1/2016)*

A compressed air fillet weld test is an air test of fillet welded tee joints wherein leak indicating solution is applied on fillet welds.

1.2.10 Vacuum box test (leak) *(1/1/2016)*

A vacuum box test is a box over a joint with leak indicating solution applied on the welds. A vacuum is created inside the box to detect any leaks.

1.2.11 Ultrasonic test (leak) *(1/1/2016)*

An ultrasonic test is a test to verify the tightness of the sealing of closing devices such as hatch covers by means of ultrasonic detection techniques.

1.2.12 Penetration test (leak) *(1/1/2016)*

A penetration test is a test to verify that no visual dye penetrant indications of potential continuous leakages exist in the boundaries of a compartment by means of low surface tension liquids (i.e. dye penetrant test).

1.2.13 Margin line

The margin line is a line drawn at least 76 mm below the upper surface of the bulkhead deck at side.

1.2.14 Sister ship

A sister ship is a ship having the same main dimensions, general arrangement, capacity plan and structural design as those of the first ship in a series.

1.2.15 Top of the overflow *(1/1/2024)*

The top of the overflow is defined as being the top of any overflow system which is used to prevent overfilling of a tank. Such system can be an overflow pipe, airpipe, intermediate tank. For gravity tanks (i.e. sewage, grey water and similar tanks, not filled with pumps) the top of the overflow is to be taken as the highest point of the filling line.

Note 1: Gauging devices are not considered equivalent to an overflow system with the exception of fuel oil overflow tanks not intended to hold fuel which have been fitted with a level alarm.

Where a tank is fitted with multiple means of preventing overfilling, the decision on which overflow system is to be used to determine the test head is to be based on the highest point to which the liquid may rise in service.

2 Test procedures

2.1 General

2.1.1 *(1/7/2013)*

Tests are to be carried out in the presence of a Surveyor at a stage sufficiently close to the completion of work with all hatches, doors, windows, etc., installed and all penetrations including pipe connections fitted, and before any ceiling and cement work is applied over the joints.

In particular, tests are to be carried out after air vents and sounding pipes have been fitted.

Specific test requirements are given in [2.4] and Tab 1. For the timing of the application of coating and the provision of safe access to joints, see [2.5], [2.6] and Tab 3.

2.2 Structural test procedures

2.2.1 Type and time of test *(1/1/2024)*

Where a structural test is specified in Tab 1 or Tab 2, a hydrostatic test in accordance with [2.4.1] will be acceptable. Where practical limitations (strength of building berth, light density of liquid, etc.) prevent the performance of a hydrostatic test, a hydropneumatic test in accordance with [2.4.2] may be accepted instead.

A hydrostatic test or hydropneumatic test for the confirmation of structural adequacy may be carried out while the vessel is afloat, provided the results of a leak test are confirmed to be satisfactory before the vessel is afloat.

Alternative equivalent tank testing procedures may be considered for tanks which are constructed from composite materials such as glass reinforced plastic (GRP) and fibre reinforced plastic (FRP) based on the recommendations of the composite manufacturer.

2.2.2 SOLAS Ships: Testing schedule for new construction or major structural conversion *(1/1/2018)*

The requirements given in the following apply to SOLAS ships, as defined in [1.1.3].

a) Tanks which are intended to hold liquids, and which form part of the watertight subdivision of the ship (see Note 1), shall be tested for tightness and structural strength as indicated in Tab 1 and Tab 2.

b) The tank boundaries are to be tested from at least one side. The tanks for structural test are to be selected so that all representative structural members are tested for the expected tension and compression.

c) The watertight boundaries of spaces other than tanks for structural testing may be exempted, provided that the water-tightness of boundaries of exempted spaces is verified by leak tests and inspections. Structural testing may not be exempted and the requirements for structural testing of tanks in a) and b) shall apply, for ballast holds, chain lockers and a representative cargo hold if intended for in-port ballasting.

d) Tanks which do not form part of the watertight subdivision of the ship (see Note 1), may be exempted from structural testing provided that the water-tightness of boundaries of exempted spaces is verified by leak tests and inspections.

Note 1: Watertight subdivision means the transverse and longitudinal subdivisions of the ship required to satisfy the subdivision requirements of SOLAS Chapter II-1.

2.2.3 ~~Non-~~SOLAS ~~Ships and SOLAS Exemption~~Exempt/Equivalent Ships: Testing schedule for new construction or major structural conversion *(1/1/2024)*

Testing procedures are to be carried out in accordance with ~~T~~the requirements ~~given~~ in [2.2.2] in association with the following alternative procedures for [2.2.2] which apply to ~~Non-SOLAS ships and to~~ SOLAS exemption/equivalent ships, as defined in [1.1.4].

a) The tank boundaries are to be tested from at least one side. The tanks for structural testing are to be selected so that all representative structural members are tested for the expected tension and compression.

b) Structural tests are to be carried out on at least one tank of a group of tanks having structural similarity (i.e. same design conditions, alike structural configurations with only minor localised differences determined to be acceptable by the attending Surveyor) on each vessel provided all other tanks are tested for leaks by an air test. The acceptance of leak testing using an air test instead of a structural test does not apply to cargo space boundaries adjacent to other compartments in tankers and combination carriers or to the boundaries of tanks for segregated cargoes or pollutant cargoes in other types of ships.

c) Additional tanks may require structural testing if found necessary after the structural testing of the first tank.

d) For tanks which are less than 2 m^3 in volume, structural testing may be replaced by leak testing.

e) Where the structural adequacy of the tanks and spaces of a vessel was verified by the structural testing required ~~in~~ by either [2.2.2] or b)~~Tab 1~~, subsequent vessels in the series (i.e. sister ships built from the same plans at the same shipyard) may be exempted from structural testing of tanks, provided that:

1) Watertightness of boundaries of all tanks and spaces~~is~~ are verified by leak tests and thorough inspections are carried out.

2) Structural testing is carried out on at least one tank or space of each type among all tanks/spaces of each sister vessel.

3) Additional tanks and spaces may require structural testing if found necessary after the structural testing of the first tank or if deemed necessary by the attending Surveyor.

For cargo space boundaries adjacent to other compartments in tankers and combination carriers or boundaries of tanks for segregated cargoes or pollutant cargoes in other types of ships, ~~the provisions of b) are to be applied in lieu of d) 2)~~structural tests are to be carried out for at least one tank of a group of tanks having structural similarity (i.e. same design conditions, alike structural configurations with only minor localised differences determined to be acceptable by the attending Surveyor) on each vessel provided all other tanks are tested for leaks by an air test.

f) Sister ships built (i.e. keel laid) two years or more after the delivery of the last ship of the series, may be tested in accordance with c~~d~~) at the discretion of the Society, provided that:

1) general workmanship has been maintained (i.e. there has been no discontinuity of shipbuilding or significant changes in the construction methodology or technology at the yard, shipyard personnel are appropriately qualified and demonstrate an adequate level of workmanship as determined by the Society) and,

2) an enhanced NDT plan is implemented and evaluated by the Society for the tanks not subject to structural tests. Shipbuilding quality standards for the hull structure during new construction are to be reviewed and agreed during the kick-off meeting. ~~Structural fabrication is to be carried out in accordance with IACS Recommendation 47, "Shipbuilding and Repair Quality Standard", or a recognised fabrication standard which has been accepted by the Society prior to the commencement of fabrication/construction.~~ The work is to be carried out in accordance with the requirements and under survey of the Society.

2.2.4 Non-SOLAS Ships: Testing schedule for new construction or major structural conversion *(1/1/2024)*

Testing procedures are to be carried out in accordance with the requirements in [2.2.2] in association with the following alternative procedures for [2.2.2] which apply to Non-SOLAS ships, as defined in [1.1.5].

a) The tank boundaries are to be tested from at least one side. The tanks for structural test are to be selected so that all representative structural members are tested for the expected tension and compression.

b) The requirements given in Tab 1 to structurally test tanks to 2,4 metres above the top of the tank do not apply. Instead, the minimum test pressure for structural testing is to be taken as 0,3D + 0,76 metres above the top of the tank where the top of the tank is the deck forming the top of the tank, excluding any hatchways and D is the depth of the ship. The minimum test pressure need not be taken greater than 2,4 metres above the top of the tank.

c) Structural tests are to be carried out for at least one tank of a group of tanks having structural similarity (i.e. same design conditions, alike structural configurations with only minor localised differences determined to be acceptable by the attending Surveyor) on each vessel provided all other tanks are tested for leaks by an air test. The acceptance of leak testing using an air test instead of a structural test does not apply to cargo space boundaries adjacent to other compartments in tankers and combination carriers or the boundaries of tanks for segregated cargoes or pollutant cargoes in other types of ships.

d) Additional tanks may require structural testing if found necessary after the structural testing of the first tank.

e) For tanks which are less than 2 m^3 in volume, structural testing may be replaced by leak testing.

f) Where the structural adequacy of the tanks and spaces of a vessel was verified by the structural testing required by either [2.2.2] or c), subsequent vessels in the series (i.e. sister ships built from the same plans at the same shipyard) may be exempted from structural testing of tanks, provided that:

1) Watertightness of boundaries of all tanks and spaces are verified by leak tests and thorough inspections are carried out.

2) Structural testing is carried out on at least one tank or space of each type among all tanks/spaces of each sister vessel.

3) Additional tanks and spaces may require structural testing if found necessary after the structural testing of the first tank or if deemed necessary by the attending Surveyor.

For cargo space boundaries adjacent to other compartments in tankers and combination carriers or boundaries of tanks for segregated cargoes or pollutant cargoes in other types of ships, structural tests are to be carried out for at least one tank of a group of tanks having structural similarity (i.e. same design conditions, alike structural configurations with only minor localised differences determined to be acceptable by the attending Surveyor) on each vessel provided all other tanks are tested for leaks by an air test.

g) Sister ships built (i.e. keel laid) two years or more after the delivery of the last ship of the series, may be tested in accordance with f) at the discretion of the Society, provided that:

1) general workmanship has been maintained (i.e. there has been no discontinuity of shipbuilding or significant changes in the construction methodology or technology at the yard, shipyard personnel are appropriately qualified and demonstrate an adequate level of workmanship as determined by the Society) and,

2) an enhanced NDT plan is implemented and evaluated by the Society for the tanks not subject to structural tests. Shipbuilding quality standards for the hull structure during new construction are to be reviewed and agreed during the kick-off meeting. The work is to be carried out in accordance with the requirements and under survey of the Society.

2.3 Leak test procedures

2.3.1 *(1/1/2018)*

For the leak test specified in Tab 1, tank air tests, compressed air fillet weld test, vacuum box test in accordance with [2.4.4] to [2.4.6], or their combination will be acceptable. Hydrostatic or hydropneumatic tests may also be accepted as leak tests provided that [2.5], [2.6] and [2.7] are complied with. Hose tests will also be acceptable for such locations as specified in Tab 1, Note 3, in accordance with [2.4.3].

The application of the leak test for each type of welded joint is specified in Tab 3.

Air tests of joints may be carried out in the block stage provided that all work on the block that may affect the tightness of a joint is completed before the test. See also [2.5.1] for the application of final coatings and [2.6] for the safe access to joints and the summary in Tab 3.

2.4 Test methods

2.4.1 Hydrostatic test *(1/1/2024)*

Unless another liquid is approved, hydrostatic tests are to consist of filling the space with fresh water or sea water, whichever is appropriate for testing, to the level specified in Tab 1 or Tab 2. See also [2.7].

In cases where a tank is designed for cargo densities greater than sea water and testing is with fresh water or sea water, the testing pressure height is to simulate the actual loading for those greater cargo densities as far as practicable, but the test pressure is not to exceed the maximum design internal pressure at the top of tank.

All external surfaces of the tested space are to be examined for structural distortion, bulging and buckling, other related damage and leaks.

2.4.2 Hydropneumatic test *(1/1/2018)*

Hydropneumatic tests, where approved, are to be such that the test condition in conjunction with the approved liquid level and supplemental air pressure will simulate the actual loading as far as practicable. The requirements and recommendations for tank air tests in [2.4.4] will also apply to hydropneumatic tests. See also [2.7].

All external surfaces of the tested space are to be examined for structural distortion, bulging and buckling, other related damage and leaks.

2.4.3 Hose test *(1/1/2016)*

Hose tests are to be carried out with the pressure in the hose nozzle maintained at least at $2 \cdot 10^5$ Pa during the test. The nozzle is to have a minimum inside diameter of 12 mm and be at a perpendicular distance from the joint not exceeding 1,5 m.

The water jet is to impinge directly upon the weld.

Where a hose test is not practical because of possible damage to machinery, electrical equipment insulation or outfitting items, it may be replaced by a careful visual examination of welded connections, supported where necessary by means such as a dye penetrant test or ultrasonic leak test or the equivalent.

2.4.4 Tank air test *(1/1/2018)*

All boundary welds, erection joints and penetrations, including pipe connections, are to be examined in accordance with approved procedure and under a stabilized pressure differential above atmospheric pressure not less than $0{,}15 \cdot 10^5$ Pa, with a leak indicating solution such as soapy water/detergent or a proprietary brand applied.

A U-tube with a sufficient height to hold a head of water corresponding to the required test pressure is to be arranged. The cross sectional of the U-tube is not to be less than that of the pipe supplying air to the tank.

Arrangements involving the use of two calibrated pressure gauges to verify the required test pressure may be accepted taking into account the provisions in F5.1 and F7.4 of IACS

Table 1 : Test Requirements for tanks and boundaries *(1/1/2024)*

Item	Tank or boundary to be tested	Test type	Test head or pressure	Remarks
1	Double bottom tanks **(4)**	Leak and structural **(1)**	The greater of: - top of the overflow **(10)**, - to 2,4m above top of tank **(2)**, or - to bulkhead deck	
2	Double bottom voids **(5)**	Leak	See [2.4.4] through [2.4.6], as applicable	Including pump room double bottom and bunker tank protection double hull required by MARPOL Annex I
3	Double side tanks	Leak and structural **(1)**	The greater of - top of the overflow **(10)**, - to 2,4m above top of tank **(2)**, or - to bulkhead deck	
4	Double side voids	Leak	See [2.4.4] through [2.4.6], as applicable	
5	Deep tanks other than those listed elsewhere in this table	Leak and structural **(1)**	The greater of - top of the overflow **(10)**, or - to 2.4m above top of tank **(2)**	
6	Cargo oil tanks	Leak and structural **(1)**	The greater of - top of the overflow **(10)**, - to 2,4m above top of tank **(2)**, or - to top of tank **(2)** plus ~~setting of any~~ the design vapour pressure ~~relief valve~~	
7	Ballast hold of bulk carriers	Leak and structural **(1)**	Top of cargo hatch coaming	
8	Peak tanks	Leak and structural **(1)**	The greater of - top of the overflow **(10)**, or - to 2,4m above top of tank **(2)**	After peak to be tested after installation of stern tube

(1) Refer to [2.2.2] ~~or~~, [2.2.3] or [2.2.4] as the case may be.

(2) The top of a tank is the deck forming the top of the tank, excluding any hatchways.

(3) Hose Test may also be considered as a test medium. See [1.2.4].

(4) Including tanks arranged in accordance with the provisions of SOLAS regulation II-1/9.4.

(5) Including duct keels and dry compartments arranged in accordance with the provisions of SOLAS regulation II-1/11.2 and II-1/9.4 respectively, and/or oil fuel tank protection and pump room bottom protection arranged in accordance with the provisions of MARPOL Annex I, Chapter 3, Part A regulation 12A and Chapter 4, Part A, regulation 22 respectively.

