NR467 DT AMD 019 JANUARY 2023

RULES FOR THE CLASSIFICATION OF STEEL SHIPS

NR467 – JANUARY 2023 AMENDMENTS

AMENDMENTS TO JULY 2022 EDITION

STEEL SHIPS

BUREAU VERITAS

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NR467 - JANUARY 2023 AMENDMENTS

This document contains the January 2023 amendments to the July 2022 edition of the Rules for the Classification of Steel Ships (NR467).

These amendments are effective from January 1, 2023.

The official version of the Rules for the Classification of Steel Ships is available at the Bureau Veritas Marine & Offshore website: https://marine-offshore.bureauveritas.com/

These Rules are provided within the scope of the Bureau Veritas Marine & Offshore General Conditions, enclosed at the end of Part A of NR467 "Rules for the Classification of Steel Ships". The current version of these General Conditions is available on the Bureau Veritas Marine & Offshore website.

PART A

CLASSIFICATION AND SURVEYS

NR467 A DT R19 JULY 2022

PART B

HULL AND STABILITY

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PART F

ADDITIONAL CLASS NOTATIONS

NR467 F DT R14 JULY 2022

REFERENCE DOCUMENT

NR467 DT AMD 019 JANUARY 2023

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Summary table

The following table specifies the sections and appendices which have been amended with respect to the July 2022 edition of the Rules for the Classification of Steel Ships (NR467).
Other editorial corrections are not described in this document.

Part	Reference	Chapter	Section / Appendix
PART A	NR467 A DT R19 July 2022	Chapter 1	Sec 1, Sec 2
		Chapter 2	Sec 2, App 3, *(new)* App 5
		Chapter 3	Sec 1, Sec 3,
		Chapter 4	Sec 3, Sec 4,
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PART C	NR467 C DT R14 July 2022	Chapter 1	Sec 2, Sec 5, Sec 6, Sec 7, Sec 8, Sec 9, Sec10, Sec 11, *(new)* Sec 12, *(existing)* Sec 12, Sec 13, Sec 15, Sec 16, App 1, App 6
		Chapter 2	Sec 3, Sec 10, Sec 11, Sec 14
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PART E	NR467 E DT R05 July 2022	Chapter 1	App 1
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		Chapter 4	Sec 3, *(new)* Sec 4
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		Chapter 12	Sec 3, *(new)* Sec 9
		Chapter 14	Sec 1
		Chapter 15	Sec 6, Sec 8

Amendments to PART A

CHAPTER 1

Ch 1, Sec 1, [3.1.1]

Add the following new Note 2:

Note 2: From the 1st January 2023, newly identified asbestos on board by the Society acting as the Recognized Organization for ISM/MLC/IHM is to be reported to the Owner, the Flag Administration and the Recognized Organization classing the vessel and responsible for the main statutory certificates, as per the Society's procedure.

Ch 1, Sec 2, Table 1

Delete the row "SMART( )".

Replace the row "LNGfuel or CNGfuel or LFPfuel" and insert the row "OCC" as follows:

Table 1: List of service notations and additional service features

Service notation [ref. in Part A]	Reference	Corresponding type of ship according to Conventions and/or Codes
OTHER ADDITIONAL SERVICE FEATURES		Remarks
OCC [4.16.15]	*(new)* Pt C, Ch 1, Sec 12	
LNGfuel or **CNGfuel** or **LFPfuel** [4.16.3]	NR529 or Part D, Chapter 9 or NR670	

Ch 1, Sec 2, [4.13.1]

Replace the third paragraph by:

The additional service feature **EOC** (Enhanced Operating Conditions) is granted to:

- ships greater than 90 m in length and assigned the service notation **dredger**,
- ships greater than 65 m in length and assigned one of the service notation **hopper dredger**, **hopper unit**, **split hopper dredger** or **split hopper unit**,

when specific fatigue calculations are performed, according to the applicable requirements of Pt D, Ch 13, Sec 2, to allow enhanced operational limits, unless no operating area notation other than **unrestricted dredging area (T = x m)** as defined in [5.3.2], is assigned.

Ch 1, Sec 2, [4.16.3]

Replace the first bulleted list by:

- **LNGFuel,** for ships fitted with engines, fuel cells or gas turbines using natural gas as fuel, stored in liquefied form
- **CNGFuel,** for ships fitted with engines, fuel cells or gas turbines using compressed natural gas as fuel
- **LPGFuel,** for ships fitted with engines, fuel cells or gas turbines using petroleum gas as fuel, in liquefied or gaseous form
- **methanolfuel,** for ships fitted with engines, fuel cells or gas turbines using methanol as fuel
- **ammoniafuel,** for ships fitted with engines, fuel cells or gas turbines using ammonia as fuel
- **LFPFuel,** for ships fitted with engines, fuel cells or gas turbines using a low flashpoint fuel different from the fuels mentioned above.

Replace the 4th bullet in the 4th paragraph by:

- NR670 Methanol & Ethanol fuelled Ships

Replace the 6th paragraph (before "Examples") by:

The additional service feature **LFPfuel** is assigned to ships fitted with engines, fuel cells or gas turbines using a low flashpoint liquid fuel or gas different from the fuels mentioned above when this has been specially considered by the Society.

Ch 1, Sec 2, [4.16.4]

Replace the reference to [4.13.3] by a reference to [4.16.3] in the third paragraph.

Ch 1, Sec 2, [4.16]

Delete requirement [4.16.13].

Add the following new requirement [4.16.15]:

4.16.15 Onboard carbon capture and storage system (OCC)

The additional service feature **OCC** is assigned to ships fitted with a carbon capture and storage (CCS) system intended to separate the carbon dioxide (CO_2) from the ship engine exhaust gases and store it on board.

The requirements for the assignment of this additional service feature are given in *(new)* Part C, Ch 1 Sec 12.

Ch 1, Sec 2, Table 5

Delete the row "SYS-COM" and insert the following rows "ASYNC-COM", "CII-REALTIME", "DATA-INFRA", "EVOC" and "SMART ( )":

Replace the rows "CYBER MANAGED / CYBER MANAGED PREPARED" and "CYBER SECURE / CYBER SECURE PREPARED" by the row "CYBER MANAGED / CYBER RESILIENT / CYBER SECURE".

Replace the rows "CLEANSHIP SUPER ( )","GWT", "HABITABILITY" and "REF-CONT" as follows:

Table 5: List of additional class notations

Additional class notation	Definition in	Reference in NR 467 or to other Rule Notes	Remarks
ASYNC-COM	[6.5.6]	Pt F, Ch 4, Sec 3	**ASYNC-COM** may be completed by **-R**
CII-REALTIME	[6.6.5]	Pt F, Ch 5, Sec 3	
CLEANSHIP SUPER ( )	[6.8.2]	Part F, Chapter 9	between brackets, at least 3 eligible notations are to be assigned among the following ones: **AWT-A**, **AWT-B**, **AWT-A/B**, **BWT**, **GWT**, **GWT-B**, **HVSC**, **NDO -x days**, **NOX-x%**, **OWS-x ppm**, **SOX-x%**. **CLEANSHIP SUPER ( )** may be completed by **CEMS**.
CYBER MANAGED **CYBER RESILIENT** **(1)** **CYBER SECURE** **(1)**	[6.21.1]	NR659	
DATA-INFRA	[6.5.7]	Pt F, Ch 4, Sec 4	**DATA-INFRA** may be completed by **-STAND**
EVOC	[6.16.11]	Pt F, Ch 12, Sec 9	
GWT **GWT-B**	[6.8.6]	Part F, Chapter 9	
HABITABILITY	[6.7.6]	Pt F, Ch 6, Sec 6	
REF-CONT **(1)**	[6.9.3]	Pt F, Ch 7, Sec 3	
SMART( )	[6.23.1]	NR675	**SMART( )** is to be completed between brackets by at least one of the following notations: **Hx**, **Mx**, **MHx**, **Nx**, **EnEx** and **Xx** where **x** indicates the smart group designation (**1** or **2**). The notation **EnEx** may be complemented by one or by a combination of the following complementary notations: **-Em**, **-T**, **-LIT**, **-S**, **-W** and **-CII**.

Ch 1, Sec 2, [6.5]

Replace the title of sub-article [6.5] by:

6.5 Integrated and digital systems

Replace requirement [6.5.4] by:

6.5.4 Safety and security of communication system (SYS-COM)

The additional class notation **SYS-COM** may have been assigned to ships contracted for construction before 1st January 2023 and is not applicable to ships contracted for construction on or after 1st January 2023.

The requirements for maintenance of this additional class notation are given in Ch 5, Sec 5.

Add the following new requirements [6.5.6] and [6.5.7]:

6.5.6 Ship-Shore Communication

The additional class notation **ASYNC-COM** may be assigned to ships equipped with asynchronous communication systems which can ensure transfer of data between the ship and the shore.

When the communication systems are redundant, the additional class notation **ASYNC-COM** is complemented by the suffix **-R**.

The requirements for the assignment and maintenance of this notation are given respectively in Pt F, Ch 4, Sec 3 and Ch 5, Sec 5.

6.5.7 DATA-INFRA

The additional class notation **DATA-INFRA** may be assigned to ships fitted with a data infrastructure on board, which ensure reliable data collection, transmission, storage, control, sharing and availability to multiple data consumers.

The additional class notation **DATA-INFRA** may be completed by the suffix **-STAND**, when the data infrastructure supports international standards or norms which are ensuring a higher level of interoperability with other systems.

The requirements for the assignment and maintenance of this notation are given respectively in Pt F, Ch 4, Sec 4 and Ch 5, Sec 5.