(6) Where watertightness of a watertight doors has not been confirmed by prototype test, testing by filling watertight spaces with water is to be carried out. See SOLAS regulation II-1/16.2 and MSC.1/Circ.1~~1~~576~~2~~2/Rev.1.

(7) As an alternative to the hose test, other testing methods listed in [2.4.7] through [2.4.9] may be applicable subject to the adequacy of such testing methods being verified. See SOLAS regulation II-1/11.1. For watertight bulkheads (item 11.a), alternatives to hose testing may only be used where a hose test is not practicable.

(8) A "Leak and structural test", see [2.2.3], or [2.2.4] is to be carried out for a representative cargo hold if intended for in-port ballasting. The filling level requirement for testing cargo holds intended for in-port ballasting is to be the maximum loading that will occur in-port as indicated in the loading manual.

(9) Where L.O. sump tanks and other similar spaces under main engines intended to hold liquid form part of the watertight subdivision of the ship, they are to be tested as per the requirements of Item 5, Deep tanks other than those listed elsewhere in this table.

(10) Refer to [1.2.15].

Item	Tank or boundary to be tested	Test type	Test head or pressure	Remarks
20	Ballast ducts	Leak and structural **(1)**	The greater of - ballast pump maximum pressure, or - setting of any pressure relief valve	
21	Fuel Oil Tanks	Leak and structural **(1)**	The greater of - top of the overflow **(10)**, - to 2.4m above top of tank **(2)**, or - to top of tank **(2)** plus ~~setting of any~~ the design vapour pressure~~ relief valve~~, or - to bulkhead deck	
22	Fuel oil overflow tanks not intended to hold fuel	Leak and structural **(1)**	The greater of - top of the overflow **(10)**, - to 2.4m above top of tank **(2)**, or - to bulkhead deck	

(1) Refer to [2.2.2]~~ or~~, [2.2.3] or [2.2.4] as the case may be.

(2) The top of a tank is the deck forming the top of the tank, excluding any hatchways.

(3) Hose Test may also be considered as a test medium. See [1.2.4].

(4) Including tanks arranged in accordance with the provisions of SOLAS regulation II-1/9.4.

(5) Including duct keels and dry compartments arranged in accordance with the provisions of SOLAS regulation II-1/11.2 and II-1/9.4 respectively, and/or oil fuel tank protection and pump room bottom protection arranged in accordance with the provisions of MARPOL Annex I, Chapter 3, Part A regulation 12A and Chapter 4, Part A, regulation 22 respectively.

(6) Where watertightness of a watertight doors has not been confirmed by prototype test, testing by filling watertight spaces with water is to be carried out. See SOLAS regulation II-1/16.2 and MSC.1/Circ.1~~1~~57~~6~~2/Rev.1.

(7) As an alternative to the hose test, other testing methods listed in [2.4.7] through [2.4.9] may be applicable subject to the adequacy of such testing methods being verified. See SOLAS regulation II-1/11.1. For watertight bulkheads (item 11.a), alternatives to hose testing may only be used where a hose test is not practicable.

(8) A "Leak and structural test", see [2.2.3], or [2.2.4] is to be carried out for a representative cargo hold if intended for in-port ballasting. The filling level requirement for testing cargo holds intended for in-port ballasting is to be the maximum loading that will occur in-port as indicated in the loading manual.

(9) Where L.O. sump tanks and other similar spaces under main engines intended to hold liquid form part of the watertight subdivision of the ship, they are to be tested as per the requirements of Item 5, Deep tanks other than those listed elsewhere in this table.

(10) Refer to [1.2.15].

Table 2 : Additional test requirements for special service ships/tanks *(1/1/2024)*

	Type of ship/tank	Structures to be tested	Type of test	Test head or pressure	Remarks
1	Liquefied gas carrier	Integral tanks	Leak and structural	The greater of - to 2,4m above top of tank **(2)**, or - to top of tank **(2)** plus ~~setting of any~~ the design vapour~~pressure relief valve~~ See also Pt E, Ch 9, Sec 4, [13.1]	Where a cargo tank is designed for the carriage of cargoes with specific gravities greater than 1,0, ~~an appropriate additional head is to be considered~~see [2.4.1]
		Hull structure supporting membrane or semi-membrane tanks		The greater of - to 2,4m above top of tank **(2)**, or - to top of tank **(2)** plus ~~setting of any~~ the design vapour~~pressure relief valve~~ See also Pt E, Ch 9, Sec 4, [13.3]	Where a cargo tank is designed for the carriage of cargoes with specific gravities greater than 1,0, ~~an appropriate additional head is to be considered~~see [2.4.1]
		Independent tanks type A		See Pt E, Ch 9, Sec 4, [13.4]	
		Independent tanks type B		See Pt E, Ch 9, Sec 4, [13.4]	
		Independent tanks type C		See Pt E, Ch 9, Sec 4, [13.4]	
2	Edible liquid tanks	Independent tanks	Leak and structural **(1)**	The greater of - top of the overflow **(3)**, or - to 0,9m above top of tank **(2)**	
3	Chemical carriers	Integral or independent cargo tanks	Leak and structural **(1)**	The greater of - to 2,4m above top of tank **(2)**, or - to top of tank **(2)** plus ~~setting of any~~ the design vapour~~pressure relief valve~~	Where a cargo tank is designed for the carriage of cargoes with specific gravities greater than 1,0, ~~an appropriate additional head is to be considered~~see [2.4.1]

(1) Refer to [2.2.2] ~~or~~, [2.2.3] or [2.2.4], as the case may be

(2) Top of tank is deck forming the top of the tank excluding any hatchways.

(3) Refer to [1.2.15].

SECTION 2 DIESEL ENGINES

1 General

1.1 Application

1.1.1 *(1/7/2019)*

Diesel engines listed below are to be designed, constructed, installed, tested and certified in accordance with the requirements of this Section, under the supervision and to the satisfaction of the Society's Surveyors:

a) main propulsion engines

b) engines driving electrical generators and other auxiliaries essential for safety and navigation and cargo pumps in tankers, when they develop a power of 110 kW and over.

All other engines are to be designed and constructed according to sound marine practice, with the equipment required in [4.3.4], [4.5.2], [4.7.2] [4.7.3], [4.7.5] and [4.7.8] and delivered with the relevant works' certificate (see Pt D, Ch 1, Sec 1, [4.2.3]).

Additional requirements for control and safety systems for dual fuel engines supplied with high pressure methane gas are given in App 2.

Additional requirements for trunk piston engines supplied with low pressure natural gas are given in App 12.

In addition to the requirements of this Section, those given in Sec 1 apply.

1.2 Type approval certificate

1.2.1 *(1/7/2016)*

For each type of engine that is required to be certified, a type approval certificate is to be obtained by the engine designer.

The type approval process consists of:

- drawing and specification approval,
- conformity of production,
- approval of type testing programme,
- type testing of engines,
- review of the obtained type testing results,
- evaluation of the manufacturing arrangements,
- issue of a type approval certificate upon satisfactorily meeting the Rule requirements.

1.3 Engine certificate

1.3.1 *(1/7/2016)*

Each diesel engine manufactured for a shipboard application per [1.1.1] is to have an engine certificate:

The certification process consists of:

- the engine builder/licensee obtaining design approval of the engine application specific documents, if any, by submitting a comparison list of the production drawings to the previously approved engine design drawings referenced in [1.2.1]
- forwarding the relevant production drawings and comparison list for the use of the Surveyors at the manufacturing plant and shipyard if necessary
- engine's components testing and engine works trials
- the issuance of an engine certificate upon satisfactorily meeting the Rule requirements.

1.4 Documentation

1.4.1 Document flow for obtaining a type approval certificate *(1/7/2016)*

a) For the initial engine type, the engine designer is to submit to the Society the documentation in accordance with requirements in Tab 1 and Tab 2.

b) Upon review and approval of the submitted documentation (evidence of approval), it will be returned to the engine designer.

c) The engine designer arranges for a Surveyor to attend an engine type test

d) Upon satisfactory testing and examination of relevant reports, the Society issues a type approval certificate.

1.4.2 Document flow for engine certificate *(1/7/2016)*

a) The engine type must have a type approval certificate. For the first engine of a type, process and the engine certification process (ECP) may be performed simultaneously.

b) Engines to be installed in specific applications may require the engine designer/licensor to modify the design or performance requirements. The modified drawings are forwarded by the engine designer to the engine builder/licensee to develop production documentation for use in the engine manufacture in accordance with Tab 3.

c) The engine builder/licensee develops a comparison list of the production documentation to the documentation listed in Tab 1 and Tab 2. An example comparison list is provided in App 10. If there are differences in the technical content on the licensee's production drawings/documents compared to the corresponding licensor's drawings, the licensee must obtain agreement to such differences from the designer using the template in App 11.

If the designer agreement is not confirmed, the engine is to be regarded as a different engine type and is to be

No.	Item
28	Counterweights (if not integral with crankshaft), including fastening
29	Connecting rod with cap
30	Crosshead
31	Piston rod
32	Piston, assembly **(7)**
33	Piston head
34	Camshaft drive, assembly **(7)**
35	Flywheel
36	Arrangement of foundation (for main engines only)
37	Fuel oil injection pump
38	Shielding and insulation of exhaust pipes and other parts of high temperature which may be impinged as a result of a fuel system failure, assembly
39	Construction and arrangement of dampers
	For electronically controlled engines, assembly drawings or arrangements of:
40	• Control valves
41	• High-pressure pumps
42	• Drive for high pressure pumps
43	• Valve bodies, if applicable
44	Operation and service manuals **(8)**
45	Test program resulting from FMEA (for engine control system) **(9)**
46	Production specifications for castings and welding (sequence)
47	Type approval certification for environmental tests, control components **(10)**
48	Quality requirements for engine production

(1) For comparison with Society requirements for material, NDT and pressure testing as applicable.
(2) For approval of materials and weld procedure specifications. The weld procedure specification is to include details of pre and post weld heat treatment, weld consumables and fit-up conditions.
(3) Details of the system so far as supplied by the engine manufacturer such as: main dimensions, operating media and maximum working pressures.
(4) All engines.
(5) The documentation to contain specifications for pressures, pipe dimensions and materials.
(6) Only for engines of a cylinder diameter of 200 mm or more or a crankcase volume of 0.6 m^3 or more.
(7) Including identification (e.g. drawing number) of components.
(8) Operation and service manuals are to contain maintenance requirements (servicing and repair) including details of any special tools and gauges that are to be used with their fitting/settings together with any test requirements on completion of maintenance.
(9) Required for engines that rely on hydraulic, pneumatic or electronic control of fuel injection and/or valves.
(10) Documents modified for a specific application are to be submitted to the Classification Society for information or approval, as applicable. See [3.2], App 9 and App 10.

4 Design and construction

4.1 Materials and welding

4.1.1 Crankshaft materials *(1/7/2016)*

In general, crankshafts are to be of forged steel having a tensile strength not less than 400 N/mm^2 and not greater than 1000 N/mm^2.

The use of forged steels of higher tensile strength is subject to special consideration by the Society in each case.

The Society, at its discretion and subject to special conditions (such as restrictions in ship navigation), may accept crankshafts made of cast carbon steel, cast alloyed steel or spheroidal or nodular graphite cast iron of appropriate quality and manufactured by a suitable procedure having a tensile strength as follows:

4.7 Control and monitoring

4.7.1 General *(1/7/2016)*

In addition to those of this item [4.7], the general requirements given in Chapter 3 apply.

In the case of ships with automation notations, the requirements in Part F, Chapter 3 also apply.

4.7.2 Alarm *(1/7/2016)*

The lubricating oil system of diesel engines with a power equal to or in excess of 37 kW is to be fitted with alarms to give audible and visual warning in the event of an appreciable reduction in pressure of the lubricating oil supply.

4.7.3 Governors of main and auxiliary engines *(1/7/2016)*

Each engine, except the auxiliary engines for driving electric generators for which [4.7.5] applies, is to be fitted with a speed governor so adjusted that the engine does not exceed the rated speed by more than 15%.

4.7.4 Overspeed protective devices of main and auxiliary engines *(1/7/2016)*

In addition to the speed governor, each

- main propulsion engine having a rated power of 220kW and above, which can be declutched or which drives a controllable pitch propeller, and
- auxiliary engine having a rated power of 220kW and above, except those for driving electric generators, for which [4.7.6] applies

is to be fitted with a separate overspeed protective device so adjusted that the engine cannot exceed the rated speed n by more than 20%; arrangements are to be made to test the overspeed protective device.

Equivalent arrangements may be accepted subject to special consideration by the Society in each case.

The overspeed protective device, including its driving mechanism or speed sensor, is to be independent of the governor.

4.7.5 Governors for auxiliary engines driving electric generators *(1/1/2020)*

a) Auxiliary engines intended for driving electric generators are to be fitted with a speed governor which prevents transient frequency variations in the electrical network in excess of ±10% of the rated frequency with a recovery time to steady state conditions not exceeding 5 seconds, when the maximum electrical step load is switched on or off.

When a step load equivalent to the rated output of a generator is switched off, a transient speed variation in excess of 10% of the rated speed may be acceptable, provided this does not cause the intervention of the overspeed device as required by [4.7.4].

b) At all loads between no load and rated power, the permanent speed variation is not to be more than 5% of the rated speed.

c) Prime movers are to be selected in such a way that they meet the load demand within the ship's mains and, when running at no load, can satisfy the requirement in item a) above if suddenly loaded to 50% of the rated power of the generator, followed by the remaining 50% after an interval sufficient to restore speed to steady state. Steady state conditions (see Note 1) are to be achieved in not more than 5 s.

Note 1: Steady state conditions are those at which the envelope of speed variation does not exceed ±1% of the declared speed at the new power.

d) Application of the electrical load in more than 2 load steps can only be allowed if the conditions within the ship's mains permit the use of those auxiliary engines which can only be loaded in more than 2 load steps (see Fig 1 on 4-stroke diesel engines expected maximum possible sudden power increase) and provided that this is already allowed for in the designing stage.

This is to be verified in the form of system specifications to be approved and to be demonstrated at ship's trials. In this case, due consideration is to be given to the power required for the electrical equipment to be automatically switched on after blackout and to the sequence in which it is connected.

This also applies to generators to be operated in parallel and where the power is to be transferred from one generator to another, in the event that any one generator is to be switched off.

e) Emergency generator sets must satisfy the governor conditions as per items a) and b), even when:

1) their total consumer load is applied suddenly, or

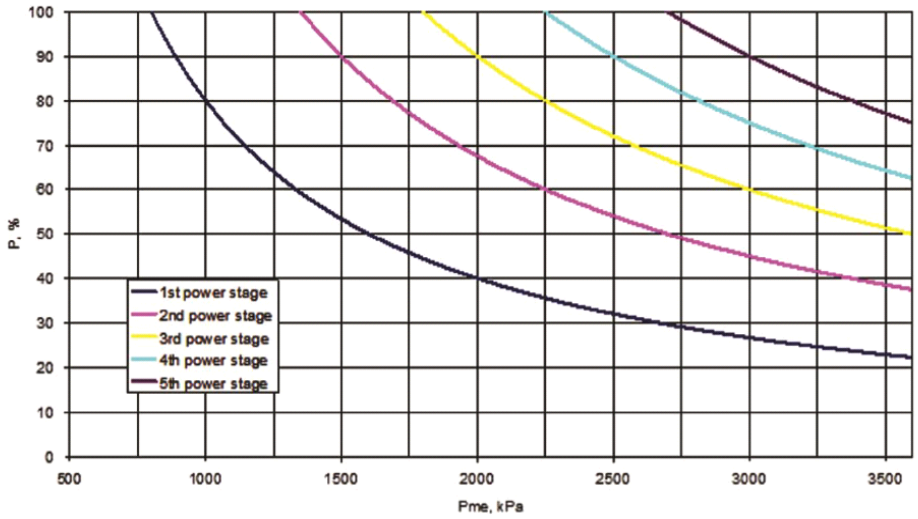
2) their total consumer load is applied in steps, provided that:

- the total load is supplied within 45 seconds of power failure on the main switchboard, and
- the maximum step load is declared and demonstrated, and
- the power distribution system is designed such that the declared maximum step loading is not exceeded, and
- compliance of time delays and loading sequence with the above is demonstrated at ship's trials.

f) For alternating current generating sets operating in parallel, the governing characteristics of the prime movers are to be such that, within the limits of 20% and 100% total load, the load on any generating set will not normally differ from its proportionate share of the total load by more than 15% of the rated power in kW of the largest machine or 25% of the rated power in kW of the individual machine in question, whichever is the lesser.

For alternating current generating sets intended to operate in parallel, facilities are to be provided to adjust the governor sufficiently finely to permit an adjustment of load not exceeding 5% of the rated load at normal frequency.

Figure 1 : Reference values for maximum possible sudden power increases as a function of brake mean effective pressure, Pme, at declared power (four-stroke diesel engines) *(1/1/2020)*



Pme: declared power mean effective pressure

P : power increase referred to declared power at site conditions

1 : first power stage - 2 : second power stage - 3 : third power stage - 4 : fourth power stage - 5 : fifth power stage

4.7.6 Overspeed protective devices of auxiliary engines driving electric generators *(1/7/2016)*

In addition to the speed governor, auxiliary engines of rated power equal to or greater than 220 kW driving electric generators are to be fitted with a separate overspeed protective device, with a means for manual tripping, adjusted so as to prevent the rated speed from being exceeded by more than 15%.

This device is to automatically shut down the engine.

4.7.7 Use of electronic governors *(1/1/2017)*

a) Type approval

Electronic governors and their actuators are to be type approved by the Society, according to Ch 3, Sec 6.

b) Electronic governors for main propulsion engines

If an electronic governor is fitted to ensure continuous speed control or resumption of control after a fault, an additional separate governor is to be provided unless the engine has a manually operated fuel admission control system suitable for its control.

A fault in the governor system is not to lead to sudden major changes in propulsion power or direction of propeller rotation.

Alarms are to be fitted to indicate faults in the governor system.

The acceptance of electronic governors not in compliance with the above requirements will be considered by the Society on a case by case basis, when fitted on ships with two or more main propulsion engines.

c) Electronic governors for auxiliary engines driving electric generators

In the event of a fault in the electronic governor system the fuel admission is to be set to "zero".

Alarms are to be fitted to indicate faults in the governor system.

d) The acceptance of electronic governors fitted on engines driving emergency generators will be considered by the Society on a case by case basis, anyway, a back-up pre-programmed governor is to be provided for immediate replacement in case of failure of the governor in use; if practicable, the backup governor is to be in place, fixed to the engine in a position near to the governor in use, and arranged so that the exchange is quick, easy and error-free; special consideration is to be given to the governor power supply.

4.7.8 Alarms and safeguards for emergency ~~diesel~~reciprocating I.C. engines *(1/1/2024)*

a) These requirements apply to ~~diesel~~reciprocating I.C. engines, which use distillate marine fuels covered by ISO 8217:2017, required to be immediately available in an emergency (i.e. emergency generating set engine, emergency fire pump engine, etc.) and capable of being controlled remotely or automatically operated.

b) Information demonstrating compliance with these requirements is to be submitted to the Society. The information is to include instructions to test the alarm and safety systems.

c) The alarms and safeguards are to be fitted in accordance with Tab 6. It is the responsibility of the Manufacturer to set the alarms and safeguards so that they activate when the controlled parameter deviates from normal values but before reaching hazardous conditions.

d) The safety and alarm systems are to be designed to 'fail safe'. The characteristics of the 'fail safe' operation are to be evaluated on the basis not only of the system and

its associated machinery, but also the complete installation, as well as the ship.

e) Regardless of the engine output, if shutdowns additional to those specified in Tab 6, except for the overspeed shutdown, are provided, they are to be automatically overridden when the engine is in automatic or remote control mode during navigation.

f) The alarm system is to function in accordance with Part F, Chapter 3 with the additional requirement that grouped alarms are to be arranged on the bridge.

g) In addition to the fuel oil control from outside the space, a local means of engine shutdown is to be provided.

h) Local indications of at least those parameters listed in are Tab 6 to be provided within the same space as the ~~diesel~~reciprocating I.C. engines and are to remain operational in the event of failure of the alarm and safety systems.

4.7.9 Summary tables *(1/7/2021)*

Diesel engines are to be equipped with monitoring equipment as detailed in Tab 4 and Tab 5, for main propulsion and auxiliary services, respectively.

For ships classed for restricted navigation, the acceptance of a reduction in the monitoring equipment required in Tab 4 and Tab 5 may be considered.

The alarms are to be visual and audible.

The indicators are to be fitted at a normally attended position (on the engine or at the local control station).

It is the responsibility of the Manufacturer to set the alarms and safeguards so that they activate when the controlled parameter deviates from normal values but before reaching hazardous conditions.

In the case of diesel engines required to be immediately available in an emergency and capable of being controlled remotely or automatically operated, Tab 6 applies.

Table 5 : Monitoring of diesel engines used for auxiliary services *(1/7/2021)*

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				
			Engine			Auxiliary	
Identification of system parameter	Alarm	Indication	Slow-down	Shut-down	Control	Stand by Start	Stop
Fuel oil viscosity or temperature before injection **(2)**		local					
Fuel oil pressure **(2)**		local					
Fuel oil leakage from pressure pipes	H						
Lubricating oil pressure	L	local		X **(1)**			
Pressure or flow of cooling water, if not connected to main system	L	local					
Temperature of cooling water or cooling air		local					
Engine speed **(4)**		local					
	H			X **(3)**			
Fault in the electronic governor system	X						

(1) Not acceptable to emergency generator set
(2) Where heavy fuel is used
(3) Only requested for diesel engines having rating of 220 kW and above
(4) To ensure independency of safety functions from control and monitoring functions, a separate sensor is to be installed for each row of the table.

Table 6 : Monitoring of ~~diesel~~reciprocating I.C. engines required to be immediately available in an emergency and capable of being controlled remotely or automatically operated *(1/1/2024)*

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				
			Engine			Auxiliary	
Identification of system parameter	Alarm activation	Indication	Slow-down	Shut-down with alarm	Control	Stand by Start	Stop
Fuel oil leakage from high pressure pipes (fuel injection pipes and common rails)	~~H~~X						
Lubricating oil pressure	L	local					
Lubricating oil temperature **(1)**	H	local					
Pressure or flow of cooling water **(1)**	L	local					
Activation of ~~O~~oil mist detection arrangements (or activation of the temperature monitoring systems or equivalent devices of:~~concentration in crankcase **(2)**~~ • the engine main and crank bearing oil outlet; or • the engine main and crank bearing) **(2)**	~~H~~X	local					
Temperature of cooling water or cooling air	H	local					
Engine Overspeed activated **(1)**, **(3)**		local					
	~~H **(1)**~~			X ~~**(1)**~~			

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				
			Engine			Auxiliary	
Identification of system parameter	Alarm activation	Indication	Slow-down	Shut-down with alarm	Control	Stand by Start	Stop
Fault in the electronic governor system	X						

(1) Requested only for ~~diesel~~ engines having a power of or more than ~~rating of~~ 220 kW ~~and above~~.

(2) Requested only for ~~diesel~~ engines having a power of or more than ~~rating of~~ 2250 kW ~~and above~~ or cylinder bore of 300 mm and above

(3) To ensure independency of safety functions from control and monitoring functions, a separate sensor is to be installed for each row of the table.

...OMISSIS...

SECTION 10 PIPING SYSTEMS

1 General

1.1 Application

1.1.1

a) General requirements applying to all piping systems are contained in:

- [2] for their design and construction
- [3] for the welding of steel pipes
- [4] for the bending of pipes
- [5] for their arrangement and installation
- [21] for their certification, inspection and testing.

b) Specific requirements for ship piping systems and machinery piping systems are given in Articles [6] to [19].

1.2 Documentation to be submitted

1.2.1 Documents

The documents listed in Tab 1 are to be submitted.

1.2.2 Additional information

The information listed in Tab 2 is also to be submitted.

Table 1 : Documents to be submitted *(1/7/2006)*

No.	I/A **(1)**	Document **(2)**
1	A	Drawing showing the arrangement of the sea chests and ship side valves
2	A	Diagram of the bilge and ballast systems (in and outside machinery spaces)
3	A	Specification of the central priming system intended for bilge pumps, when provided
4	A	Diagram of the scuppers and sanitary discharge systems
5	A	Diagram of the air, sounding and overflow systems
6	A	Diagram of cooling systems (sea water and fresh water)
7	A	Diagram of fuel oil system
8	A	Drawings of the fuel oil tanks not forming part of the ship's structure
9	A	Diagram of the lubricating oil system
10	A	Diagram of the thermal oil system
11	A	Diagram of the hydraulic systems intended for essential services or located in machinery spaces
12	A	Diagram of steam system, including safety valve exhaust and drain pipes
13	A I	For high temperature steam pipes: • stress calculation note • drawing showing the actual arrangement of the piping in three dimensions
14	A	Diagram of the boiler feed water and condensate system
15	A	Diagram of the compressed air system
16	A	Diagram of the hydraulic and pneumatic remote control systems
17	A	Diagram of the remote level gauging system
18	I	Diagram of the exhaust gas system
19	A	Diagram of drip trays and gutterway draining system
20	A	Diagram of the oxyacetylene welding system
21	A	Drawings and specification of valves and accessories, where required in [2.7]

(1) A = to be submitted for approval, in four copies;
I = to be submitted for information, in duplicate.

(2) Diagrams are also to include, where applicable, the (local and remote) control and monitoring systems and automation systems.

19.4.3 Piping

a) Piping is not to be led through accommodation or service spaces.

b) Piping is to be protected against any possible mechanical damage.

c) In way of deck or bulkhead penetrations, piping is to be suitably enclosed in sleeves so arranged as to prevent any fretting of the pipe with the sleeve.

19.4.4 Signboards

Signboards are to be posted on board the ship in accordance with Tab 33.

Table 33 : Signboards

Location of the signboard	Signboard to be posted
in the gas bottle room	diagram of the oxyacetylene plant
	"no smoking"
in way of: • bottle stop valves • distribution station stop valves	"to be kept shut when distribution stations are not working"
in way of the pressure reducing devices	indication of the maximum allowable pressure at the pressure reducing device outlet
in way of the safety valve discharge outlet	"no smoking"

20 Exhaust gas treatment systems

20.1 Application

20.1.1 *(1/1/2018)*

This Article applies to:

- exhaust gas cleaning systems (scrubbers)
- selective catalytic reduction (SCR) systems.

20.1.2 Applicability of other Rules *(1/4/2021)*

Exhaust gas treatment systems are regarded as non-essential services, therefore:

- redundancy is not necessary, and
- testing of materials and components is to be in compliance with the requirements for equipment intended non essential services.

  However, equipment intended to ensure the ship safety or essential to ensure personnel safety (such as but not limited to valves connected to the outer shell, sea water piping, pipes conveying hazardous substances, exhaust gas by-pass valves), is anyway to be inspected and tested as requested for equipment intended for essential services.

20.2 Efficiency

20.2.1 *(1/1/2018)*

When the additional class notations "**EGCS-Sox**" or "**EGCS NOx**" are issued, the efficiency of the equipment is to be certified against the requirements of the latest IMO Guidelines published at the Building Contract date.

20.3 Exhaust ducting

20.3.1 *(1/1/2018)*

The parts of the Exhaust gas treatment systems containing exhaust gas are to be in compliance with [18].

When the exhaust gas treatment system may influence the operation of essential machinery, arrangements are to be made to ensure the continuity of the service concerned also in case of possible failures of the exhaust gas treatment system (e.g. exhaust gas bypasses are to be arranged, to enable continued operation of engine intended to drive single essential users in case of filters clogging by particulate matter).

20.4 Materials

20.4.1 *(1/1/2018)*

Materials used for equipment and piping systems are to be suitable with fluids conveyed, taking into account their chemical reactivity.

Aluminium and galvanized pipes are to be avoided for equipment and piping systems in contact with fluids containing sodium hydroxide or acids.

Copper is to be avoided for equipment and piping systems in contact with fluids containing ammonia.

20.5 Use of hazardous substances

20.5.1 *(1/1/2018)*

When hazardous substances are produced, or loaded and stored on board or anyway used in connection with exhaust gas treatment systems, the arrangements are to take into account the risks involved in such a production, loading, storage and use.

Substances containing products listed in the IMDG Code are to be regarded as hazardous substances, unless documented otherwise.

20.6 Use of reductants in SCR systems

20.6.1 Use of aqueous ~~and anydrous~~ ammonia (28% or less concentration of ammonia) *(1/1/2024)*

Aqueous ~~and Anydrous~~ ammonia ~~are~~is not to be used as a reductant in a SCR except where it can be demonstrated that it is not practicable to use a urea based reductant.

~~Use of Anydrous ammonia is to be agreed with the Flag Administration~~Where an application is made to use aqueous ammonia as the reductant then the arrangements for its loading, carriage and use are to be derived from a risk based analysis.

20.6.2 Use of anydrous ammonia (99.5% or greater concentration of ammonia by weight) *(1/1/2024)*

Anydrous ammonia is not to be used as a reductant in a SCR except where it can be demonstrated that it is not practicable to use a urea based reductant and where the Flag Administration agrees to its use.

Where it is not practicable to use a urea reductant then it is also to be demonstrated that it is not practicable to use aqueous ammonia.

Where an application is made to use anhydrous ammonia as the reductant then the arrangements for its loading, carriage and use are to be derived from a risk based analysis.

20.6.23 Use of urea based ammonia (e.g. 40%/60% urea/water solution) *(1/1/2024)*

The requirements for SCR reductants tanks with volume below of 500 L will be considered by the Society on a case by case basis.

Where urea based ammonia (e.g. AUS 40 - aqueous urea solution specified in ISO 18611-1:2014) is used, the storage tank is to be arranged so that any leakage will be contained and prevented from making contact with heated surfaces. All pipes or other tank penetrations are to be provided with manual closing valves attached to the tank. Tank and piping arrangements are to be approved.

The storage tank may be located within the engine room.

The storage tank is to be protected from excessively high or low temperatures applicable to the particular concentration of the solution. Depending on the operational area of the ship, this may necessitate the fitting of heating and/or cooling systems. The physical conditions recommended by applicable recognized standards (such as ISO 18611-3:2014) are to be taken into account to ensure that the contents of the aqueous urea tank are maintained to avoid any impairment of the urea solution during storage.