Ch 1 Sec 2, [6.6]

Replace the title of sub-article [6.6] by:

6.6 Monitoring equipment

Add the following new requirement [6.6.5]:

6.6.5 Real-Time Carbon Intensity Indicator (CII-REALTIME)

The additional class notation **CII-REALTIME** may be assigned to ships provided with computer based systems which:

- collect the data for the IMO Data Collection System (DCS) in order to calculate a Continuous Carbon Index (Continuous CII, as defined in Pt F, Ch 5, Sec 3, [1.2.1])
- allow access to the data by the users on board and on shore through a dedicated digital interface.

The requirements for the assignment and maintenance of this notation are given respectively in Pt F, Ch 5, Sec 3 and Ch 5, Sec 6.

Ch 1, Sec 2, [6.7.6]

Replace the first paragraph by:

The additional class notation **HABITABILITY** may be assigned to ships found to be in compliance with the criteria of the Maritime Labour Convention and with the provisions contained in Pt F, Ch 6, Sec 6.

Ch 1, Sec 2, [6.8.2]

Replace Note 1 by:

Note 1: At least 3 eligible notations are to be assigned among the following ones:

AWT-A, AWT-B, AWT-A/B, BWT, **GWT**, **GWT-B**, **HVSC**, **NDO-x days**, **NOX-x%**, **OWS-x ppm**, **SOX-x%**

Ch 1, Sec 2, [6.8]

Replace requirement [6.8.6] by:

6.8.6 Grey water treatment (GWT)

The following additional class notations are assigned to ships fitted with a treatment installation for grey waters in accordance with the provisions of Pt F, Ch 9, Sec 1 and Pt F, Ch 9, Sec 5:

- **GWT** for ships complying with the requirements of IMO Resolution MEPC.227(64) section 4.1
- **GWT-B** for ships complying with the requirements of IMO Resolution MEPC.227(64) sections 4.1 and 4.2.

The requirements for the maintenance of these notations are given in Ch 5, Sec 8.

Ch 1, Sec 2, [6.8.14]

Replace the first paragraph by:

The additional class notation **ULEV** may be assigned to sea-going ships. The additional class notation **ULEV** may not be assigned to vessels dedicated to operations on inland waterways (including estuaries, rivers, estuary and lakes) falling into the scope of EU Regulation 2016/1628.

Ch 1, Sec 2, [6.9.5]

Replace the first sentence by:

The additional class notations **REF-CARGO** and **REF-STORE** may also be completed by the following notations:

Ch 1, Sec 2, [6.16]

Add the following new requirement [6.16.11]:

6.16.11 Electric vehicles onboard charging (EVOC)

The additional class notation **EVOC** may be assigned to ships having the service notation **ro-ro passenger ship**, carrying electric vehicles intended to be charged on board.

The requirements for the assignment and maintenance of this notation are given respectively in Pt F, Ch 12, Sec 9 and Ch 5, Sec 13.

Ch 1, Sec 2, [6.21]

Replace requirement [6.21.1] by:

6.21.1 The additional class notations **CYBER MANAGED**, **CYBER RESILIENT** and **CYBER SECURE** may be assigned to ships that are equipped with systems and equipment which comply with the requirements of NR659 Rules on Cyber Security for the Classification of Marine Units.

- The additional class notation **CYBER MANAGED** covers cyber security measures implemented mainly with the administrative control based on operator actions subject to procedures and policies. The additional class notation **CYBER MANAGED** may be assigned to ships compliant with the set of requirements for critical equipment management, crew training, remote access and change management.
- The additional class notation **CYBER RESILIENT** covers cyber security measures implemented with the administrative and engineering controls subject to the requirements for procedures, software and hardware design. The additional class notation **CYBER RESILIENT** may be assigned to ships compliant with the minimum requirements regarding ships resilience when dealing with cyber-attacks.
- The additional class notation **CYBER SECURE** covers cyber security measures implemented mainly with the engineering control based on the software and hardware. The additional class notation **CYBER SECURE** may be assigned to ships compliant with the set of requirements for cyber management, equipment hardening and overall design of the systems to guarantee a defence in depth.

In compliance with [6.1.3], the additional class notation **CYBER RESILIENT** and **CYBER SECURE** are assigned a construction mark, as defined in Article [3].

The requirements for the assignment of notations **CYBER MANAGED**, **CYBER RESILIENT** and **CYBER SECURE** are given in NR659 Rules on Cyber Security for the Classification of Marine Units.

The requirements for the maintenance of the notations **CYBER MANAGED**, **CYBER RESILIENT** and **CYBER SECURE** are given in Ch 5, Sec 17.

Note 1: Ships already granted with the additional class notation **CYBER MANAGED PREPARED**, as defined in NR467 Rules for the Classification of Steel Ships July 2022 edition, may be assigned the additional class notation **CYBER MANAGED** upon satisfactorily compliance with the relevant parts of NR659.

Ch 1, Sec 2, [6]

Insert the following new sub-article [6.23]:

6.23 Smart systems (SMART)

6.23.1 The additional class notation **SMART( )** may be assigned to ships fitted with computerized based systems that incorporate smart functions for collection, transmission, analysis and visualisation of data.

These smart functions may be related to operation or maintenance of ships and may include monitoring, decision making support, remote monitoring, maintenance from shore or remote operation of systems.

The additional class notation **SMART( )** is to be completed between brackets by at least one of the following notations indicating the scope of application of the smart function:

- **Hx** for Hull
- **Mx** for Machinery
- **MHx** for Machinery Health Monitoring
- **Nx** for Navigation
- **EnEx** for Energy Efficiency
- **Xx** for Special smart function

where **x** indicates the smart group designation and can take one of the following values:

- **1** for "Computer Based ship", i.e. for ships equipped with at least one smart system, which is in accordance with requirements related to computer based systems and smart functions as specified in the relevant Sections of NR675.
- **2** for "Connected ship", i.e. for ships equipped with at least one smart system, which is in accordance with smart group **1** requirements and with additional requirements related to data infrastructures, ship-shore data communication and cybersecurity as specified in the relevant Section of NR675.

The notation **EnEx** may be complemented by one or by a combination of the following complementary notations: **-Em**, **-T**, **-LIT**, **-S**, **-W** and **-CII**.

Each smart system with a distinctive smart function may be assigned the smart group **1** or **2**.

Examples:

SMART(H1)

SMART(MH2, N1, EnE2-LIT)

The requirements for the assignment and maintenance of the additional class notation **SMART( )** are given respectively in NR675 and Ch 5, Sec 17.

Ch 1, Sec 2, [6.23.9]

Replace the first paragraph by:

The additional class notation **LNGFUEL-PREPARED** may be assigned to new ships that are designed to accommodate future installation of an LNG fuel system.

CHAPTER 2

Ch 2, Sec 2, [2.1]

Replace requirement [2.1.6] by:

2.1.6 Classification memoranda

Those defects and/or deficiencies which do not affect the maintenance of class and which may therefore be cleared at the Owner's convenience and any other information deemed noteworthy for the Society's convenience are indicated as classification memoranda.

Classification memoranda are not to be regarded as condition of class.

Insert the following new requirement [2.1.7]:

2.1.7 Statutory memoranda

Those defects and/or deficiencies which do not affect the statutory certification and which may therefore be cleared at the Owner's convenience and any other information noteworthy for the Society's convenience are indicated as statutory memoranda.

Statutory memoranda are not to be regarded as statutory recommendations

Ch 2, Sec 2, [2.2]

Add the following new requirement [2.2.21]:

2.2.21 Remote Survey

A "Remote Survey" is a process of verifying that a ship and its equipment are in compliance with the Rules where the verification is undertaken, or partially undertaken, without attendance on board by a Surveyor.

Ch 2, Sec 2, [2]

Add the following new sub-article [2.13]:

2.13 Remote survey

2.13.1 For the planning and execution of remote surveys, the requirements given in Ch 2, App 5 are to be applied.

Ch 2, App 3, [4.3]

Replace requirement [4.3.1] by:

4.3.1 Local and global strength criteria are given for the following ship types:

- general cargo ships
- bulk carriers
- oil tankers.

These criteria are generally expressed for each structural item as a maximum percentage of acceptable wastage (W). When the maximum percentage of wastage is indicated, the minimum acceptable thickness (t_{min}) is that resulting from applying this percentage to the rule thickness (t_{rule}), according to the following formula:

$$t_{min} = \left(1 - \frac{W}{100}\right) t_{rule} - t_{wc}$$

Where t_{wc} is to be taken equal to:

- 0 in general
- 1,5 mm for the inner bottom plating when not protected by any continuous wooden ceiling, for ships contracted for construction on or after January 1st 2001 and assigned one of the following service notations:
  - **bulk carrier**
  - **bulk carrier ESP,** not assigned the additional service feature **CSR**
  - **ore carrier ESP**
  - **combination carrier/OBO ESP**
  - **combination carrier/OOC ESP**

However, when the rule thickness is not available, the as-built thickness can be used.

Only for criteria related to an item (see [4.3.4], item b), the Society may establish a list of renewal thicknesses tailored to the different structural items. In such a case these thicknesses are used in lieu of the minimum thicknesses calculated from the percentage of wastage.

These criteria may also be used for other ship types taking into consideration the equivalence or similarity of structural elements and their contribution to local and/or global strength.

Chapter 2

Add the following new Appendix 5 "Remote Classification Surveys":

Appendix 5 Remote Classification Surveys

1 General

1.1 Scope

1.1.1 The surveys of ships may utilize different methods and concepts. This Section contains principles and minimum requirements for carrying out remote surveys.

Remote survey will only be appropriate provided the level of assurance is not compromised, and the survey is carried out with the same effectiveness as and is equivalent to a survey carried out with attendance on board by a Surveyor.

Note 1: Attendance on board by a surveyor means physical attendance on board the ship by a surveyor.

Note 2: Remote classification activities not requiring a survey, such as some administrative tasks, are not to be considered as remote surveys.

Note 3: An administrative task is a task where a survey decision is not being made, for example reissue of a certificate or record following a correction, or an update to the ship's records held by the Society or a document review.

1.2 Application

1.2.1 These requirements apply to all vessels, self-propelled or not.

1.3 Definitions

1.3.1 Remote survey

A “Remote Survey” is a process of verifying that a ship and its equipment are in compliance with the Rules where the verification is undertaken, or partially undertaken, without attendance on board by a Surveyor.

1.3.2 Information and communication technology (ICT)

Information and Communication Technology (ICT) are the technologies used in the scope of remote surveys for gathering, storing, retrieving, processing, analysing, and transmitting information which includes both software and hardware.

2 Requirements for equivalency

2.1 General

2.1.1 The requirements for equivalency of a remote survey to a survey attended on board by a Surveyor include:

- eligibility of the remote survey
- qualification of Surveyors
- planning of the remote survey
- performance of the remote survey
- assessment of the remote survey
- reporting.

Equivalency is obtained when, with the use of available ICT, a Surveyor can perform a survey remotely being able to:

- obtain the supporting and technical evidence required according to the applicable rules
- verify applicable survey items and relevant tests

and the results of the remote survey provide the same level of assurance obtained with attendance on board by a Surveyor.

2.2 Eligibility of the remote survey

2.2.1 Eligibility of the remote survey is to be decided based on type and scope of the requested survey, in accordance with [3.1] and, if applicable, flag State Administration acceptance and possible instructions, when the classification survey is also related to a statutory item, and the Society is carrying out the statutory survey on behalf of the flag State Administration.

A remote survey is deemed eligible when it provides the same level of assurance, according to the requirements for equivalency, as if it was conducted with attendance on board by a Surveyor.

Remote surveys are generally to be carried out with internet connection allowing a live streaming visual examination, although, at the discretion of the Surveyor, a combination of remote survey methods (see [2.4]) may be used. For simple/limited verifications, other types of ICT may be accepted by the Surveyor.

2.3 Planning of the remote survey

2.3.1 Planning of the remote survey is required to ensure that the remote survey is carried out in accordance with the applicable requirements. The content of the planning is to be based on the scope of the remote survey.

To ensure that the Surveyor can properly plan the remote survey and communicate with personnel/crew, so that the survey is carried out according to the applicable rules, adequate means are to be available enabling the Surveyor and allowing the Society to:

- properly interact with personnel/crew involved in the remote survey, before and during the survey process
- agree on ICT means to be used
- verify that personnel/crew involved in the remote survey are suitably skilled to use the electronic devices and/or software used by the Society to perform the remote survey
- acquire as deemed necessary information on identity and ranking of personnel/crew involved in the remote survey
- provide the survey item/scope to the personnel/crew involved in facilitating the remote surveys, including the tests that will be performed
- communicate, during the remote survey, additional actions depending on the evidence to be collected.

One or more of the following means is to be provided for planning the remote survey:

- live-streaming video and audio connection
- exchange of data / electronic documents
- other means acceptable to the Society.

The Owner is to provide the necessary facilities for the safe execution of the survey.

2.4 Performance of the remote survey

2.4.1 To ensure that the Surveyor can properly perform the remote survey according to the applicable rules, the available evidence must allow the attending surveyor to:

- examine and assess a survey item and/or a group of items and/or supporting documents
- verify and assess applicable tests and/or services.

The evidence provided to the Surveyor is subject to the technical evaluation and final acceptance by the Surveyor with respect to the completeness and accuracy, necessary to perform the requested survey according to the applicable requirements.

One or more of the following evidence is to be provided for performing the remote survey:

- live-streaming video and audio
- recorded videos provided by the Owner's representative
- photos provided by the Owner's representative
- other data and/or supporting documents acceptable to the Society.

2.5 Assessment of the remote survey

2.5.1 The Surveyor is to evaluate all evidence received and accept them before crediting the remote survey.

The means used for the remote survey must allow the Surveyor to collect the necessary evidence that will be examined according to the Surveyor's professional judgement in order to satisfactorily complete and credit the relevant survey items.

In case the Surveyor, according to their professional judgement, deems that the remote survey does not provide the same level of assurance as a survey with attendance on board by a Surveyor, the Surveyor may decide not to credit the relevant survey items.

3 Scope and procedures

3.1 Scope - eligible survey items

3.1.1 A remote survey may be proposed as an alternative to a survey attended on board by a Surveyor for the surveys listed in Tab 1.

When the classification survey is also related to a statutory item, and the Society is carrying out the statutory survey on behalf of the flag State Administration, then the flag State Administration acceptance is required, and possible additional requirements are to be complied with.

The Surveyor may require to confirm the results of the remote survey, by a survey attended on board by a Surveyor, to credit the relevant survey items, in case the remote survey is not carried out to the Surveyor's satisfaction or it is required by the Society.

Table 1 : Eligible remote survey items

No.	Surveys and related items eligible to remote survey	Live streaming required
1	Postponement, issuance, deletion of Condition of Class	X **(1)**
2	Postponement of Class surveys	X **(1)**
3	Items of Continuous Survey for Machinery (see Ch 2, Sec 2, [4.3]) or Planned Maintenance Scheme (see Ch 2, Sec 2, [4.4])	X **(1)**
4	Occasional survey for change of ship's name	X **(1)**
5	Occasional survey for loss of anchor	X **(1)**
6	Occasional survey for minor **(2)** machinery or equipment damage	X **(1)**
7	Occasional survey for minor **(2)** hull damage	X **(1)**
8	Occasional survey for minor **(2)** deficiencies/defects not subject to a Condition of Class	X **(1)**
9	In-water bottom survey	X
10	Specified items of a class periodical survey (excluding additional specific items of initial or renewal surveys), including completion of remaining items of a part held class periodical survey	X **(1)** **(3)**
11	Non-propelled / un-manned barges/pontoon – annual surveys when no survey of hull compartments is due	X **(1)**
12	Minor **(2)** retrofit / installation / upgrade of equipment	X **(1)**
13	Documentary or data based initial / periodical / renewal / occasional verifications and surveys	**(4)**

(1) Live streaming may not be required for minor survey scope or that a combination remote survey method, as listed in [2.4], may be used at the sole discretion of the Society

(2) "Minor" in the items 6, 7, 8 and 12 means that the item can be surveyed remotely according to requirements for equivalency given in [2]

(3) Pure documentary verifications are eligible in accordance with item 13

(4) Live streaming may be required for surveys not marked X in the Table, depending on the survey scope at the sole discretion of the Society

3.2 Procedures

3.2.1 Eligibility

Refer to [2.2].

3.2.2 Digital information quality, completeness, and accuracy

Final appraisal of the quality of digital information is at the discretion of the Surveyor, who is to be satisfied with the content and the quality of digital information collected, and the survey carried out, allowing the Surveyor to confirm its completion.

The Owner is responsible for the completeness and accuracy of digital information provided. The digital information submitted by the Owner to the Surveyor is to reflect the real situation of the surveyed item. The date and time, when a photo or video was taken are to be made available to the Surveyor or identifiable from its metadata.

The Society is to collect and store digital information as evidence of the survey. It is not necessary to store all of digital information received; the exact digital information stored is to support the survey decision and is to be decided by the Surveyor crediting the survey.

The remote survey is carried out under the supervision and upon instructions of the Surveyor, who is in charge of crediting the remote surveys. A surveyor attendance on board may be required to complete the survey, upon the Surveyor's request and at their discretion.

3.2.3 Requirements for a remote survey when live streaming is not used

When live streaming is not used, communication and digital information collection are to be performed through an ICT channels (such as emails, data streams and clouds), which is to be accepted by the Society prior to the survey.

The Owner's representative is to confirm the identity of the ship at the commencement of the survey.

3.2.4 Requirements for a remote survey when live streaming is used

The Owner's is to ensure that:

- the Owner's representative is attending on board and has access to the areas intended to be surveyed
- the Owner's representative has at his disposal a 2-ways visual and audible communication means complying with the requirements in [4]
- ICT solution is available on the communication means and meets the requirement described in [4].

In the case these requirements cannot be fulfilled, the remote survey may be rejected. The Surveyor is to verify the identity of the ship at the commencement of the survey by live streaming.

3.3 Hardware and ICT solution

3.3.1 Refer to [4.2].

3.4 Requirements for connectivity

3.4.1 The Owner's representative is to ensure that internet connectivity tests are carried out before the survey and that proper connectivity is available and maintained during the survey.

When remote survey by live streaming is being undertaken, a connection that enables live streaming between the Surveyor and the Owner's representative attending on board is required. The quality of the live streaming connection (audio and video) is to ensure proper communication and to allow the Surveyor to carry out the survey remotely, to the Surveyor's satisfaction. In the case where a live streaming connection with the Surveyor is not possible or is not continuous at the place of the survey (e.g., Engine Room), partly online sequences (where the Owner is able to capture pictures and videos offline of those items not covered by live streaming) may be accepted by the Surveyor.

4 Information and Communication Technology (ICT)

4.1 General

4.1.1 This Article outlines the minimum requirements for the use of ICT that can capture images, record video and/or live stream video or other data from a ship as considered acceptable to the Society.