If a urea storage tank is installed in a closed compartment, the area is to be served by an effective mechanical ventilation system of extraction type providing not less than 6 air changes per hour which is independent from the ventilation system of accommodation, service spaces, or control stations. The ventilation system is to be capable of being controlled from outside the compartment. A warning notice requiring the use of such ventilation before entering the compartment shall be provided outside the compartment adjacent to each point of entry. These requirements also apply to closed compartments normally entered by persons:

- when they are adjacent to the urea integral tanks and there are possible leak points (e.g. manhole, fittings) from these tanks; or

- when the urea piping systems pass through these compartments, unless the piping system is made of steel or other equivalent material with melting point above 925 degrees C and with fully welded joints.

Alternatively, where a urea storage tank is located within an engine room a separate ventilation system is not required when the general ventilation system for the space is arranged so as to provide an effective movement of air in the vicinity of the storage tank and is to be maintained in operation continuously except when the storage tank is empty and has been thoroughly ventilated.

Each urea storage tank is to be provided with temperature and level monitoring arrangements. High and low level alarms together with high and low temperature alarms are also to be provided.

Where urea based ammonia solution is stored in integral tanks, the following are to be considered during the design and construction:

- These tanks may be designed and constructed as integral part of the hull, (e.g. double bottom, wing tanks).
- These tanks are to be coated with appropriate anti-corrosion coating and cannot be located adjacent to any fuel oil and fresh water tank.
- These tanks are to be designed and constructed as per the structural requirements applicable to hull and primary support members for a deep tank construction.
- These tanks are to be included in the ship's stability calculation.

The reductant piping and venting systems are to be independent of other ship service piping and/or systems. Reductant piping systems are not to be located in accommodation, service spaces, or control stations. The vent pipes of the storage tank are to terminate in a safe location on the weather deck and the tank venting system is to be arranged to prevent entrance of water into the urea tank.

Reductant tanks are to be of steel or other equivalent material with a melting point above 925 degrees C.

Note 1:

Material requirement "to be of steel or other equivalent material" with a melting point above 925 degrees C is not applicable for integral tanks on FRP vessels such as those listed below, provided that the integral tanks are coated and/or insulated with a self-extinguishing material.

- FRP vessels complying with Regulation 17 of SOLAS Chapter II-2 based upon its associated IMO guidelines (MSC.1/Circ.1574), and
- FRP vessels exempted from the application of SOLAS e.g., yachts, fast patrol, navy vessels, etc., generally of less than 500 gross tonnage, subject to yacht codes or flag regulations.

Pipes/piping systems are to be of steel or other equivalent material with melting point above 925 degrees C, except downstream of the tank valve, provided this valve is metal seated and arranged as fail-to-closed or with quick closing from a safe position outside the space in the event of fire; in such case, type approved plastic piping may be accepted even if it has not passed a fire endurance test. Reductant tanks and pipes/piping systems are to be made with a material compatible with reductant or coated with appropriate anti-corrosion coating.

For the protection of crew members, the ship is to have on board suitable personnel protective equipment. Eyewash are to be provided, the location and number of these eyewash stations and safety showers are to be derived from the detailed installation arrangements.

Urea storage tanks are to be arranged so that they can be emptied of urea and ventilated by means of portable or permanent systems.

SECTION 1 REQUIREMENTS FOR FIRE PROTECTION, DETECTION AND EXTINCTION

1 General

1.1 Purpose and application

1.1.1 *(1/1/2007)*

This Section applies to cargo ships and passenger ships for which classification is requested.

Note 1: As from 1 January 2007, the statutory requirements of the SOLAS Convention and/or national safety regulations, as applicable, regarding fire protection, detection and extinction (hereinafter referred to as "fire protection statutory requirements") are no longer mandatory for the purpose of classification except where the Society carries out surveys relevant to fire protection statutory requirements on behalf of the flag Administration. In such cases, fire protection statutory requirements are considered a matter of class and therefore compliance with these requirements is also verified by the Society for classification purposes. In general, only IACS Unified Requirements in force related to fire protection, detection and extinction have been retained as Rule requirements within the scope of classification and are contained in this Chapter 4.

1.1.2 *(1/1/2007)*

[2]; [3]; [4]; [5.1]; [5.3]; [6]; [7]; [8] apply to all ships.

1.1.3 *(1/1/2007)*

[5.2]; [8]; [9] apply to cargo ships only.

1.1.4 *(1/1/2007)*

Requirements for tankers in this Section apply to tankers carrying oil having a flashpoint not exceeding 60°C (closed cup test).

1.1.5 *(1/1/2007)*

Unless otherwise stated, for materials and design criteria of piping and relevant accessories reference is to be made to Ch 1, Sec 10.

2 Documentation to be submitted

2.1

2.1.1 *(1/1/2007)*

The Interested Party is to submit to the Society the documents listed in Tab 1.

Table 1 : Documentation to be submitted *(1/7/2012)*

No.	I/A (1)	Document (2)
1	A	Ventilation systems in cargo area of tankers, excluding cargo tanks
2	A	Automatic fire detection systems in unattended machinery spaces
3	A	Arrangement of local application fixed fire-extinguishing systems (2) and inert gas systems
4	A	Gas detection systems on tankers
5	A	Fixed fire-extinguishing system in scavenge spaces of two-stroke crosshead type engines, according to the requirements of Ch 1, Sec 2, [4.4.1]
6	A	Electrical diagram of local application fixed gas fire-extinguishing systems
7	I	General arrangement plan

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

(2) Plans are to be schematic and functional and to contain all information necessary for their correct interpretation and verification such as:

- service pressures
- capacity and head of pumps and compressors, if any
- materials and dimensions of piping and associated fittings
- volumes of protected spaces
- surface areas of protected zones for pressure water-spraying systems
- type, number and location of nozzles of extinguishing media for gas and pressure water-spraying systems.

All or part of the information may be provided, instead of on the above plans, in suitable operation manuals or in specifications of the systems.

7.2 Low pressure CO2 piping system

7.2.1 General *(1/7/2022)*

Where a low-pressure CO_2 system is fitted, the piping system is to be designed in such a way that the CO_2 pressure at the nozzles is not be less than 1 N/mm^2.

8 Fire safety systems: General requirements and application for inert gas systems

8.1 General requirements

8.1.1 *(1/1/2007)*

The inert gas system is to be capable of inerting, purging and gas-freeing empty cargo tanks and maintaining the atmosphere in cargo tanks with the required oxygen content.

8.1.2 *(1/1/2007)*

The inert gas system referred to in [8.2.1] is to be designed, constructed and tested in accordance with the requirements of [9]. Unless otherwise stated, for materials and design criteria of piping and relevant accessories reference is to be made to Ch 1, Sec 10.

8.1.3 *(1/1/2007)*

Tankers fitted with a fixed inert gas system are to be provided with a closed ullage system.

8.2 Application

8.2.1 *(1/1/2016)*

For tankers (including chemical carriers and gas carriers) of 8,000 tonnes deadweight and upwards, cargo tanks are to be protected by a fixed inert gas system in accordance with the requirements of [9], except that, for tankers of less than 20,000 tonnes deadweight in lieu of the fixed installations required in [9] the Society, after having given consideration to the ship's arrangement and equipment, may accept other equivalent arrangements or means of protection in accordance with [8.3].

8.2.2 *(1/1/2007)*

Tankers operating with a cargo tank cleaning procedure using crude oil washing are to be fitted with an inert gas system complying with the requirements of [9] and with fixed tank washing machines.

8.2.3 *(1/1/2007)*

Tankers required to be fitted with inert gas systems are to comply with the following provisions:

a) double hull spaces are to be fitted with suitable connections for the supply of inert gas

b) where hull spaces are connected to a permanently fitted inert gas distribution system, means are to be provided to prevent hydrocarbon gases from the cargo tanks entering the double hull space through the system and

c) where such spaces are not permanently connected to an inert gas distribution system, appropriate means are to be provided to allow connection to the inert gas main.

8.2.4 *(1/1/2007)*

The requirements for inert gas systems given in [9] need not be applied to gas carriers:

a) ~~chemical tankers and gas carriers,~~ when carrying crude oil and petroleum products having a flashpoint not exceeding 60°C (closed cup test), provided that they comply with IMO Resolution A.567(14) ~~the requirements for inert gas systems on chemical tankers in [9]~~, or

b) ~~chemical tankers and gas carriers~~ when carrying flammable cargoes other than crude oil or petroleum products such as cargoes listed in Chapter 17 and 18 of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk, provided that the capacity of tanks used for their carriage does not exceed 3000 m^3, the individual nozzle capacities of tank washing machines do not exceed 17,5 m^3/h and the total combined throughput from the number of machines in use in a cargo tank at any one time does not exceed 110 m^3/h.

8.3 Requirements for equivalent systems

8.3.1 *(1/1/2007)*

When an installation equivalent to a fixed inert gas system is installed, it is to:

a) be capable of preventing dangerous accumulations of explosive mixtures in intact cargo tanks during normal service throughout the ballast voyage and necessary in-tank operations, and

b) be so designed as to minimise the risk of ignition from the generation of static electricity by the system itself.

9 Inert gas systems

9.1 Contents

9.1.1 *(1/1/2016)*

This item [9] gives the specifications for inert gas systems in cargo oil tanks and double hull spaces in oil tankers, chemical tankers and gas carriers as required by this Chapter.

9.2 Engineering specifications

9.2.1 Definitions *(1/1/2016)*

For the purposes of this item [9], the following definitions apply:

a) Cargo tanks means those cargo tanks, including slop tanks, which carry cargoes, or cargo residues, having a flashpoint not exceeding 60ºC.

b) Inert gas system includes inert gas systems using flue gas, inert gas generators, and nitrogen generators and means the inert gas plant and inert gas distribution together with means for preventing backflow of cargo

SECTION 5 PROCESS PRESSURE VESSELS AND LIQUID, VAPOUR AND PRESSURE PIPING SYSTEMS

1 General

1.1 Process pressure vessels

1.1.1

IGC CODE REFERENCE : Ch 5, 5.1.2

Process pressure vessels handling cargo are to be considered at least as class 2 pressure vessels, in accordance with Pt C, Ch 1, Sec 3, [1.4.1].

1.1.2 Temperature of steam and heating media within the cargo area *(1/7/2007)*

IGC CODE REFERENCE : Ch 5, 5.1

The maximum temperature of steam and heating media within the cargo area is to be adjusted to take into account the temperature class of the cargoes.

2 Cargo and process piping

2.1 General

2.1.1 *(1/1/2023)*

Cargo pipes, including single wall pipes and inner pipes of double wall arrangements, belong to Class I piping systems, as defined in Pt C, Ch 1, Sec 10, [1.5].

Outer pipes of double wall cargo piping arrangements belong to Class II piping systems, as defined in Pt C, Ch 1, Sec 10, [1.5].

2.1.2 Provisions for protection of piping against thermal stress *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.7.1, 5.11.6.4

Expansion joints are to be protected from extensions and compressions greater than the limits fixed for them and the connected piping is to be suitably supported and anchored. Bellow expansion joints are to be protected from mechanical damage.

The design and installation of expansion bellows is to be in accordance with recognized standards acceptable to the Society.

2.1.3 Segregation of high temperature piping *(1/1/2020)*

IGC CODE REFERENCE : Ch 5, 5.7.2

High temperature pipes are to be thermally isolated from the adjacent structures. In particular, the temperature of pipelines is not to exceed 220 °C in gas-dangerous zones.

2.1.4 Pressure relief valve setting *(1/1/2020)*

IGC CODE REFERENCE : Ch 5, 5.5.6 and 5.5.7

Pressure relief valves are to be set to discharge at a pressure not greater than the design pressure such that the overpressure during discharge does not exceed 110% of the design pressure.

2.1.5 Protection against leakage *(1/1/2020)*

IGC CODE REFERENCE : Ch 5, 5.2

Where the piping system is intended for liquids having a boiling point lower than - 30 °C, permanent means to avoid possibility of contact between leaks and hull structures are to be provided in all those locations where leakage might be expected, such as shore connections, pump seals, flanges subject to frequent dismantling, etc.

2.1.6 Means for detecting the presence of liquid cargo *(1/1/2020)*

IGC CODE REFERENCE : Ch 5, 5.2

The means to detect the presence of liquid cargo may be constituted by electrical level switches whose circuit is intrinsically safe. The alarm signals given by the level switches are to be transmitted to the wheelhouse and to the cargo control station, if provided.

2.1.7 Connections of relief valve discharges to cargo tanks *(1/1/2020)*

IGC CODE REFERENCE : Ch 5, 5.2

The connections, if any, to the cargo tanks of relief valve discharges fitted on the liquid phase cargo piping are not to be fitted with shut-off valves, but are to be provided with non-return valves in the proximity of the tanks.

2.1.8 Centrifugal pumps *(1/1/2020)*

IGC CODE REFERENCE : Ch 5, 5.2

Overpressure relief valves on cargo pumps may be omitted in the case of centrifugal pumps having a maximum delivery head, the delivery valve being completely closed, not greater than that permitted for the piping.

2.2 Scantlings based on internal pressure

2.2.1 Piping scantlings *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.11.2.2, 5.11.2.4 and 5.11.4

Piping systems are to be designed in accordance with recognized standards acceptable to the Society.

The minimum thickness is to be in accordance with recognized standards acceptable to the Society.

2.2.2 Piping subject to green seas *(1/1/2020)*

IGC CODE REFERENCE : Ch 5, 5.11.2.2

shall include a fire test to a standard acceptable to the Society.

3.1.2 Unit Production Testing *(1/1/2020)*

IGC CODE REFERENCE: Ch 5, 5.13

All valves are to be tested at the Manufacturer's plant in the presence of the Society's Surveyor.

Testing is to include a hydrostatic test of the valve body at a pressure equal to 1,5 times the design pressure for all valves, seat and stem leakage test at a pressure equal to 1,1 times the design pressure for valves other than safety valves. In addition, cryogenic testing consisting of valve operation and leakage verification for a minimum of 10% of each type and size of valve for valves other than safety valves intended to be used at a working temperature below -55°C. The set pressure of safety valves is to be tested at ambient temperature.

For valves used for isolation of instrumentation in piping not greater than 25 mm, unit production testing need not be witnessed by the surveyor. Records of testing are to be available for review.

As an alternative to the above, if so requested by the relevant Manufacturer, certification of a valve may be issued subject to the following:

- the valve has been approved as required by [3.1.1] for valves intended to be used at a working temperature below -55°C, and
- the Manufacturer has a recognised quality system that has been assessed and certified by the Society subject to periodical audits, and
- the quality control plan contains a provision to subject each valve to a hydrostatic test of the valve body at a pressure equal to 1,5 times the design pressure for all valves and seat and stem leakage test at a pressure equal to 1,1 times the design pressure for valves other than safety valves. The set pressure of safety valves is to be tested at ambient temperature. The Manufacturer is to maintain records of such tests, and
- cryogenic testing is performed, in the presence of the Society's representative, consisting of valve operation and leakage verification for a minimum of 10% of each type and size of valve for valves other than safety valves intended to be used at a working temperature below -55°C.

3.2 Cargo Pumps

3.2.1 Prototype Testing *(1/1/2012)*

Each size and type of pump is to be approved through design assessment and prototype testing. Prototype testing is to be witnessed in the presence of the Society's Surveyor. In lieu of prototype testing, satisfactory in-service experience of an existing pump design approved by a QSCS Classification Society submitted by the Manufacturer may be considered.