4.2 Hardware

4.2.1 The Owner is responsible for ensuring that all hardware installations on board used for the remote survey comply with the applicable requirements relevant for use and location on board, including hazardous areas. The ICT is to typically consist of:

- A host computer device, to receive the streaming of images/data/video. This is usually a laptop or desktop computer compatible with the software application used for the remote survey.
- Onboard standalone device which may include digital cameras capable of capturing videos/photos/data.
- Onboard smart device compatible with the applicable software/technology.
- Communication accessories like headphones and microphone for the noisy environment as applicable and as deemed necessary.

Note 1: The smart device may be a smartphone, tablet, computer, wearable device, smart glass, digital camera, or any other device which can be connected to the network and capable of transmitting the necessary data/images to shore.

The communication equipment used for the live streaming is to have the following minimum functionality:

- both ends are to simultaneously see the same image/videos in near real-time (i.e., live streaming)
- two-way direct voice communication
- possibility to take screenshots.

When using a portable device on board for live streaming, the movement of the handheld device may affect the stability of the video and the image, leading to lower quality outputs. When necessary, a suitable anti-shake device is to be used to provide proper stability.

Note 2: The host computer screen is to be able to present an image quality that is sufficient to enable a survey decision to be made.

Note 3: Portable equipment on board is to be equipped with a power capacity suitable for the intended scope and time of the survey.

4.3 Internet connectivity (coverage and speed)

4.3.1 For internet connectivity requirements on board, refer to [3.4].

The onboard smart devices are to have the capability of transmitting the images/video/data over a Cellular, Wi-Fi or Satellite Connection to the remote Surveyor.

When live streaming communication is applied, the internet connection is to have sufficient and stable bandwidth capacity to ensure quality (such as resolution and frame rate) of the direct colour image/video and voice communication to the remote survey location to the satisfaction of the Surveyor.

4.4 Software and data security

4.4.1 The software used for the remote survey is to be acceptable to the Society. The overall function and ability of the software used to ensure the security of data are to be evaluated prior to use as per the below requirements.

The Surveyor is to normally control the live video call, providing instructions to the on-site personnel/crew and supervising survey activities for capturing relevant information. The onboard device is to have the capability of transmitting the data over a Cellular, Wi-Fi, or Satellite Connection to the Surveyor.

The software used to perform the remote survey may also be provided with technologies that support the Surveyor in the process of making a decision, such as:

- Artificial Intelligence (AI) for the recognition and the classification of defects.
- Internet of things (IoT) for collecting parameters and evaluating acceptability/working condition of machinery and equipment.
- Data driven verification or other means considered acceptable by the Society.

The above software and technologies are to be evaluated and accepted by the Society in each case.

When considering the use of software/applications and other technologies, data protection are to be considered in accordance with applicable requirements of the Society before the remote survey is commenced. The software/application used to perform the remote survey is to be compatible with the technical requirements detailed in this paragraph; in addition, the software used is to comply with the Society's applicable requirements for:

- cybersecurity
- data protection and confidentiality for the transmitted data.

When not provided by the Society itself, the audio/video software or application used to perform the remote survey is to be accepted by the Society.

During the survey preparation, it is the Owner's responsibility to ensure that their data security policies are implemented as per the Company's Safety Management System.

Note 1: The Company's SMS may take into account IMO resolution MSC.428(98), MSCFAL.1/Circ.3 and IACS Rec.166.

5 Recording of evidence and reporting of survey

5.1 Recording of evidence

5.1.1 Required evidence

Refer to [2.4].

In principle, live streaming video and audio are to be applied to remote surveys as a primary means (refer to Tab 1).

Additionally, and/or alternatively, one or more of the following evidence may be submitted or verified as requested by the Surveyor during remote survey so that the Surveyor is able to verify conditions of survey items:

- Recorded video and audio.
- Photos.
- Master's/chief engineer's statement.
- Ship's logbook.
- Owner's confirmation.

a) Live streaming video and audio:

Live streaming video and audio using ICT are to be in accordance with the requirements in [4].

b) Recorded videos/photos:

For the recorded videos/photos, the following information is to be available:

- confirmation that they were actually taken on the ship by the Owner's representative
- date and time when they were taken
- identity of the personnel/crew responsible for taking evidence.

c) Master's/chief engineer's statement:

Recorded videos/photos provided by the Owner's representative may be supplemented with a statement signed by the master and/or the chief engineer confirming the condition of the items shown in the evidence. The final evaluation of the remote survey by the Surveyor is to be based on all of the provided evidence, and it does not delegate the responsibility to the master/chief engineer's statement only.

d) Ship's logbook:

The Master is to make entries into ship's logbook on the following occasions and submit copies of the relevant pages when requested by the Surveyor:

- when a remote survey is carried out by the Surveyor
- when videos/photos are taken and submitted to the Surveyor with the master's/chief engineer's statement and additional documents as applicable.

e) Owner's confirmation:

The Owner's representative or the master is to confirm the correctness and completeness of the provided information and evidence (if any) relevant to the condition of the items requested to be surveyed. This confirmation may be included in the survey application.

5.1.2 Retaining/filing evidence

The evidence submitted by the Owner's representative or master is to be retained/filed in accordance with the Society's procedures which are to include:

- type of evidence to be retained/filed
- duration/location to be retained/filed.

It is not required for the Society to record and save live streaming video and audio as evidence unless the Surveyor considers it necessary.

5.1.3 Other supporting documents

The Surveyor may request the Owner's representative or master to submit supplementary documents such as ship's maintenance reports and record for the operation of machinery and equipment and service reports issued by manufacturers, service suppliers or service providers.

While the Surveyor is to verify that the documents are duly prepared and issued to the ship, they may not be required to be retained/filed by the Society as evidence.

5.2 Reporting of remote survey

5.2.1 The report of a remote survey is to be issued in accordance with the Society's procedure. The survey report is also to include the following additional information:

- indication that the survey was carried out remotely
- description of the means used during the remote survey
- indication of the provided evidence
- confirmation of the Flag State Administration's authorization, when applicable.

CHAPTER 3

Ch 3, Sec 1, [3.1]

Add the following new requirement [3.1.7]:

3.1.7 When the ship is equipped with a ballast water treatment system using an inert gas generator and where this inert gas generator is used solely for the purpose of ballast water treatment, the annual survey is to include the relevant items of Ch 4, Sec 3, [3.4].

Ch 3, Sec 1, [3.3.4]

Replace the first item of the bulleted list by:

- Annual measurement, as a minimum, of the harmonic distortion levels of main busbars under seagoing conditions as close to the periodical machinery survey as possible so as to give a clear representation of the condition of the entire plant to the Surveyor. Harmonic distortion readings are to be carried out when the greatest amount of distortion is indicated by the measuring equipment. An entry showing which equipment was running and/or filters in service is to be recorded in the log so this can be replicated for the next periodical survey. Harmonic distortion levels are also to be measured following any modification to the ship's electrical distribution system or associated consumers by suitably trained ship's personnel or by a qualified outside source.

Ch 3, Sec 1, [3.3]

Add the following new requirements [3.3.5] and [3.3.6]:

3.3.5 For Li-Ion batteries of a capacity above 20kWh or used as emergency source or transitional source, the survey is to include:

- general examination of the battery pack(s)
- general examination of the battery monitoring system
- general examination of the battery support system
- general examination of the battery compartment, including visual check of the safety measures and functions related to battery spaces, i.e. battery installation, ventilation, fire safety measures and alarms
- check of the electrolyte level and pH level
- check of State of health (SOH) of battery system according to the Manufacturer's specification and verification that the battery capacity has been regularly recorded and complies with the parameters specified by the Manufacturer
- test of sensor and alarm associated to the battery at random
- undertaking of measurement of insulation of battery packs
- additional checks when some specific part of the battery is or has been replaced (e.g. battery cells, BMS) according to the Manufacturer specification and to the satisfaction of the Surveyor.

3.3.6 For batteries used for electrical supply of pods, the survey is to include:

- verification of proper working of monitoring systems
- verification of proper working of alarms and defaults and related functions and/or interfacing to the other ship systems
- disconnection of the electrical storage system (ESS) in different operating modes, and automatic start of stand-by source, as necessary
- test of the fire detection of the battery compartment
- test of the gas detection system of the battery compartment
- examination of the fire-extinguishing system of the battery compartment as applicable in accordance with the relevant requirements given in [3.4]
- verification that accessibility for common maintenance and devices for battery overhaul, if any, are maintained.

Ch 3, Sec 3, Table 3

Replace the second row of Table 3 as follows:

Table 3: Requirements for thickness measurements at class renewal survey

Age of ship (in years at time of class renewal survey)			
Class renewal survey No.1 age ≤ 5	Class renewal survey No.2 5 < age ≤ 10	Class renewal survey No.3 10 < age ≤15	Class renewal survey No.4 and subsequent age > 15
	One transverse section of deck plating within the amidships 0,5 L (in way of a cargo space, if applicable)	Two transverse sections within the amidships 0,5L (in way of two cargo spaces, if applicable) **(2)**	A minimum of three transverse sections within the amidships 0,5L (in way of cargo spaces, if applicable) **(2)**

Ch 3, Sec 3, [3.5]

Add the following new requirement [3.5.11]:

3.5.11 When the ship is equipped with a ballast water treatment system using an inert gas generator and where this inert gas generator is used solely for the purpose of ballast water treatment, the class renewal survey is to include the relevant items of Ch 4, Sec 3, [7.3].