Prototype testing is to include a hydrostatic test of the pump body equal to 1,5 times the design pressure and a capacity test. For submerged electric motor driven pumps, the capacity test is to be carried out with the design medium or with a medium below the minimum working temperature. For shaft driven deep well pumps, the capacity test may be carried out with water. In addition, for shaft driven deep well pumps, a spin test to demonstrate satisfactory operation of bearing clearances, wear rings and sealing arrangements is to be carried out at the minimum design temperature. The full length of shafting is not required for the spin test, but must be of sufficient length to include at least one bearing and sealing arrangements. After completion of tests, the pump is to be opened out for examination.

3.2.2 Unit Production Testing *(1/1/2012)*

All pumps are to be tested at the Manufacturer's plant in the presence of the Society's Surveyor. Testing is to include a hydrostatic test of the pump body equal to 1,5 times the design pressure and a capacity test. For submerged electric motor driven pumps, the capacity test is to be carried out with the design medium or with a medium below the minimum working temperature. For shaft driven deep well pumps, the capacity test may be carried out with water.

As an alternative to the above, if so requested by the relevant Manufacturer, the certification of a pump may be issued subject to the following:

- the pump has been approved as required by [3.2.1] and
- the Manufacturer has a recognised quality system that has been assessed and certified by the Society subject to periodical audits, and
- the quality control plan contains a provision to subject each pump to a hydrostatic test of the pump body equal to 1,5 times the design pressure and a capacity test. The Manufacturer is to maintain records of such tests.

4 Cargo system valving requirements

4.1 Cargo tank connections for gauging

4.1.1 Exemption *(1/1/2020)*

IGC CODE REFERENCE : Ch 5, 5.5.5

The requirements in paragraph 5.5.5 of the IGC Code relevant to cargo tank connections for pressure gauges and measuring devices do not apply to tanks with an MARVS not exceeding 0,07 MPa.

4.2 Emergency shutdown

4.2.1 Clarification on location of fusible elements *(1/1/2020)*

IGC CODE REFERENCE : Ch 18, 18.10

The cargo stations in way of which the fusible elements mentioned in paragraph 18.10.3.2 of the IGC Code are to be fitted are to be intended as the loading and unloading manifolds.

4.2.2 Fail-close action of Emergency Shut Down (ESD) valve *(1/1/2024)*

IGC CODE REFERENCE : Ch 18, 18.10.2.1.2

The following requirements specify the arrangements for emergency shut down valve (hereinafter referred to as ESD valve) installed in cargo piping of ships engaged in the carriage of liquefied gases to stop cargo flow in the event of

an emergency, either internally within the ship, or during cargo transfer to other ships or shore facilities.

When ESD valve is actuated by hydraulic or pneumatic system, the following are to be complied with:

a) audible and visible alarm is to be given in the event of loss of pressure that causes activation of fail-close action. The alarm is to be provided in a normally manned control station (e.g. Cargo Control Room and/or the navigation bridge, etc.).

b) the following conditions are also to be complied to ensure the fail-close action:

   1) failure of hydraulic or pneumatic system is not to lead to loss of fail-close functionality (i.e. activated by spring or weight); or

   2) hydraulic or pneumatic system for fail-close action is to be arranged with stored power and separated from normal valve operation.

5 Cargo transfer methods

5.1 Discharge into common header

5.1.1 *(1/1/2020)*

IGC CODE REFERENCE : Ch 5, 5.6

When two or more pumps located in different cargo tanks are operating at the same time discharging into a common header, the stopping of the pumps is to activate an alarm at the centralised cargo control location.

6 Bonding

6.1 Static electricity

6.1.1 Acceptable resistance *(1/1/2020)*

IGC CODE REFERENCE : Ch 5, 5.7.4

To avoid the hazard of an incentive discharge due to the build-up of static electricity resulting from the flow of the liquid/gases/vapours, the resistance between any point on the surface of the cargo and slop tanks, piping systems and equipment, and the hull of the ship is not to be greater than 10^6 Ω.

6.1.2 Bonding straps *(1/1/2020)*

IGC CODE REFERENCE : Ch 5, 5.7.4

Bonding straps are required for cargo and slop tanks, piping systems and equipment which are not permanently connected to the hull of the ship, for example:

a) independent cargo tanks

b) cargo tank piping systems which are electrically separated from the hull of the ship

c) pipe connections arranged for the removal of the spool pieces.

Where bonding straps are required, they are to be:

a) clearly visible so that any shortcoming can be clearly detected

b) designed and sited so that they are protected against mechanical damage and are not affected by high resistivity contamination, e.g. corrosive products or paint

c) easy to install and replace.

7 Integrated cargo and ballast system

7.1 General

7.1.1 *(1/1/2004)*

The requirements for integrated cargo and ballast systems are given in Ch 7, Sec 4, [3.5].

APPENDIX 1 LNG BUNKER SHIPS

1 General

1.1 Application

1.1.1 *(1/1/2024)*

The requirements of this Appendix apply to Liquified Gas Carriers complying Chapter 9, and intended to load LNG from land based or offshore terminals, gas carriers or truck and transfer the LNG to LNG fuelled ships.

Ships complying with the requirements of this Appendix will be granted the additional service feature **LNG bunker** which may be complemented by one or more of the following:

- **IG-Bunker (Inert Gas Bunker)**, where the LNG bunker ship is designed to also supply inert gas, to ensure gas freeing and aeration, to a LNG fuelled ship.
- **BT (Bunker Trust)** where the LNG bunker ship is designed with arrangement for the verification of the LNG quality and quantity delivered to the receiving ship.
- **VCS-Bunker (Vapour Control System Bunker)** where the LNG bunker ship is designed with systems for control of vapour emission from cargo tanks from receiving ship during bunkering.
- **NH3 Tank Ready** where the LNG bunker ship is fitted with LNG cargo tanks designed also for ammonia storage.
- **NH3 Tank** where the LNG bunker ship is fitted with LNG cargo tanks designed, built and tested also for ammonia storage.

1.1.2 *(1/12/2020)*

The requirements of this Appendix supplement those in Chapter 9.

In general, this Appendix does not address cargo containment and handling systems and the interfaces between these systems and the other parts of the ship, which are to comply with the applicable Sections of the Rules.

1.2 Scope

1.2.1 *(1/12/2020)*

This Appendix addresses:

- the design and installation of the of the piping system of the LNG bunker ship intended to transfer LNG to the LNG fueled ship and the vapour transfer system to/from these units.
- the safety arrangements.

1.2.2 *(1/12/2020)*

Ships intended to load, carry and transfer gases other than LNG will be considered on a case by case basis, and the Society reserves the right to establish additional requirements.

2 Definitions

2.1 Bunker emergency shut-down system (ESD)

2.1.1 *(1/12/2020)*

A bunker ESD is a system that safely and effectively stops the transfer of LNG (and vapour as applicable) between the receiving ship and the bunker ship in the event of an emergency during the bunkering operation, and puts the system in a safe condition.

2.2 Bunkering connections

2.2.1 *(1/12/2020)*

Bunkering connections correspond to the end of the fixed piping of the LNG bunker ship (i.e. manifold for a system with flexible hose and before the swivel for a system with transfer arm).

2.3 Custody Transfer Measuring system

2.3.1 *(1/12/2020)*

Custody transfer Measuring system in fluid measurement is a metering point (location) where the fluid is being measured for sale from one party to another.

2.4 Emergency release coupling (ERC) or breakaway coupling (BRC)

2.4.1 *(1/12/2020)*

A breakaway coupling or emergency release coupling (ERC) is a coupling located in the LNG transfer system (at one end of the transfer system, either the receiving ship end or the LNG bunker ship end, or in the middle of the transfer system), which separates at a predetermined section when required, each separated section containing a self-closing shut-off valve, which seals automatically.

An emergency release coupling can be activated:

- by external forces applied to the predetermined section exceeding a predetermined value, and/or
- by manual, remote or automatic control, in case of emergency.

2.5 ESD link system or Ship-ship link (SSL)

2.5.1 *(1/12/2020)*

ESD link system or Ship-ship or ship-shore link (SSL) is a communication system to transmit ESD signals and other signals between two different ESD systems (ship to

15 Implementation survey

15.1

15.1.1 *(1/12/2020)*

Upon issuance of the additional service feature LNG bunker, a dedicated survey if to be carried out on occasion of the first LNG bunkering, as follows:

a) The first LNG bunkering is to be carried out according to the relevant LNG bunkering procedure.

b) During the survey the following is to be carried out:

- Examination of transfer piping systems including supporting arrangements.
- Verification of satisfactory operation of:
  - Control and monitoring systems
  - Connections systems (QCDC).
  - ESD system
  - piping purging and inerting systems.

16 Additional features

16.1 IG-Bunker (Inert Gas Bunker)

16.1.1 General *(1/12/2020)*

The additional feature **IG-Bunker (Inert Gas Bunker)** is assigned to LNG bunker ship designed to also supply inert gas to a LNG fuelled ship to ensure inerting of the receiving ship systems, and complying with the following requirements.

16.1.2 Inert Gas system *(1/12/2020)*

The inert gas system is to comply with IGC Code 9.4 and 9.5 and Chapter 9.

16.1.3 Piping system *(1/12/2020)*

The lines used for the inert gas are to be independent from the LNG liquid and vapour lines used for normal operation.

16.1.4 Document to be submitted *(1/12/2020)*

The following documents are to be submitted to the Society for approval in addition to the information required in [3]:

- Diagram of the Inert gas system
- Procedure for supplying inert gas to the receiving ship.

16.2 BT (Bunker Trust)

16.2.1 General *(1/12/2020)*

The additional feature **BT (Bunker Trust)** is assigned to LNG bunker ship designed with arrangement for the verification of the LNG quality and quantity delivered to the receiving ship according to international recognized standard (e.g. ISO 23306) or equivalent or according to a gas fuel specification agreed among the stakeholders.

16.2.2 Documents to be submitted *(1/12/2020)*

The following documents are to be submitted to the Society for approval in addition to the information required in [3]:

- Diagram of the LNG sampling arrangement
- Technical specification of LNG analyzer
- LNG Sampling procedure
- Evidence of approval of the measuring system according to MID or OIML R117-1.

16.2.3 Sampling System *(1/12/2020)*

The ship has to be fitted with a sampling system in accordance with international recognized standard (e.g. ISO 8943) or equivalent. Other type of system or piping arrangement are subject to special consideration and they are evaluated case by case.

The sampling connections shall be in compliance with requirements specified in IGC Code 5.6.5 .

The sampling procedure shall be in compliance with requirements specified in IGC Code 18.9 and included in the risk assessment as required in [4.1.2].

The LNG analyzer is to be type approved.

16.2.4 Custody Transfer Measuring System *(1/12/2020)*

A Custody Transfer Measuring System is to be installed on the LNG bunker ship.

A recognized thirty party should approve the design and instruments against MID or OIML R117-1; evidence of this is required to be supplied to the Society.

16.3 VCS-Bunker (Vapour Control System Bunker)

16.3.1 General *(1/12/2020)*

The additional feature **VCS-Bunker (Vapour Control System Bunker)** is assigned to LNG bunker ship in compliance with Pt F, Ch 13, Sec 7 for the assignment of notation **VCS-Transfer**.

16.3.2 Vapour return handling *(1/12/2020)*

The LNG bunker ship is to be capable of handling all or part of the vapours from receiving ship generated during the LNG bunkering operation, in addition to its own boil-off gas (BOG), without release to the atmosphere. The vapour handling capacity of the LNG bunker ship is to be indicated and justified.

Different ways to dispose of the vapours may be considered, such as:

- re-liquefaction
- utilization by the gas consuming equipment of the LNG bunkering ship (e.g. gas or dual-fuel engines or boilers)
- gas combustion unit.

A combination of these means is possible and other solutions may be accepted if they are duly justified to the Society.

16.4 NH3 Tank Ready and NH3 Tank

16.4.1 General *(1/1/2024)*

The additional features **NH3 Tank Ready** and **NH3 Tank** are assigned to LNG bunker ship:

- fitted with LNG cargo tanks designed also for ammonia storage (**NH3 Tank Ready**)
- fitted with LNG cargo tanks designed, built and tested also for ammonia storage (**NH3 Tank**).

16.4.2 NH3 Tank Ready *(1/1/2024)*

The drawings of the tank are to be verified considering both LNG and ammonia cargoes.

The protocol to be used for testing the tank material is to be submitted for information.

The applicable design criteria are to be documented and submitted by the tank manufacturer and will be specially considered by the Society on a case-by-case basis.

16.4.3 NH3 Tank *(1/1/2024)*

The drawings of the tank are to be verified considering both LNG and ammonia cargoes.

The documents related to the tests campaign carried out for the tank material are to be provided for review.

The applicable design criteria are to be documented and submitted by the tank manufacturer and will be specially considered by the Society on a case-by-case basis.

APPENDIX 2 REGASIFICATION SYSTEMS, PROCESS PRESSURE VESSELS AND LIQUID, VAPOUR AND PRESSURE PIPING SYSTEMS

1 Regasification systems

1.1 General

1.1.1 *(1/1/2021)*

These are systems where the cargo is regasified from a liquid to a vapour and then sent ashore via a pipeline for use as a gaseous fuel. The vapour may or may not be treated on board the installation dependent on the requirements of the end user.

The vaporisers are to be selected to satisfy the heaviest demand of the end user and should be able to function during all motions of the installation.

Selection of the vaporisers is to consider environmental impact in terms of air emissions, use of biocides or changes in seawater temperature.

The availability of auxiliary systems serving the process system and on which the process system may depend is also to be considered in selection of design code and specification of such systems.

The design is to ensure that cross contamination of auxiliary systems with hydrocarbons will be adequately protected against.

1.2 Design and construction

1.2.1 *(1/1/2021)*

The design and construction of regasification systems are to be in accordance with a recognized Standard and with the requirement of this section. The standards are to be adhered to in their entirety.

Use of other standards is subject to the approval by the Society.

1.3 Documentation to be submitted

1.3.1 *(1/1/2021)*

Sec 1, Table 1 lists the plans, information, analysis, etc. which are to be submitted in addition to the information required in the other Parts of the Rules for the parts of the unit not affected by the cargo, as applicable.

Table 1 : Documents to be submitted *(1/1/2021)*

No.	A/I	Documents
1	A	Details of process pressure vessels and relative valving arrangement
2	I	Regasification system

2 Process pressure vessels

2.1

2.1.1 *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.1.2

Process pressure vessels handling cargo are to be considered at least as class 2 pressure vessels, in accordance with Pt C, Ch 1, Sec 3, [1.4.1].

2.1.2 *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.1

The maximum temperature of steam and heating media within the cargo area is to be adjusted to take into account the temperature class of the cargoes.

3 Regassification process piping

3.1

3.1.1 Cargo import and export system *(1/1/2021)*

Provisions for cargo import and export systems are given in [5] too.

3.1.2 Provisions for protection of piping against thermal stress *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.7.1

Expansion joints are to be protected from extensions and compressions greater than the limits fixed for them and the connected piping is to be suitably supported and anchored. Bellow expansion joints are to be protected from mechanical damage.

3.1.3 Segregation of high temperature piping *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.7.2

High temperature pipes are to be thermally isolated from the adjacent structures. In particular, the temperature of pipelines is not to exceed 220 °C in gas-dangerous zones.

3.1.4 Pressure relief valve setting *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.5.6 and 5.5.7

Pressure relief valves are to be set to discharge at a pressure not greater than the design pressure such that the overpressure during discharge does not exceed 110% of the design pressure.

3.1.5 Protection against leakage *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.2

Where the piping system is intended for liquids having a boiling point lower than - 30 °C, permanent means to avoid

3.4.7 Piping with expansion devices *(1/1/2021)* IGC

IGC CODE REFERENCE : Ch 5, 5.11.5

For piping fitted with expansion devices, their characteristics are to be submitted to the Society. Where these charac-teristics are such that the forces and moments at the ends of the devices are negligible for the contraction they must absorb, the calculation of the loads due to contraction in the corresponding piping is not required. It is, however, to be checked that the stress intensity corresponding to the primary stresses does not exceed the limits given in [3.4.6].

3.4.8 Flexibility coefficient *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.11.5

The flexibility coefficient of elbows is to be determined from the formulae given in Pt C, Ch 1, Sec 10, [2.3.2] for pipes intended for high temperatures.

3.4.9 Local stresses *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.11.5

Particular attention is to be paid to the calculation of local stresses in the assemblies subjected to axial forces and bending moments. The Society reserves the right to request additional justifications or local strengthening where considered necessary.

3.5 Aluminised pipes

3.5.1 *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.12

Aluminised pipes may be fitted in ballast tanks, in inerted cargo tanks and, provided the pipes are protected from accidental impact, in hazardous areas on open deck.

4 Cargo system valving requirements

4.1 Cargo tank connections for gauging

4.1.1 Exemption *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.5.5

The requirements in paragraph 5.5.5 of the IGC Code relevant to cargo tank connections for pressure gauges and measuring devices do not apply to tanks with an MARVS not exceeding 0,07 MPa.

4.2 Emergency shutdown

4.2.1 Clarification on location of fusible elements *(1/1/2021)*

IGC CODE REFERENCE : Ch 18, 18.10

The cargo stations in way of which the fusible elements mentioned in paragraph 18.10.3.2 of the IGC Code are to be fitted are to be intended as the loading and unloading manifolds.

The system may be integrated into the fire and gas systems and appropriate level of redundancy based on risk analysis in these locations.

The need to enhance the reliability of the system and of process shutdowns may require the use of different technologies for this system or the use of voting duplicated systems.

4.2.2 Fail-close action of Emergency Shut Down (ESD) valve *(1/1/2024)*

IGC CODE REFERENCE : Ch 18, 18.10.2.1.2

The following requirements specify the arrangements for emergency shut down valve (hereinafter referred to as ESD valve) installed in cargo piping of ships engaged in the carriage of liquefied gases to stop cargo flow in the event of an emergency, either internally within the ship, or during cargo transfer to other ships or shore facilities.

When ESD valve is actuated by hydraulic or pneumatic system, the following are to be complied with:

a) audible and visible alarm is to be given in the event of loss of pressure that causes activation of fail-close action. The alarm is to be provided in a normally manned control station (e.g. Cargo Control Room and/or the navigation bridge, etc.).

b) the following conditions are also to be complied to ensure the fail-close action:

   1) failure of hydraulic or pneumatic system is not to lead to loss of fail-close functionality (i.e. activated by spring or weight); or

   2) hydraulic or pneumatic system for fail-close action is to be arranged with stored power and separated from normal valve operation.

5 Cargo transfer methods

5.1 Discharge into common header

5.1.1 *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.6

When two or more pumps located in different cargo tanks are operating at the same time discharging into a common header, the stop of the pumps is to activate an alarm at the centralised cargo control location.

Equipment for liquefied gas transfer (e.g. hoses, loading arms) is to be certified for its intended use.

6 Bonding

6.1 Static electricity

6.1.1 Acceptable resistance *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.7.4

To avoid the hazard of a discharge due to the build-up of static electricity resulting from the flow of the liquid/gases/vapours, the resistance between any point on the surface of the cargo and slop tanks, piping systems and equipment, and the hull of the unit is not to be greater than 10^6 Ω.

6.1.2 Bonding straps *(1/1/2021)*

IGC CODE REFERENCE : Ch 5, 5.7.4

SECTION 5 COMFORT WITH REGARD TO NOISE ON BOARD SHIPS (PLUS)

1 General

1.1 Application

1.1.1 *(1/1/2024)*

The **COMF-NOISE-PLUS** additional class notation is assigned in accordance with Pt A, Ch 1, Sec 2, [6.7.2] 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.

1.1.2 *(1/1/2024)*

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-years period based on a limited set of measurements covering at least 5% of those made when the Certificate was first issued.

1.1.3 *(1/1/2024)*

The requirements apply to conventional passenger ships irrespective of the ship's age, as far as reasonable and practicable, to the satisfaction of the Society. For ships less than 65 m (length between perpendiculars), special consideration will be given by the Society.

1.2 Basic principles

1.2.1 Tonal noise evaluation *(1/1/2024)*

The requirements of this Section define the limits of acceptability of tonal noise on board, the methods for verification of compliance and the criteria for acceptance.

1.2.2 Non-Standard Source Sound Reduction Index (R'w-speaker) evaluation *(1/1/2024)*

The requirements of this Section define a Non-Standard Source Sound Reduction Index (R'w-speaker), a method for verification of compliance and the criteria for acceptance.

1.2.3 Non-Standard Source Apparent Sound Reduction Index (R'-speaker) evaluation *(1/1/2024)*

The requirements of this Section define a Non-Standard Source Apparent Sound Reduction Index (R'-speaker), a method for verification of compliance and the criteria for acceptance.

1.2.4 Verification of compliance *(1/1/2024)*

Verification of compliance is based on the measurements of noise levels as specified in [5.3] and on the evaluation of the insulation characteristics of barriers as specified in [6.1.3]. These measurements are to be carried out either by a Surveyor of the Society or by a technician from a company recognized 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 *(1/1/2024)*

For the purposes of this Section, the specific, comfort-related categorization of the ship spaces is in accordance with Sec 1, [2.1].

2.2 Noise

2.2.1 General *(1/1/2024)*

The definitions of Noise and A-weighted noise levels are in accordance with Sec 1, [2.3].

2.2.2 Tonal Noise *(1/1/2024)*

For the purposes of this Rule, a tonal noise is a prominent noise at a localized frequency that is established by the following procedure:

- obtain the minimum time-average sound pressure level for each 3rd octave frequency band
- determine each frequency band at which the sound pressure level is at least 5 dB above both of the adjacent frequency bands
- compare these peaks in the minimum sound pressure level spectrum with the equal loudness level contours defined by ISO 226:2003.

If a peak reaches an equal loudness contour level that is equal or greater to the highest equal loudness contour level reached by all other frequency bands, than a tonal noise is present.

If no tonal noise was evident, a further check on the 48th octave frequency bands spectrum is to be performed as follows:

- obtain the minimum time-average sound pressure level for each 48th octave frequency band
- within the spectrum of minimum sound pressure levels in 3rd octave bands, determine the frequency band where the sound pressure level is the maximum
- in the above frequency band range, determine the 48th octave frequency band at which the sound pressure level is at least 8 dB above both of the adjacent frequency bands

- compare these peaks in the minimum sound pressure level spectrum with the equal loudness level contours defined by ISO 226:2003.

If a peak reaches an equal loudness contour level that is equal or greater to the highest equal loudness contour level reached by all other frequency bands, than a tonal noise is present.

2.3 Sound Index

2.3.1 Non-standard Source Sound Reduction Index (R'w-speaker) *(1/1/2024)*

R'w is the value of field measurements of total airborne sound insulation between rooms according to EN ISO 717-1:2013 and EN ISO 140-4:1998. For the purposes of this Rule, R'w-speaker is to be measured with the use of a non-standard noise source as described in [6.1.3].

Field measurements should be performed according to ISO 140-4:1998. When the area of the tested space is smaller than 10 m^2, a minimum value of 10 m^2 should be considered for the calculation of the R'w-speaker index.

2.3.2 Non-standard Source Apparent Sound Reduction Index (R'-speaker) *(1/1/2024)*

Apparent Sound Reduction Index R' is defined according to EN ISO 140-4:1998 as the ratio of sound power incident on a partition over the sound power transmitted through it into a receiving space. For the purposes of this Rule, R'-speaker is to be measured with the use of a non-standard noise source as described in [6.1.3].

3 General requirements

3.1 Instrumentation

3.1.1 *(1/1/2024)*

Noise level measurements are to be carried out by means of integrating-averaging sound precision level meters in accordance with Sec 1, [5.3].

4 Documentation to be submitted

4.1 Measurement plan

4.1.1 *(1/1/2024)*

A plan is to be prepared detailing the proposed noise measurement campaign developed in compliance with [5.2.1] and [6.1.2]. The plan, which is to be submitted for information well in advance of the measurement campaign, is to include the following:

- extension and classification of the ship zones that are assigned a noise limit
- proposed locations of measurements to be taken in each ship space
- position of the speakers inside discotheques and lounges.

The aim is to obtain a rational distribution of measurement points throughout the ship.

4.2 Noise measurement results

4.2.1 *(1/1/2024)*

A duly signed detailed report in accordance with Sec 1, [8.1] is to be submitted for approval and is to be witnessed by representatives of the Builder, the Owner and the Society in accordance with Sec 1, [4.4.1].

5 Tonal noise levels: testing conditions and acceptance criteria

5.1 Testing conditions

5.1.1 *(1/1/2024)*

For the purposes of this Section, measurements are to be taken at CSR operational power as defined in Sec 1, [2.3.2] with equipment running during tests and ship loading in accordance with Sec 1, [5.1].

5.2 Measurement positions

5.2.1 *(1/1/2024)*

Measurements of sound pressure level are to be carried out in suites and standard passenger cabins only, selected according to Sec 1, [5.2.2] a).

In case of assignment of both **COMF-NOISE** and **COMF-NOISE-PLUS** additional class notations, the measurements for the assignment of the **COMF-NOISE-PLUS** additional notation are to be made in the same cabins and suites checked for the assignment of the **COMF-NOISE** additional class notation.

5.3 Measurement procedure

5.3.1 *(1/1/2024)*

When recording noise levels, the procedure to follow is to be in accordance with Sec 1, [5.4].

5.4 Acceptable noise levels in the CSR condition

5.4.1 *(1/1/2024)*

In the presence of a tonal noise as defined in [2.2.2], the parameter LAeq-tonal is calculated. Such parameter is obtained by adding 3 dB to the time-space averaged noise level LAeq, calculated according to Sec 1, [5.4]. Finally, for the evaluation of the noise comfort level, LAeq-tonal is to be compared to the limits given in Tab 1.

Table 1 : Noise limits levels *(1/1/2024)*

Passenger spaces	Limit
Suite or mini-suite (S)	45
Standard cabins (Cb)	50

6 R'w-speaker and R'-speaker: testing conditions and acceptance criteria

6.1 Testing conditions

6.1.1 General *(1/1/2024)*

Measurements are to be carried out in passenger cabins according to the following indications. The noise insulation

characteristics of division R'-speaker and R'w-speaker are to be measured with the ship at berth once the installation of the walls, floors, ceilings and furnishings is complete.

At the discretion of the Society, additional measurements are to be carried out in extra locations within the measurement area.

6.1.2 Measurement positions *(1/1/2024)*

For the purposes of this Section, R'-speaker and R'w-speaker are to be evaluated to determine the transmission of noise between discotheques / lounges and passenger cabins / suites when the speakers are in use. For each type of vertical and horizontal division, at least 30% of passenger cabins adjacent to a discotheque / lounge are to be assessed. If possible, the cabins that are closest to the speakers should be measured.

Noise source space is to be the discotheque / lounge as it is the one where the speakers are mounted.

6.1.3 Measurement procedure *(1/1/2024)*

In order to assign the **COMF-NOISE-PLUS** additional class notation, measurements of R'-speaker and R'w-speaker are to be taken with the ship's sound system as the noise source. Specifically, all speakers in the source room that function during normal operating conditions are to be turned on emitting a continuous spectrum of Pink Noise. Further, the system in the source room is to be set at such power to guarantee that sound pressure levels in the receiving room are at least 10 dB above the background noise at each frequency band of the receiving room. If this condition cannot be met, corrective factors according to ISO Standards in [2.3] are to be applied.

When the ship has an active noise reduction of the discotheque/lounge's noise source, it can be used during the measurements for the assignment of the **COMF-NOISE-PLUS** additional class notation.

6.2 Acceptance criteria

6.2.1 *(1/1/2024)*

Depending on the type of space separated by vertical or horizontal divisions, for each floor or wall measured according to [6.1.3], the characteristic values of R'-speaker and R'w-speaker are to be compared to the values in Tab 2.

The requested comfort is achieved if the following requirements are satisfied simultaneously:

- R'w-speaker is greater than the specified limits
- Value of R'-speaker at 100 Hz is above the limits.

Table 2 : Noise insulation characteristics of the divisions *(1/1/2024)*

Division between:	R'w-speaker limit [dB]	R'-speaker at 100 Hz [dB]
Discotheque / passenger cabin	65	45
Lounge / passenger cabin	60	40

7 Global noise comfort level of the ship

7.1 General

7.1.1 *(1/1/2024)*

The **COMF-NOISE-PLUS** additional class notation is assigned upon evaluation of the measured noise levels, of Non-Standard Source Sound Reduction and of Non-Standard Source Apparent Sound Reduction Indexes. Provided that conditions described in [5.4] and [6.2] are respected, the notation is assigned if:

- noise levels at CSR are below limits in Tab 1
- non-Standard Source Sound Reduction Index R'w-speaker is greater than limit in Tab 2
- non-Standard Source Apparent Sound Reduction Index R'-speaker at 100 Hz is greater than limit in Tab 2.

8 Report

8.1 General

8.1.1 *(1/1/2024)*

The report for noise measurements is to contain the Tables specified in Sec 1, [8.1].

SECTION 40 ENHANCED MAINTENANCE (EM)

1 General

1.1 Application

1.1.1 *(1/1/2024)*

The additional class notation **ENHANCED MAINTENANCE (EM)** is assigned, in accordance with Pt A, Ch 1, Sec 2, [6.14.60] to ships of 20 years old and above, already assigned with the additional service feature **ESP** and complying with the requirements of this Section.

1.1.2 Scope *(1/1/2024)*

The additional class notation **EM** is assigned to ships subject to enhanced maintenance as follows:

- a structural three-dimensional analysis to the extent agreed with the Society is ~~has been~~ performed for the hull structures, as defined in Pt B, Ch 7, App 1 or Pt B, Ch 7, App 2 or Pt B, Ch 7, App 3, as applicable,
- a Planned Maintenance Scheme (PMS) approved by the Society is in place and is enhanced by a risk analysis of the essential systems, and
- periodical and corrective maintenance, as well as periodical and occasional surveys of hull structures and equipment are carried out according to approved procedures included in the Inspection and Maintenance Plan (IMP), together with audits at the Owner's office.

The implementation of the IMP is surveyed by the Society through:

- periodical audits carried out at the Owner's offices and surveys carried out on board by Tasneef Surveyors, according to the types of inspection schemes in [3.3], and
- examination of the data recorded by the Owner and made available to the Society. ~~through an electronic ship database suitable for consultation and analysis~~
- ~~periodical check of the hull structure, normally at the class renewal survey, against defined acceptance criteria and based on:~~
  - ~~the collected data from actual implementation of the IMP~~
  - ~~the results of the inspections, thickness measurements and other checks carried out during the class renewal survey (see [6.4])~~
- ~~periodical audits of the PMS implementation taking into account the results of the risk analysis, updated as necessary.~~

1.1.3 Safety management system *(1/11/2022)*

The IMP and the PMS required under the scope of the **EM** notation are to be part of the Safety Management System to be certified in compliance with the ISM Code.