Ch 3, Sec 3, [3.6.13]

Replace the first item of the bulleted list by:

- Annual measurement, as a minimum, of the harmonic distortion levels of main busbars under seagoing conditions as close to the periodical machinery survey as possible so as to give a clear representation of the condition of the entire plant to the surveyor. Harmonic distortion readings are to be carried out when the greatest amount of distortion is indicated by the measuring equipment. An entry showing which equipment was running and/or filters in service is to be recorded in the log so this can be replicated for the next periodical survey. Harmonic distortion levels are also to be measured following any modification to the ship's electrical distribution system or associated consumers by suitably trained ship's personnel or by a qualified outside source.

Ch 3, Sec 3 [3.6]

Add the following new requirements [3.6.14] and [3.6.15]:

3.6.14 For Li-Ion batteries of a capacity above 20kWh or used as emergency source or transitional source, the requirements given in Sec 1, [3.3.5] for annual survey are to be complied with.

In addition:

- a comprehensive test of indication and alarms is to be carried out
- the traceability of cells replacement is to be checked
- the traceability of software modification is to be checked
- a battery capacity (State of Health - SOH) test is to be witnessed when:
  - release of flammable or toxic gases during battery operation was identified
  - loss of battery might jeopardize the manoeuvrability of the ship.

3.6.15 For batteries used for electrical supply of pods, the requirements given in Sec 1, [3.3.6] for annual survey are to be complied with.

In addition the class renewal survey is to include:

- verification of the quality of the power supply
- examination of the fire-extinguishing system as applicable in accordance with the relevant requirements given in [3.8].

CHAPTER 4

Ch 4, Sec 3, Table 3

Replace the second and third rows as follows:

Add the table footnote (4):

Table 3: Thickness measurements at class renewal survey of oil tankers and combination carriers

Age of ship (in years at time of class renewal survey)			
Class renewal survey No.1 age ≤ 5	Class renewal survey No.2 5 < age ≤ 10	Class renewal survey No.3 10 < age ≤ 15	Class renewal survey No.4 and subsequent age > 15
One section of deck plating for the full beam of the ship within the cargo area (in way of a ballast tank, if any, or a cargo tank used primarily for water ballast) **(4)**	Within the cargo area: • each deck plate **(1)** • 1 transverse section **(2)**	Within the cargo area: • each deck plate **(1)** • 2 transverse sections **(2) (3)** • all wind and water strakes	Within the cargo area: • each deck plate **(1)** • 3 transverse sections **(2) (3)** • each bottom plate
Measurements, for general assessment and recording of corrosion pattern, of those structural members subject to close-up survey according to Tab 1 **(4)**	Measurements, for general assessment and recording of corrosion pattern, of those structural members subject to close-up survey according to Tab 1 and Tab 2	Measurements, for general assessment and recording of corrosion pattern, of those structural members subject to close-up survey according to Tab 1 and Tab 2	Measurements, for general assessment and recording of corrosion pattern, of those structural members subject to close-up survey according to Tab 1 and Tab 2
(1) For combination carriers only the deck plating outside line of cargo hold hatch openings is to be measured. **(2)** Transverse sections are to be chosen where the largest reductions are likely to occur or as revealed by deck plating measurements. **(3)** At least one section is to be within 0,5 L amidships and, where applicable, in way of a ballast tank. **(4)** Not applicable to double hull oil tankers.			

Ch 4, Sec 4, Table 3

Replace the second and third rows as follows:

Table 3: Requirements for thickness measurements at class renewal survey of chemical tankers

Age of ship (in years at time of class renewal survey)			
Class renewal survey No.1 age ≤ 5	Class renewal survey No.2 5 < age ≤ 10	Class renewal survey No.3 10 < age ≤ 15	Class renewal survey No.4 and subsequent age > 15
	Within the cargo area: • each deck plate • one transverse section **(1)**	Within the cargo area: • each deck plate • two transverse sections **(1) (2)** • selected bottom plates • all wind and water strakes	Within the cargo area: • each deck plate • three transverse sections **(1) (2)** • each bottom plate
	Measurements, for general assessment and recording of corrosion pattern, of those structural members subject to close-up survey according to Tab 1 or Tab 2, as applicable	Measurements, for general assessment and recording of corrosion pattern, of those structural members subject to close-up survey according to Tab 1 or Tab 2, as applicable	Measurements, for general assessment and recording of corrosion pattern, of those structural members subject to close-up survey according to Tab 1 or Tab 2, as applicable

CHAPTER 5

Ch 5, Sec 1, Table 1

Replace rows "Integrated ship systems", "Monitoring equipment", "Environmental protection", '"Cargo operation, security and safety" and "Additional notations for computer based systems and cyber security" as follows:

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

Additional class notation	Section or Article applicable in this Chapter	Type of surveys affected by these specific requirements
Integrated and digital systems: **SYS-NEQ** and **SYS-NEQ-1** **SYS-COM** **SYS-IBS** and **SYS-IBS-1** **ASYNC-COM** and **ASYNC-COM-R** **DATA-INFRA** and **DATA-INFRA-STAND**	Ch 5, Sec 5	annual survey class renewal survey
Monitoring equipment: **MON-HULL** **MON-SHAFT** **MON-ICE L(i)** and **MON-ICE G** **CII-REALTIME**	Ch 5, Sec 6	annual survey class renewal survey tailshaft survey
Environmental protection: **CLEANSHIP** and **CLEANSHIP CEMS** **CLEANSHIP SUPER( )** and **CLEANSHIP SUPER( ) CEMS** **AWT-A**, **AWT-B** and **AWT-A/B** **BWE** **BWT** **GWT** **GWT-B** **NDO-x days** **OWS-x ppm** **NOX-x%** **SOX-x%** **EGCS-SCRUBBER** **SEEMP** **ULEV** **VCS**	Ch 5, Sec 8	annual survey intermediate survey class renewal survey
Cargo operation, securing and safety: **CARGOCONTROL** **EVOC**	Ch 5, Sec 13	annual survey class renewal survey
Additional notations for cyber security and computer based systems: **CYBER MANAGED** **CYBER RESILIENT** **CYBER SECURE** **SMART( )**	Ch 5, Sec 17	annual survey intermediate survey class renewal survey

Ch 5, Sec 5

Replace the title of Section 5 by:

Section 5 Integrated and Digital Systems

Ch 5, Sec 5, [1.1]

Replace requirement [1.1.1] by

1.1.1 The requirements of this Section apply to ships which have been assigned one of the following additional class notations related to integrated and digital systems, as described in Ch 1, Sec 2, [6.5]:

SYS-NEQ or **SYS-NEQ-1**

SYS-COM

SYS-IBS or **SYS-IBS-1**

ASYNC-COM or **ASYNC-COM-R**

DATA-INFRA or **DATA-INFRA-STAND**

Ch 5, Sec 5, [2]

Add the following new sub-articles [2.5] and [2.6]:

2.5 Notations ASYNC-COM and ASYNC-COM-R

2.5.1 The annual survey includes checking the following items:

- transmission log for the last month to confirm regular data exchanges by connected systems
- subscription validity for the external communication provider for the communication devices in use by onboard connected systems
- visual examination of antennas and cabling of the communication devices
- checking if the connected system has been operated within the geographic area of the redundant coverage by randomly checking the latest passage plans and reports for activities which involve the use of the connected system (for notation **ASYNC-COM-R**)
- a test of a communication device changeover following a simulated single failure due to a loss of the power supply as per the FMEA test programme for the ship-shore communication system (for notation **ASYNC-COM-R**).

2.6 Notations DATA-INFRA and DATA-INFRA-STAND

2.6.1 The Owner has to declare to the Society any major modifications to the data infrastructure.

2.6.2 The annual survey includes checking, the following items:

- general visual examination of the network devices
- ship-shore communication subscription has not been downgraded

  Note 1: In case of diminution of the ship-shore subscription, new tests may be carried out at the discretion of the Society.
- record of failures log
- calibration of sensors and equipment, when applicable
- verification that the documentation listed in Part F, Ch 4, Sec 4, Tab 1, items 9 and 10 is available on board.
- check of the Service Level Definition report as defined in Part F, Ch 4, Sec 4, [10.4]
- personnel for network maintenance is identified and familiar with the dedicated documentation and procedures.

Ch 5, Sec 5, [3]

Add the following new sub-articles [3.2] and [3.3]:

3.2 Notations ASYNC-COM and ASYNC-COM-R

3.2.1 In addition to the scope in [2.5] the class renewal survey includes the following items:

- demonstration of a two-way transmission of the two test data packages between the ship and the shore in the scope of testing the communication management software
- checking the transmission schedule in the communication management software
- checking the transmission log to confirm that the test data is transferred in an order established by the priority
- complete testing of the protection, detection and alarms as per the FMEA test programme for the ship-shore communication system (**ASYNC-COM -R**).

3.3 Notations DATA-INFRA and DATA-INFRA-STAND

3.3.1 In addition to the scope in [2.6] the class renewal survey includes the following items:

- on board testing as per Pt F, Ch 4, Sec 4, [11.2].

Ch 5, Sec 6, [1.1.1]

Add the following item in the list:

CII-REALTIME

Ch 5, Sec 6

Add the following Article [5]:

5 Real-time carbon intensity indicator (CII-REALTIME)

5.1 Annual survey

5.1.1 The annual survey includes checking of the following items for CII ODS (Onboard Digital Solution):

- reports generated available on board by the CII ODS as listed in Part F, Ch. 5, Sec 3 [2.1.4] at the time of survey in compliance with the regulations indicated in the Type Approval Certificate and the applicable regulations when the annual survey is performed
- maintenance records for the entries concerning hardware repair, maintenance or replacement of equipment or components
- maintenance and calibration records for the measurement instrumentation for the fuel quantity stored and transferred.