1.2 Conditions for the assignment and maintenance of the notation

1.2.1 Assignment of the notation *(1/1/2024)*

The procedure for the assignment of the **EM** notation is the following:

- a request for the notation is to be sent to the Society signed by the Owner~~:~~
  - ~~signed by the party applying for the classification, in the case of new ships~~
  - ~~signed by the Owner, in the case of existing ships~~
- the documents, specified in [2], are to be submitted to the Society by the Interested Party
- the Society reviews the already approved PMS and the results of the risk analysis
- the Society reviews and approves the IMP, taking into account the results of the structural analysis, as well as the information concerning the ship database and history
- the Society carries out an initial survey on board and audit at Owner's office ~~shipboard audit~~ to verify the ~~compliance of the procedures on board with respect to the~~ submitted and approved documentation.

1.2.2 Maintenance of the notation *(1/1/2024)*

The maintenance of the **EM** notation is based on the following surveys and checks, whose scope and periodicity are specified in [6], to be carried out by the Society:

- annual audits at the Owner's offices (see [6.1])
- annual shipboard ~~audits~~ surveys (see [6.2])
- class renewal surveys (see [6.4]).

1.3 ~~Ship database~~

1.3.1 ~~*(1/11/2022)*~~

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

- ~~the hot spot map, as indicated in [2.2]~~
- ~~the PMS documentation, which includes the results of the risk analysis~~
- ~~the risk assessment table for the management of the spare parts~~
- ~~the documents required for the IMP, as indicated in [2.3], and the corresponding reports during the ship operation, as indicated in [3.5]~~
- ~~a periodical verification of the performances of specific items selected by the Owner, if any.~~

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

1.3.2 ~~*(1/11/2022)*~~

~~The ship database is to be:~~

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

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

1.3.3 ~~*(1/11/2022)*~~

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

~~The ship database is to be amended and shared with the Society by the Owner in case of any ship modification.~~

~~It may be agreed between the Owner and the Society that the required data are automatically uploaded into the Society's ship database after they are collected.~~

2 Documentation to be submitted

2.1 Plans and documents to be submitted for hull structures

2.1.1 Structural analysis *(1/1/2024)*

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

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

Table 1 : Existing ships - Plans and documents to be submitted to perform the structural analysis *(1/11/2022)*

i	Plans and documents
1	Midship section and Loading Manual
2	Transverse sections
3	Shell expansion
4	Longitudinal sections and decks
5	Double bottom
6	Pillar arrangements
7	Framing plan
8	Deep tank and ballast tank bulkheads
9	Watertight subdivision bulkheads
10	Watertight tunnels
11	Wash bulkheads
12	Fore part structure
13	Aft part structure
14	Last thickness measurement report

2.1.2 Coatings *(1/11/2022)*

The following information on coatings is to be submitted:

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

2.1.3 Cathodic protection *(1/11/2022)*

The following information on sacrificial anodes is to be submitted:

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

2.2 Hot spot map

2.2.1 *(1/11/2022)*

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

- items (such as a plating panels, ordinary stiffeners or primary supporting members) for which the structural analysis carried out at the design stage showed that the ratio between the applied loads and the allowable limits exceeded 0,975
- items identified as "hot spot item" during the structural reassessment, according to Ch 1, App 2
- structural details subjected to fatigue, based on the list defined in Pt B, Ch 12, App 1
- other items, depending on the results of the structural analyses and/or on experience.

2.2.2 *(1/1/2024)*

The hot spot map ~~may~~is to also indicate the survey frequency~~which items are to be inspected periodically under the Owner's responsibility~~.

2.3 Inspection and Maintenance Plan (IMP)

2.3.1 *(1/1/2024)*

The IMP is to be based on the ~~Owner's experience~~ship's history and on the results of the structural analyses including the hot spot map.

The IMP is to include:

- the list of areas, spaces and hull equipment to be subjected to inspection
- the periodicity of inspections
- the elements to be assessed at annual and renewal surveys for the purpose of the **EM** notation, during the inspection for each area or space, as applicable:
  - coating
  - anodes
  - thicknesses
  - pitting
  - fractures
  - deformations
- the elements to be assessed during the inspection of hull equipment.

2.3.2 *(1/1/2024)*

As regards the IMP~~maintenance~~ plan, the following information is to be given:~~.~~

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

2.4 Plans and documents to be submitted for machinery

2.4.1 Plans, documents and specifications *(1/1/2024)*

The following plans and documents are necessary to assign the **EM** notation:

- the risk analysis report, including the assumptions, considerations, risk models etc. that have brought to the resulting list of critical machinery/equipment of the selected systems, for the approval of the enhanced PMS
- the risk analysis report for the spare parts management applicable to those items considered critical, taking into account their location and availability for replacement
- the maintenance plan of machinery / equipment of the selected systems.

The documents~~plans~~ are to be supplemented with the Manufacturer's specifications, including the list of relevant equipment and accessories and instructions for their use, as required.

The Society may request additional documents or information, when needed.

3 Inspection and Maintenance Plan (IMP)

3.1 Minimum requirements

3.1.1 *(1/11/2022)*

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

3.1.2 *(1/11/2022)*

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

3.1.3 *(1/1/2024)*

The IMP-based surveys performed at periodical intervals does not prevent the Owner from carrying out occasional inspections and maintenance as a result of an unexpected failure or event (such as damage resulting from heavy weather or cargo loading/unloading operation) which may affect the hull or hull equipment condition.

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

The IMP is to be kept duly updated for any changes on board and findings during surveys.

3.2 General scope of IMP

3.2.1 *(1/11/2022)*

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

- deck area structure
- access hatches
- deck fittings
- steering gear
- superstructures
- shell plating
- ballast tanks, including peaks,
- cargo tanks and spaces
- other accessible spaces
- rudders
- sea connections and overboard discharges
- sea chests
- propellers
- further machinery/electrical items
- fire protection items

3.3 Periodicity of inspections

3.3.1 *(1/1/2024)*

Inspections schedule plan is to be arranged and finalized for each vessel taking into account the Type 1 to Type 3 inspection schemes in [3.3.2] to [3.3.4].~~As general reference, these items are to be carried out at least with the following periodicity:~~

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

The IMP inspections performed at periodical intervals by the Society does not prevent Owner from carrying out occasional inspections and maintenance according to the instructions specified in the IMP, or unexpected failure or event (such as damage resulting from heavy weather or

cargo loading/unloading) which may affect the ship or ship equipment condition.

3.3.2 Type 1 *(1/1/2024)*

The following areas/items are to be inspected ~~with a periodicity of Type 1~~at each annual EM survey:

- deck area structure
- welding seams between stainless steel and normal carbon steel
- shell plating above waterline
- access hatches
- deck equipment
- superstructures
- ballast tanks, including peaks
- other accessible spaces
- sea connections and overboard discharges.

~~All ballast tanks are to be inspected annually.~~

3.3.3 Type 2 *(1/1/2024)*

The following areas/items are to be inspected ~~with a periodicity of Type 2~~at each intermediate EM survey:

- bunker and double bottom fuel oil tanks
- fresh-water tanks
- shell plating
- cargo tanks~~.~~
- rudders
- propellers
- bottom plating
- sea chests and anodes.

3.3.4 Type 3 *(1/1/2024)*

The areas/items listed in [3.3.2] and [3.3.3] are to be inspected at each renewal EM survey. ~~Whenever the outside of the ship's bottom is examined in drydock or on a slipway, inspections are to be carried out on the following items:~~

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

3.4 Extent of inspections

3.4.1 Deck area structure *(1/11/2022)*

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

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

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

3.4.2 Small hatches *(1/11/2022)*

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

Any defective tightness device or securing/locking arrangement is to be dealt with.

3.4.3 Deck fittings *(1/11/2022)*

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

- Piping on deck

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

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

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

  Any defective item is to be dealt with.
- Ladders, guard rails, bulwarks, walkways

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

  Any defective item is to be dealt with.
- Anchoring and mooring equipment

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

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

  The manufacturer's maintenance requirements, if any, are to be complied with.
- Other deck fittings

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

3.4.4 Steering gear *(1/11/2022)*

The inspection of the installation is to cover:

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

3.4.5 Superstructures *(1/11/2022)*

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

3.4.14 Bunker and fuel oil tanks, fresh-water tanks *(1/11/2022)*

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

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

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

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

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

3.5 ~~Inspection reports~~

3.5.1 ~~*(1/11/2022)*~~

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

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

3.5.2 ~~*(1/11/2022)*~~

~~The inspection reports are to include the following:~~

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

3.5.3 ~~*(1/11/2022)*~~

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

- ~~location and dimension of fractures, pitting, deformations~~
- ~~condition of equipment before repairs~~
- ~~measurements taken.~~

3.5.4 ~~*(1/11/2022)*~~

~~Models of inspection reports for structural elements and equipment are given in Ch 1, App 5.~~

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

3.5~~6~~ Changes to Inspection and Maintenance Plan

3.5~~6~~.1 *(1/11/2022)*

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

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

4 Acceptance criteria

4.1 Coating assessment

4.1.1 Criteria *(1/1/2024)*

The acceptance criteria for the coating condition of each coated space is that the coating is to be in GOOD condition (i.e. with only minor spot rusting) ~~indicated in Tab 2~~.

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

4.1.2 Repairs *(1/11/2022)*

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

Table 2 : ~~Acceptance criteria for coatings~~ ~~*(1/11/2022)*~~

~~Condition~~	~~Acceptance criteria~~
~~Ships less than 10 years old~~	~~Coatings in GOOD condition~~

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

4.2 Sacrificial anode condition

4.2.1 Criteria *(1/1/2024)*

The acceptance criteria for sacrificial anodes in each coated space fitted with anodes is that the loss in weight is to be less than 25 % indicated in Tab 3 in terms of percentage of losses in weight.

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

Table 3 : Acceptance criteria for sacrificial anodes *(1/1/2022)*

Condition	Percentage of loss in weight
Ships less than 10 years old	Less than 25
Ships 10 years old or more	Less than 50

4.3 Thickness measurements

4.3.1 General *(1/1/2022)*

The acceptance criteria for measured thicknesses are indicated in:

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

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

Specific considerations are given to stainless steel structures and the effects of passivation.

4.3.2 Isolated area *(1/11/2022)*

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

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

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

4.3.3 Item *(1/11/2022)*

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

If the criteria of measured thicknesses are not fulfilled for an item, then this item is to be repaired or replaced. Where the criteria are fulfilled, but substantial corrosion as defined in Pt A, Ch 2, Sec 2, [2.2.9] is found, the IMP is to be adjusted to increase the frequency and/or extent of the maintenance program. In any case, for the items which contribute to the hull girder longitudinal strength, the criteria in [4.3.4] are to be considered.

4.3.4 Zone *(1/11/2022)*

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

- deck zone
- neutral axis zone
- bottom zone.

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

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

4.4 Pitting

4.4.1 Pitting intensity *(1/11/2022)*

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

The diagrams in Ch 1, App 4 are to be used to identify the per- centage of area affected by pitting and thus the pitting intensity.

4.4.2 Acceptable wastage *(1/11/2022)*

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

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

For intermediate values (between localized pit and 50% of affected area), the acceptable wastage in pits is to be obtained by interpolation between 23% and 13% of the average residual thicknesses (see Tab 42).

4.4.3 Repairs *(1/11/2022)*

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

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

Table 24 : Pitting intensity and corresponding acceptable wastage in pits *(1/11/2022)*

Pitting intensity, in % (see Ch 1, App 4)	Acceptable wastage in pits, in percentage of the average residual thickness
≤3	23
5	22
10	21
15	20
20	19
25	18
30	17
40	15
50	13

4.5 Fractures

4.5.1 General *(1/11/2022)*

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

In particular, fractures occur at the following locations:

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

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

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

4.5.2 Criteria *(1/11/2022)*

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

5 Machinery items

5.1 Scope of IMP for machinery and systems

5.1.1 General *(1/11/2022)*

The ship is to hold the **PMS** additional Class notation as per Pt A, Ch 2, Sec 2 and Ch 12, Sec 1.

A general examination of machinery and systems is to be carried out as part of the survey, paying attention to their overall condition, records of defects and functional tests.

In case a system to be surveyed (e.g. pumps) is fitted with equipment at quantity higher than the minimum required by the Rules, the total system equipment (e.g. all the pumps) will be considered for the notation application.

5.1.2 Machinery *(1/11/2022)*

The survey of machinery is to include:

a) general examination, including functional tests, of the main propulsion plant;

b) internal inspection of items opened for maintenance:
   - assessment of items such as crankcase, scavenge spaces, piston rings, bearing clearance, cylinder heads of diesel engines;
   - bearing clearance and gearing condition of steam turbines;
   - internal examination including where possible water and gas spaces, and external examination of casing, burner equipment, blowers and safety valves of boilers and economisers;

c) oil sample of oil systems such as gearing, crankcase, sterntube, to be taken for analysis.

5.1.3 Electrical installations *(1/11/2022)*

The survey of electrical installations is to include:

a) alternators functional tests under working conditions, both individually and during load sharing operations;

b) visual inspection of the fittings and equipment of the main and emergency switchboards, section boards and subsidiary distribution boards;

c) records of insulation-resistance tests performed on cables, switchgear, generators, motors, heaters and lighting fittings, spot tests to be witnessed;

d) functional tests of the emergency source of power, associated circuits and equipment, including testing under working conditions.

5.1.4 Auxiliary systems *(1/11/2022)*

The survey is to include the general examination including functional tests of auxiliary systems for propulsion, power generation, steering, fuel oil, lube oil, cooling water, compressed air, steam, ventilation and accommodation services.

Each system is to be examined having regard to the general condition, leakages, supporting instrumentation, emergency arrangements, etc.

5.1.5 Safety protection devices *(1/11/2022)*

The various safety protection devices fitted to protect machinery and machinery spaces (alarms, shutdowns, standby pumps cut-in, remote stops, remote closing valves, bilge alarms, fire flaps, etc.) are to be assessed in order to verify their correct operation.

5.1.6 Other equipment *(1/11/2022)*

Anchor equipment, mooring systems, cargo gear and life-saving appliances are to be inspected and assessed by means of functional tests.

5.1.7 Plant performance in terms of environmental impact *(1/11/2022)*

Performance tests and assessments are to be carried out for all equipment that has an impact on the environment such

as fuel management, lube oil leakages, air emission, bilge cleanness and oily water management.

5.1.8 Cargo and ballast systems *(1/11/2022)*

The survey is to include the inspection and testing of cargo related equipment and systems, including:

a) for tankers:

cargo pumps and piping with associated installations such as inert gas plant, washing systems, level indication/sounding systems, venting systems, ballast pumps and piping, and remote closing valves;

b) for other types of ships:

cargo equipment and closing devices, bilge, ballast and ventilation systems.

A functional test is to be carried out while the ship is trading (during loading or unloading in the harbour).

5.1.9 Winches and Windlasses *(1/11/2022)*

The survey of this equipment is to include:

a) visual inspections of equipment foundations to confirm the absence of any deformation, excessive wear, corrosion or damage in general;

b) visual examination of each equipment;

c) functional tests of the equipment including prime mover, clutches, brakes, and other significant components on a case-by-case basis;

d) braking systems are to be tested to check the rendering loads. A copy of the brake test results is to be retained on-board the ship.