5.2 Class renewal survey

5.2.1 In addition to the scope of the annual survey as listed in [5.1.1], the class renewal survey includes the following items:

- functional test of the CII ODS (Onboard Digital Solution) by completion of entries for one day
- when calculations can be done by the CII ODS, functional test of the CII ODS by checking the results of calculations against the endorsed test datasets
- functional test by synchronising the CII ODS with the CII SDS (Shore Digital Solution)
- functional test of the CII SDS by viewing the Continuous CII updated with the new entries created on board as a part of the test, the CII SDS is to be accessed by an external Internet connection
- when calculations can be done by the CII SDS, functional test of the CII SDS by checking the results of calculations against the endorsed test datasets.

Ch 5, Sec 8, [1.1.1]

Replace the list by:

CLEANSHIP or **CLEANSHIP-CEMS**

CLEANSHIP SUPER( ) or **CLEANSHIP SUPER( )-CEMS**

AWT-A or **AWT-B** or **AWT-A/B**

BWE

BWT

GWT

GWT-B

NDO-x days

OWS-x ppm

NOX-x%

SOX-x%

EGCS-SCRUBBER

SEEMP

ULEV

VCS

Ch 5, Sec 8, [2.2.1]

Replace the last paragraph by:

For some pollution prevention system of [1.1.1], the survey is also to include, as far as practicable:

- ascertainment of the correct concentration of the disinfectant in the effluent (for **CLEANSHIP**, **CLEANSHIP SUPER**, **AWT-A**, **AWT-B**, **AWT-A/B**, **GWT** and **GWT-B**)
- ascertainment of possible concentration of other chemicals in the effluent (for **CLEANSHIP**, **CLEANSHIP SUPER**, **AWT-A**, **AWT-B**, **AWT-A/B**, **GWT** and **GWT-B**).

Ch 5, Sec 8, [2.2.2]

Replace the 5th bullet of the bulleted list by:

- sewage and grey water discharge book (for **CLEANSHIP**, **CLEANSHIP SUPER**, **GWT**, **GWT-B** and **AWT-A**, **AWT-B**, **AWT-A/B**)

Ch 5, Sec 13

Replace Article [1] by:

1 General

1.1

1.1.1 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, [6.16]:

CARGOCONTROL

EVOC

Add the following new Articles [2] and [3]:

2 CARGOCONTROL

2.1 General

2.1.1 The requirements of this Article apply to ships which have been assigned the following additional class notation **CARGOCONTROL** as described in Ch 1, Sec 2, [6.16.5].

2.2 Annual survey

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

2.2.2 The annual survey is to include:

- a general examination of the items of equipment regarding remote control of operations and gauging/alarms provided for all those parameters that are required to be kept under control to verify their satisfactory condition
- a running test which may be also performed by a spot check method.

2.3 Class renewal survey

2.3.1 The requirements given in [2.2] for annual survey are to be complied with. Additionally, the following is to be carried out:

- a check and test of the instrumentation fitted to the components of the system
- an overall running test of the system.

3 EVOC

3.1 General

3.1.1 The requirements of this Article apply to ships which have been assigned the following additional class notation **EVOC** as described in Ch 1, Sec 2 [6.16.11].

3.2 Annual survey

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

3.2.2 The annual survey is to include:

- a general examination of the charging stations with a visual inspection of the safety measures and functions related to the recharging area (e.g. visual check on the charging stations and their cable assemblies, fire safety measures and alarms, ventilation, possibility of disconnection of the charging stations, …)
- verification that the charging equipment, cables and sockets are maintained according to the maintenance plan
- verification of proper working of alarms involving defaults and malfunctions related to the charging stations and cable assemblies
- examination and testing, as feasible at random, of the fixed fire detection and fire alarm system
- checking of portable thermal imaging camera, fire blanket and water fog applicators and confirmation that they are stored in the appropriate location
- in case the recharging area is located on the weather deck, the following items are to be checked with respect to the fixed water monitors covering this area:
  - general examination of all parts of the water monitor system (pumps, piping system, valves and other fittings)
  - checking for proper operation of the system, including local manual control and remote control
  - general examination of foundations of water monitors.

3.3 Class renewal survey

3.3.1 The requirements given in [3.2] for annual survey are to be complied with. In addition, the class renewal survey is to include:

- a comprehensive test of indications and alarms
- verification of the quality of the power supply intended for electric vehicles (EV) charging
- verification if the charging stations maintenance is performed according to the manufacturers' recommendation
- examination of the fire-extinguishing system and fire detection system as applicable in accordance with the relevant requirements given in Ch 3, Sec 3, [3.8]
- operational testing and internal examination of the pumps feeding the water monitors covering recharging areas on weather deck, if provided
- testing of the electrical installation to the same extent as required in Ch 3, Sec 3, [3] for similar equipment for the class renewal survey of machinery
- testing of the cooling installation of the charging station.

Ch 5, Sec 17

Replace Article [1] by:

1 General

1.1

1.1.1 The requirements of this Section apply to ships which have been assigned one of the following additional class notations related to cyber security as described in Ch 1, Sec 2, [6.21] and smart systems as described in Ch 1, Sec 2 [6.23]:

CYBER MANAGED

CYBER RESILIENT

CYBER SECURE

SMART( )

Add the following new Articles [2] and [3]:

2 CYBER

2.1 General

2.1.1 The surveys for maintaining the additional class notations **CYBER MANAGED**, **CYBER RESILIENT** and **CYBER SECURE** are to be systematically recorded along with all cyber security events, as set out in the Policy document: date, actors, tests performed, results and conclusions.

2.2 Annual surveys

2.2.1 Documents

Confirmation from Cyber Security Responsible, that any modification carried out on the approved documents as listed in NR659 has been declared to the Society.

2.2.2 Surveys

The annual survey is to confirm that:

- the Cyber Handbook present on board is the up to date and approved
- Cyber Security events are logged
- crew cyber training is logged
- up to date and approved Cyber Policy is printed and available on board
- during the interview by the Surveyor, the Person in charge of Cyber is able to answers the questions related to crew training described in the Cyber Policy
- during the interview by the Surveyor, the person in charge of the equipment mentioned in the Cyber Handbook is aware of the monitoring procedures described in the document and knows how to implement the procedures
- during the interview by the Surveyor, the relevant crew demonstrates a complete understanding of the equipment maintenance procedures described in the Cyber Handbook for the equipment they use regularly
- during the interview by the Surveyor, the relevant crew demonstrates that they fully understand the incident response procedures described in the Cyber Handbook for the equipment they use on a daily basis.

2.3 Intermediate surveys

2.3.1 Documents to be updated

Regarding Level 3 equipment only, the following documents are to be updated:

- Cyber Risk Analysis and Criticality Assessment
- Cyber Inventory (system identification part)
- Cyber Handbook, reflecting procedures only for the critical updated systems.

2.3.2 Evidences to be submitted

Evidence of implementation of cyber security rules (from the Policy), crew training (as described in Policy), maintenance procedures (from the Handbook) and incident response procedures (from the Handbook) must be provided.

2.3.3 Surveys

In addition to the requirements given in [2.2.2] for annual surveys, the intermediate survey is to include:

- confirmation that, during the interview, the person in charge of Cyber demonstrates awareness on Cyber Policy and its implementation
- confirmation that, during the interview, the person in charge of Cyber answers the questions related to the responsibilities described in the Policy
- confirmation that any anti-virus usage and update is in accordance with the Cyber Policy
- confirmation that, during the interview, the person in charge of an equipment present in the Handbook is aware of the remote access monitoring procedures described in the Handbook and knows how to implement them.

2.4 Class renewal surveys

2.4.1 Documents to be updated

The following documents are to be updated:

- Cyber Risk Analysis.

Regarding Level 2 and Level 3 equipment only, the following documents are to be updated:

- Cyber Inventory (system identification part).

2.4.2 Evidences to be submitted

Evidence of implementation of cyber security rules (from the Policy), crew training (as described in Policy), maintenance procedures (from the Handbook) and incident response procedures (from the Handbook) must be provided.

2.4.3 Surveys

In addition to the requirements given in [2.2.2] for annual survey and in [2.3.3] for intermediate survey, the class renewal survey is to include:

- confirmation that the password policy present in the Policy is effectively implemented on board
- confirmation that, during the interview, the person in charge of an equipment present in the Handbook is aware of the wireless monitoring procedures described in the Handbook and knows how to implement them
- confirmation that, during the interview, the relevant crew demonstrates their complete understanding of the software maintenance procedures described in the Handbook for the equipment they use on a daily basis.

3 SMART( )

3.1 Application

3.1.1 The present Article defines the requirements for the maintenance of the additional class notation **SMART( )**.

3.1.2 The applicable requirements for the maintenance of the additional class notations which are referred to in NR675 are prerequisites for the maintenance of the notations **SMART(H1)**, **SMART(H2)**, **SMART(M1)**, **SMART(M2)**, **SMART(MH2)**, **SMART(N1)**, **SMART(N2)**, **SMART(EnEx-CII)**, **SMART(EnE2)** and **SMART(X2)**.

3.1.3 The annual and class renewal surveys applicable to the Computer Based Systems and the Software Registry, in particular, are to be completed as defined in Ch 3, Sec 1, [3.3.3] and in Ch 3, Sec 3, [3.6.12] respectively.

3.1.4 In addition to requirements of [3.1.2] and [3.1.3], the maintenance of **SMART(MHx)**, **SMART(EnEx)** and **SMART(Xx)** is to comply with the applicable requirements of [3.2] and [3.3].

3.2 Annual surveys

3.2.1 SMART(MHx)

The annual survey for **SMART(MHx)** includes checking the following items:

- reports generated by the smart system during the last 12 months
- maintenance records for the entries concerning hardware repair, maintenance or replacement of equipment or components
- maintenance and calibration records for the connected measurement instrumentation.

3.2.2 SMART(EnEx)

The annual survey for **SMART(EnEx)** includes checking the following items:

- reports defined in NR675, Sec 5, [2.4.1] items a), b) and c) generated during the last 12 months
- maintenance records for the entries concerning hardware repair, maintenance or replacement of equipment or components
- maintenance and calibration records for the connected measurement instrumentation.

Addtional requirements for complementary notations **-Em**, **-T**, **-LIT**, **-S**, **-W** and **-CII** are defined in [3.2.3] to [3.2.8].

3.2.3 SMART(EnEx-Em)

In addition to the scope of the annual survey defined in |3.2.2], the annual survey for the complementary class notation **-Em** includes checking, as a minimum the following items:

- reports generated for emission performance indicators during the last 12 months.

3.2.4 SMART(EnEx-T)

In addition to the scope of the annual survey defined in |3.2.2], the annual survey for the complementary class notation **-T** includes checking, as a minimum the following items:

- records of energy consumption assigned to the loading conditions under which the ship sailed in the past 12 months.

3.2.5 SMART(EnEx-LIT)

In addition to the scope of the annual survey defined in |3.2.2], the annual survey for the complementary class notation **-LIT** includes checking, as a minimum the following items:

- records of loading conditions under which the ship sailed in the past 12 months with the corresponding energy efficiency performance indicators.

3.2.6 SMART(EnEx-S)

In addition to the scope of the annual survey defined in |3.2.2], the annual survey for the complementary class notation **-S** includes checking of the following items:

- three latest voyage reports, which are to incorporate the planned and the actual energy efficiency parameters established.

3.2.7 SMART(EnEx-W)

In addition to the scope of the annual survey defined in |3.2.2], the annual survey for the complementary class notation **-W** includes checking of the following items:

- three latest voyage reports by comparing against the relevant surface weather analysis reports.

3.2.8 SMART(EnEx-CII)

In addition to the scope of the annual survey defined in |3.2.2], the annual survey for the complementary class notation **-CII** includes checking of the following items:

- list of alarms generated by the CII ODS for the discrepancies between the manual and automatic entries.

3.2.9 SMART(Xx)

The annual survey for **SMART(Xx)** includes checking of the following items:

- reports generated by the smart system during the last 12 months
- maintenance records for the entries concerning hardware repair, maintenance or replacement of equipment or components
- maintenance and calibration records for the connected measurement instrumentation.

3.3 Class renewal survey

3.3.1 SMART(MHx)

In addition to the scope of the annual survey defined in [3.2.1], the class renewal survey for **SMART(MHx)** includes the following items:

- consistency check of parameter trends with the recent operation of the equipment. Consistency check is completed by extracting data for a period of 1 to 12 months in a readable format for a review by a Surveyor of the Society. This may include, but not limited to, raw time series, descriptors, diagnostic assessments selected at the discretion of a Surveyor. The preferred format is a report or a non-encrypted delimited text file easily readable on a PC
- functional test by generating a recommended maintenance profile
- functional test by generating a condition report for the list of equipment considered in the scope of the notation
- functional test by generating a condition report in a test mode with a simulated introduction of incipient failures. This condition report is to be used to compare the results to a corresponding pre-calculated test case.

3.3.2 SMART(EnEx)

In addition to the scope of the annual survey defined in [3.2.2], the class renewal survey for **SMART(EnEx)** includes the following items:

- consistency check between the SEEMP and the reports defined in NR675, Sec 5, [2.4.1] items a), b) and c) for a period of 12 months
- general examination of the list of time series with uptime history and source equipment
- functional test by generating recommended performance profile for the latest operational conditions typical for the ship's trade in the last 12 months
- functional test by simulating energy consumption and emissions for a laden voyage and for a port activity and comparing the results to an equivalent profile recorded during the last 12 months.

Addtional requirements for complementary notations **-Em**, **-T**, **-LIT**, **-S**, **-W** and **-CII** are defined in [3.3.3] to [3.3.8].

3.3.3 SMART(EnEx-EM)

In addition to the scope of the class renewal survey defined in [3.3.2], the class renewal survey for the complementary class notation **-Em** includes the following items:

- functional test by estimating an emission performance indicator for three last loading conditions under which the ship sailed in the preceding 12 months.

3.3.4 SMART(EnEx-T)

In addition to the scope of the class renewal survey defined in [3.3.2], the class renewal survey for the complementary class notation **-T** includes the following items:

- functional test by estimating the energy consumption for three last loading conditions under which the ship sailed in the preceding 12 months.

3.3.5 SMART(EnEx-LIT)

In addition to the scope of the class renewal survey defined in [3.3.2], the class renewal survey for the complementary class notation **-LIT** includes the following items:

- consistency check of three loading conditions under which the ship sailed in the preceding 12 months with a focus on the corresponding energy efficiency performance indicators and on the compliance to the intact stability and hull girder criteria
- functional test by generating an optimized stowage plan for the last laden voyage.

3.3.6 SMART(EnEx-S)

In addition to the scope of the class renewal survey defined in [3.3.2], the class renewal survey for the complementary class notation **-S** includes the following items:

- consistency check of three latest voyage reports, which is to incorporate the planned and the actual energy efficiency parameters established
- functional test by generating an optimized voyage plan for the last laden voyage
- if the smart system automatically transfers the route to the ship's ECDIS: functional test for the automatic display of the optimized voyage plan in ECDIS in both planning mode and voyage execution mode with a thorough examination of the safety contour alerts produced by the ECDIS in relation to the route

3.3.7 SMART(EnEx-W)

In addition to the scope of the class renewal survey defined in [3.3.2], the class renewal survey for the complementary class notation **-W** includes the following items:

- consistency check of onboard procedures for managing the weather routing information to confirm that the weather routing system is regularly updated with the surface analysis information
- functional test by generating an optimized ocean voyage plan
- if the smart system automatically transfers the route to the ship's ECDIS: functional test for the automatic display of the optimized voyage plan in ECDIS in both planning mode and voyage execution mode with a thorough examination of the safety contour alerts produced by the ECDIS in relation to the route.

3.3.8 SMART(EnEx-CII)

In addition to the scope of the class renewal survey defined in [3.3.2], the class renewal survey for the complementary class notation **-CII** includes the following items:

- items in the scope of the annual survey as per [3.2.8]
- functional test of CII ODS (Onboard Digital Solution) by completion of entries for one day.

3.3.9 SMART(Xx)

In addition to the scope of the annual survey defined in [3.2.9], the class renewal survey includes the following items:

- consistency check of the list of time series with uptime history and source equipment
- functional test by generating a report relevant for the onboard process supported by the smart system.

Amendments to PART B

CHAPTER 1

Ch 1, Sec 4, [1.1.1]

Add the following paragraphs at the end of requirement [1.1.1]:

The structural drawings are to indicate for each structural element the as-built scantling and the renewal thickness as specified in Pt A, Ch 2, App 3, [4.5.3]. If thickness for voluntary addition, as defined in Ch 4, Sec 2, is included in the as-built thickness, this is to be clearly mentioned and identified on the drawings.

An alternative means for reporting the renewal thicknesses may be accepted by the Society on a case-by-case basis.

CHAPTER 2

Ch 2, Sec 2

Add the following new Article [11]:

11 Tanks containing solvent for onboard carbon capture systems (ships assigned the additional service feature OCC)

11.1 Tank protection and segregation

11.1.1 Tanks containing solvent (as defined in *(new)* Pt C, Ch 1, Sec 12, [1.3.5]) for OCC are to comply with the requirements of *(new)* Pt C, Ch 1, Sec 12, [2.4.4].

CHAPTER 3

Ch 3, Sec 2, [2.1.2]

Replace Note 1 by:

Note 1: θ_f is an angle of heel at which openings in the hull, superstructures or deckhouses which cannot be closed weathertight submerge.

In applying this criterion, openings which cannot be closed weathertight include ventilators that have to remain open to supply air to the engine room, to the emergency generator room or to closed ro-ro and vehicle spaces for the effective operation of the ship, but exclude small openings through which progressive flooding cannot take place. This interpretation is not intended to be applied to existing ships.

The means of closing air pipes are to be weathertight and of an automatic type if the openings of the air pipes to which the devices are fitted would be submerged at an angle of less than 40 degrees (or any lesser angle which may be needed to suit stability requirements) when the ship is floating at its summer load line draught. Pressure/vacuum valves (P.V. valves) may be accepted on tankers. Wooden plugs and trailing canvas hoses may not be accepted in positions 1 and 2 as defined in Ch 1, Sec 3, [2.4].

Ch 3, Sec 3, [3.3.2]

Replace the first item of the bulleted list by:

- Unprotected

  Unprotected openings may lead to progressive flooding if they are situated within the range of the positive righting lever curve or if they are located below the waterline after damage (at any stage of flooding). Unprotected openings are openings which are not fitted with at least weathertight means of closure, or ventilators that have to remain open to supply air to the engine room, to the emergency generator room or to closed ro-ro and vehicle spaces for the effective operation of the ship.