5.1.10 Anchoring equipment *(1/11/2022)*

The survey of this equipment is to include:

a) visual examination;

b) functional tests;

c) braking systems are to be tested to check the rendering loads. A copy of the brake test results is to be retained on-board the ship.

5.1.11 Navigation equipment *(1/11/2022)*

Navigation equipment is to be tested under working conditions, and correct operation of navigation lights verified.

5.2 Performances

5.2.1 *(1/11/2022)*

The Owner, in agreement with the Society, may also select specific items on which to perform periodical verification of performances.

Minimum checks performed on internal combustion engines to ascertain their performance:

- Oil analysis
- Compression checks
- Specific consumption checks in a specified condition (reports of check carried out in specified conditions by the Company can be submitted to the Society for review)
- Injectors
- Engine power, through a minimum acceptable percentage of the original value
- Pressure test and maintenance of heat exchangers.

5.2.2 *(1/11/2022)*

Minimum features for cargo systems:

- Use of stainless steel in piping
- Periodical passivation of stainless steel piping every 3 years or less
- Procedures for periodical and occasional inspections of the following minimum components in cooperation with Makers:
  - Double valves
  - Gaskets
  - Washing and stripping system efficiency
  - Inert gas system efficiency.

5.3 Manufacturer's recommendations

5.3.1 *(1/11/2022)*

The **EM** notation is by no means to be considered a relaxation or a variation of the type and timing of maintenance recommended by the Manufacturer.

5.3.2 *(1/11/2022)*

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

6 Maintenance of the notation

6.1 Annual audit at the Owner's offices

6.1.1 *(1/11/2022)*

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

Figure 1 : ~~Audit periodicity~~ *~~(1/11/2022)~~*

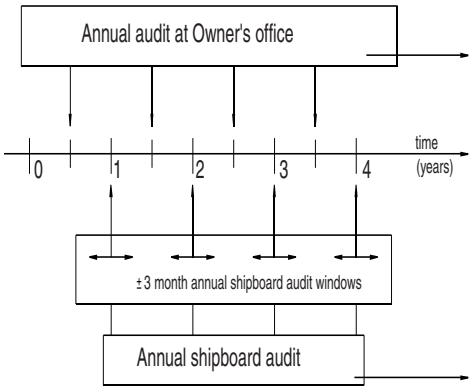
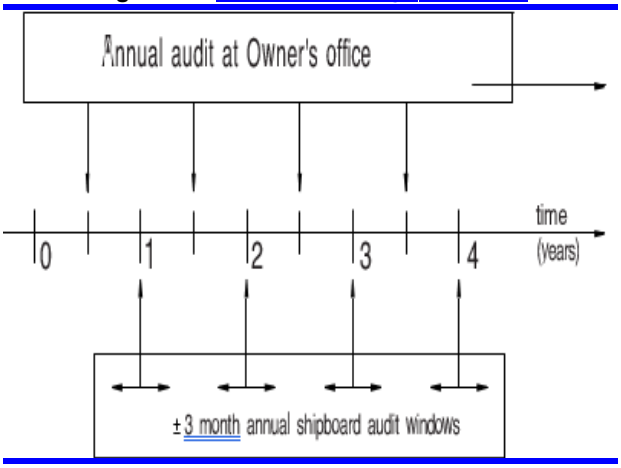


Figure 1 : Audit periodicity *(1/1/2024)*



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

6.1.2 *(1/1/2024)*

The Surveyor checks that the EM notation documents ~~ship database~~ held at the Owner's offices ~~is~~are kept updated, in particular with the ~~inspection and maintenance reports of the~~ IMP.

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

~~Depending on this evaluation, t~~The Society may call for:

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

From the data collected during this audit and data received from the ship, a preliminary review is done. This review may lead to extending the scope of the audit and/or an occasional machinery survey on board the ship, specifically for machinery the performance of which is deteriorating. The audit includes the examination of:

- preventive maintenance records
- corrective maintenance records
- predictive maintenance records, i.e. planning records about outstanding inspections or other actions for the forthcoming period.

6.1.3 *(1/11/2022)*

The annual audit at the Owner's offices performed before the commencement of the class renewal survey is to include the planning required for this survey (see [6.4.2]).

6.2 Annual EM survey~~shipboard audit~~

6.2.1 *(1/1/2024)*

The annual EM survey ~~shipboard audit~~ is to be carried out con- currently with the annual survey.

6.2.2 *(1/1/2024)*

During this survey,~~audit~~ the Surveyor:

- ~~verifies that the ship database is kept updated and transmitted to the Owner's offices~~
- verifies the consistency, implementation and management of the IMP by the Owner
- carries out additional inspections relevant to hull (structure and equipment), if deemed necessary~~required as a result of the audit at the Owner's offices~~
- carries out PMS surveys according to Ch 12, Sec 1, [4.2]~~.~~
- verifies the items under the Type 1 inspection scheme in [3.3.2].

6.3 Occasional EM survey~~onboard audits and/or surveys~~

6.3.1 *(1/1/2024)*

Occasional surveys~~audits~~ may be required when audits at the Owner's offices reveals that IMP or PMS has not been applied or working in the manner intended, or that particular equipment shows abnormal behaviour.

The Society is to be notified when an item is due to be repaired on a non-scheduled basis because of failure. The notification is to include the place, time and specification of the corrective action which has to be executed. The Society will decide whether to carry out an occasional on board survey.

The Society is to be notified of changes to the operation of the ship and/or modifications to machinery and/or equipment to, so that:

- a survey on board the ship may be carried out to verify the changes and modifications
- the effects of the changes and modifications may be taken into consideration, if deemed necessary, during the next risk analysis
- an immediate revision of the IMP is conducted, if deemed necessary.

The effects of any changes in relation to the IMP are monitored during the next annual shipboard audit.

6.4 ~~Class r~~Renewal EM survey

6.4.1 *(1/1/2024)*

The survey for the renewal of the **EM** notation is to be carried out concurrently with the class renewal survey. taking into account the items under the Type 3 inspection scheme in [3.3.4].

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

6.4.2 *(1/1/2024)*

~~For ESP ships, t~~The planning of the class renewal survey as required in Part A, Chapter 4 is to be used, taking into account possible presence of stainless steel and recommendation issued by manufacturers.

~~For ships other than ESP ships, the planning of the class renewal survey is to be prepared in advance of the survey by the Owner in cooperation with the Society. This planning is preferably to be agreed during the annual audit at the Owner's offices performed approximately eighteen months before the due date of the class renewal survey (see [6.1.3]).~~

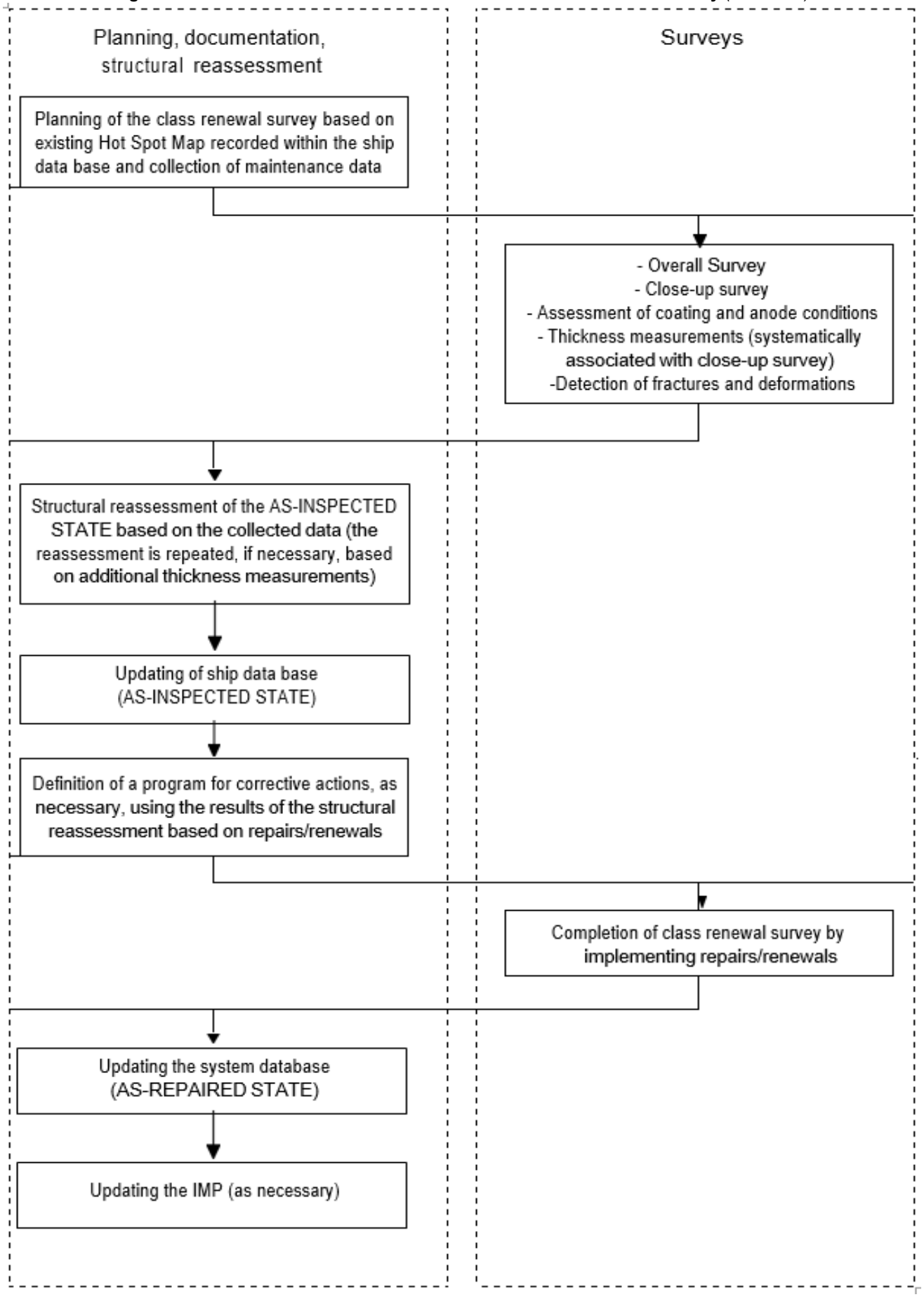
~~The planning is to include the following information:~~

- ~~conditions for survey~~
- ~~provisions and methods for access to structures~~
- ~~equipment for survey~~
- ~~indication of spaces (holds, tanks, etc.) and areas for internal examination, overall survey and close-up survey~~
- ~~indication of sections and areas to be thickness measured~~
- ~~indication of tanks to be tested~~
- ~~indication of areas to be checked for fatigue fracture detection (see [6.4.3])~~
- ~~indication of areas built in stainless steel.~~

~~It is to take account of:~~

- ~~the results of the IMP held by the Owner during the current class period, as well as the class surveys carried out during the same period~~
- ~~the scope of the class renewal survey as required in Pt A, Ch 3, Sec 3 and Part A, Chapter 4, as applicable to the ship concerned~~
- ~~the additional requirements related to the **EM** notation as indicated in [6.4.3]~~
- ~~the presence of structures built in stainless steel.~~

Figure 3 : Actions to be taken in connection with the Class Renewal Survey *(1/11/2022)*



6.4.3 *(1/1/2024)*

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

- an annual ~~shipboard~~ **EM** survey~~audit~~ as detailed in [6.2]
- the assessment of the condition of coating and anodes
- the close-up survey and thickness measurements as required in the survey planning as a result of the previous structural assessment
- a specific survey for fatigue fracture detection in accordance with the planning as a result of the previous hot spot map
- a specific survey for assessing the effects of stainless steel structures passivation.

6.4.4 *(1/11/2022)*

On the basis of the results of the surveys, thickness measurements and fatigue fracture detection carried out as indicated in [6.4.3], the "as-inspected state" of the ship is established. A structural reassessment of the "as-inspected state" is performed according to the criteria in Ch 1, App 2. This state may be progressively updated based on the results of additional inspections and/or thickness measurements required on the basis of the first "running" of the analysis.

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

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

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

6.4.5 *(1/11/2022)*

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

6.4.6 *(1/11/2022)*

The assignment of the **EM** notation implies that the class renewal surveys of machinery are carried out by applying the PMS described in Pt A, Ch 2, Sec 2 and Ch 12, Sec 1. The procedure of recognizing surveys carried out by the Chief Engineer, as indicated in Pt A, Ch 2, Sec 2 when CMS or PMS are adopted, is also to be applied.

6.5 Suspension and withdrawal of the notation

6.5.1 *(1/11/2022)*

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

The suspension of class automatically causes the suspension of the **EM** notation.

6.5.2 *(1/1/2024)*

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

- The condition of the ship is below the minimum level required for class (e.g. scantling of hull structure below the corrosion margin). The action to be taken is either the immediate repair or the imposition of a recommendation for the class (if acceptable) and suspension of the **EM** notation. However, in cases where the recommendation is of a minor nature, the notation may not be suspended.
- The condition of the ship is below the minimum level for the EM notation, but still above the level for the class (e.g. the scantling of a hull structure is below the corrosion margin acceptable for the notation but is still above the corrosion margin). The action to be taken is either the immediate repair or the imposition of a recommendation for the **EM** notation (without recommendation for class).
- The IMP is not complied with (e.g. delays in performing the operations programmed according to the plan or the scope of inspection and/or maintenance not completely fulfilled), and/or the maintenance of the database is not fulfilled.

  The action to be taken is:

  - either the immediate compliance with the requirements or the imposition of a recommendation if the non-conformity is of a minor nature or is an exceptional occurrence
  - or the suspension of the EM notation if the non-conformity is of a major nature or a recurrence.
- A defect or a deficiency is found in applying the IMP. The actions to be taken are the same as stated both for repair of structure/coating/equipment (first two cases above) and for the application of the IMP (third case above)).
- An unexpected defect or deficiency is found or an accident occurs, i.e. not as a result of lack of maintenance or failure in the application of the IMP. The actions to be taken are the same as stated for repair of structure/coating/equipment (first two cases above).
- The condition of the machinery installations (i.e. for each system, all its equipment will be considered, see also [5.1.1]) is below the minimum level required for class. The action to be taken is either the immediate repair or the imposition of a recommendation for class (if acceptable) and suspension of the **EM** notation. However, in cases where the recommendation is of a minor nature, the notation may not be suspended.
- The spare parts availability is outside the risk analysis carried out.
- The PMS is not complied with (e.g. delays in performing the operations scheduled according to the plan or the scope of inspection and/or maintenance is not completely fulfilled), and/or the maintenance of the database is not fulfilled.

The action to be taken is either:

- the immediate compliance with the requirements or the imposition of a recommendation, if the non-conformity is of a minor nature or is an exceptional occurrence, or
- the suspension of the **EM** notation, if the non-conformity is of a major nature or a recurrence.

- A defect or a deficiency is found in applying the PMS.

  The actions to be taken are the same as stated above both for repair of machinery installations ~~(case a) above)~~ and for the application of the PMS ~~(case b))~~.
- An unexpected defect or deficiency is found or a failure occurs, i.e. not as a result of lack of maintenance or failure in the application of the PMS. ~~The actions to be taken are the same as stated in the case a) above.~~

6.5.3 *(1/11/2022)*

The withdrawal of the **EM** notation may be decided in different cases, such as:

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