Ch 3, App 2, [1.2]

Delete requirement [1.2.15]

Add the following new requirements [1.2.19] and [1.2.20]:

1.2.19 Ships assigned the additional service feature SPxxx or SPxxx-capable

In addition to the loading conditions specified in [1.2.1] and [1.2.2] to [1.2.17] as applicable, for ships assigned the additional service feature **SPxxx** or **SPxxx-capable**, the following cases are to be included in the trim and stability booklet:

- ship in the fully loaded departure condition, having cargo specified by position and weight, with full stores and fuel, and with the total number of persons on board, including crew, special personnel and passengers
- ship in the fully loaded arrival condition, with cargo and total number of persons as specified above, but with 10 per cent stores and fuel
- ship in the worst anticipated operating condition.

1.2.20 Ships assigned the additional service feature OCC (ships fitted with onboard carbon capture and storage system)

For ships assigned the additional service feature **OCC**, the arrival conditions specified in [1.2.1] and [1.2.2] to [1.2.19] as applicable, are to include the CO_2 storage tank filled at its maximum allowable filling level.

CHAPTER 4

Ch 4, Sec 1

Replace Tables 11, 12 and 13 as follows:

Table 11 : Material grade requirements for class I at low temperatures

Gross thickness, in mm	–11°C / –15°C		–16°C / –25°C		–26°C / –35°C		–36°C / –45°C		–46°C / –55°C	
	NSS	HSS	NSS	HSS	NSS	HSS	NSS	HSS	NSS	HSS
t ≤ 10	A	AH	A	AH	B	AH	D	DH	D	DH
10 < t ≤ 15	A	AH	B	AH	D	DH	D	DH	D	DH
15 < t ≤ 20	A	AH	B	AH	D	DH	D	DH	E	EH
20 < t ≤ 25	B	AH	D	DH	D	DH	D	DH	E	EH
25 < t ≤ 30	B	AH	D	DH	D	DH	E	EH	E	EH
30 < t ≤ 35	D	DH	D	DH	D	DH	E	EH	E	EH
35 < t ≤ 45	D	DH	D	DH	E	EH	E	EH	N.A.	FH
45 < t ≤ 50	D	DH	E	EH	E	EH	N.A.	FH	N.A.	FH

Note 1: "NSS" and "HSS" mean, respectively, "Normal Strength Steel" and "Higher Strength Steel".
Note 2: N.A. = not applicable.

Table 12 : Material grade requirements for class II at low temperatures

Gross thickness, in mm	–11°C / –15°C		–16°C / –25°C		–26°C / –35°C		–36°C / –45°C		–46°C / –55°C	
	NSS	HSS	NSS	HSS	NSS	HSS	NSS	HSS	NSS	HSS
t ≤ 10	A	AH	B	AH	D	DH	D	DH	E	EH
10 < t ≤ 20	B	AH	D	DH	D	DH	E	EH	E	EH
20 < t ≤ 30	D	DH	D	DH	E	EH	E	EH	N.A.	FH
30 < t ≤ 40	D	DH	E	EH	E	EH	N.A.	FH	N.A.	FH
40 < t ≤ 45	E	EH	E	EH	N.A.	FH	N.A.	FH	N.A.	N.A.
45 < t ≤ 50	E	EH	E	EH	N.A.	FH	N.A.	FH	N.A.	N.A.

Note 3: "NSS" and "HSS" mean, respectively, "Normal Strength Steel" and "Higher Strength Steel".
Note 4: N.A. = not applicable.

Table 13 : Material grade requirements for class III at low temperatures

Gross thickness, in mm	–11°C / –15°C		–16°C / –25°C		–26°C / –35°C		–36°C / –45°C		–46°C / –55°C	
	NSS	HSS	NSS	HSS	NSS	HSS	NSS	HSS	NSS	HSS
t ≤ 10	B	AH	D	DH	D	DH	E	EH	E	EH
10 < t ≤ 20	D	DH	D	DH	E	EH	E	EH	N.A.	FH
20 < t ≤ 25	D	DH	E	EH	E	EH	E	FH	N.A.	FH
25 < t ≤ 30	D	DH	E	EH	E	EH	N.A.	FH	N.A.	FH
30 < t ≤ 35	E	EH	E	EH	N.A.	FH	N.A.	FH	N.A.	N.A.
35 < t ≤ 40	E	EH	E	EH	N.A.	FH	N.A.	FH	N.A.	N.A.
40 < t ≤ 50	E	EH	N.A.	FH	N.A.	FH	N.A.	N.A.	N.A.	N.A.

Note 5: "NSS" and "HSS" mean, respectively, "Normal Strength Steel" and "Higher Strength Steel".
Note 6: N.A. = not applicable.

CHAPTER 5

Ch 5, Sec 3, Symbols

Replace the definition of L_{ref} by:

L_{ref} : Reference length, in m, to be taken as:

$$L_{ref} = \min\left[\alpha f_{\alpha} L_c ; L\left(\frac{L_c}{40}\right)\right]$$

Ch 5, Sec 5, [4.3.1]

Replace the formula of "P_{FI}" by:

$$P_{FI} = C_S C_Z (0{,}22 + 0{,}15\tan\alpha)(0{,}4V\sin\beta + 0{,}6\sqrt{L})^2$$

Ch 5, Sec 5, Table 31

Replace the first row of Table 31 as follows:

Table 31 : Berthing impact pressure

Ship moulded displacement Δ at T_{SC}, in t	P_{BI}
0 < Δ ≤ 50000	170

CHAPTER 6

Ch 6, Sec 1, [1.2]

Replace requirement [1.2.12] by:

1.2.12 Lightening holes, draining holes and single scallops

Lightening holes, draining holes and single scallops in longitudinals need not be deducted if their height is less than 0,25 h_W, without being greater than 75 mm for single scallops, where h_W is the web height, in mm, defined in Ch 4, Sec 2.

Otherwise, the excess is to be deducted from the sectional area or compensated.

Ch 6, Sec 1, [1.4]

Replace requirement [1.4.2] by:

1.4.2 The net section moduli at bottom and at the equivalent deck line are obtained, in m^3, from the following formulae:

- at bottom:

$$Z_{AB} = \frac{I_{y-n50}}{z_n}$$

- at the equivalent deck line:

$$Z_{AD} = \frac{I_{y-n50}}{V_D}$$

where:

V_D : Vertical distance to the equivalent deck line, in m:

- when no effective longitudinal members specified in [1.2.4]and [1.2.5] are positioned above a line extending from strength deck at side to a position $(z_D - z_N)/0,9$ from the neutral axis at the centreline:

  $V_D = z_D - z_n$

  where:

  z_D : Z co-ordinate, in m, of strength deck, defined in [1.3], with respect to the reference co-ordinate system defined in Ch 1, Sec 3, [2.6]

- when effective longitudinal members as specified in [1.2.4]and [1.2.5] are positioned above a line extending from strength deck at side to a position $(z_D - z_N)/0,9$ from the neutral axis at the centreline:

$$V_D = (z_T - z_n)\left(0,9 + 0,2\frac{y_T}{B}\right) \geq z_D - z_n$$

  where:

  y_T, z_T : Y and Z co-ordinates, in m, of the top of continuous trunk or hatch coaming or longitudinal ordinary stiffeners or girders welded above the strength deck, with respect to the reference co-ordinate system defined in Ch 1, Sec 3, [2.6].

  y_T and z_T are to be measured for the point which maximises the value of V_D.

CHAPTER 7

Ch 7, Sec 4, [6.3.1]

Replace the 6th item of the bulleted list by:

- **combination carrier/OBO ESP**
- **combination carrier/OOC ESP**

Ch 7, Sec 5, Symbols

Replace the definition of K_{corr} by:

K_{corr} : Coefficient to take into account the corrosion:

- in general: $K_{corr} = 1,0$
- for tank testing: $K_{corr} = 1,1$

CHAPTER 10

Ch 10, Sec 1, [5.1.2]

Replace the second item of the bulleted list by:

- ship speed, to be taken as 75% of the design speed

CHAPTER 12

Ch 12, Sec 1, [11.1.2]

Replace references to "Pt C, Ch 1, Sec 11 and Pt C, Ch 1, Sec 12" by references to "Pt C, Ch 1, Sec 13 and Pt C, Ch 1, Sec 14".

Ch 12, Sec 4, [1.1.1]

Replace the second item of the bulleted list by:

- is intended for holding a ship in good holding ground, where the conditions are such as to avoid dragging of the anchor. In poor holding ground the holding power of the anchors is significantly reduced.

Ch 12, Sec 4, [2.5]

Replace requirement [2.5.1] by:

2.5.1 Considering the windlass brake capacity defined in [2.5.2], the anchor windlass is to comply with the applicable requirements given in NR626 Anchor Windlass and Chain Stopper.

Ch 12, Sec 4, [2.6.1]

Replace the last paragraph by:

The chain stopper is to comply with the applicable requirements given in NR626 Anchor Windlass and Chain Stopper.

CHAPTER 13

Ch 13, Sec 3, Table 1

Replace the row "Deck" as follows:

Table 1 : Weld factors w_F and coefficient φ for the various hull structural connections

Hull area	Connection			w_F **(1)**	φ **(2)(3)**			p_1, in mm (see [3.2.9]) **(3)**
	of	to			CH	SC	ST	
Deck	strength deck $t_{as\text{-}built} \geq 15$ mm	side plating within 0,6 L amidships		Partial penetration welding				
		elsewhere		0,48				
	strength deck $t_{as\text{-}built} < 15$ mm	side plating		0,48				
	non-watertight decks	side plating		0,38	2,2			CH 160
	ordinary stiffeners and intercostal girders	deck plating		0,20	3,5	3,0	4,6	ST 260
	hatch coamings	deck plating	in general	0,38				
			at corners of hatchways for 15% of the hatch length	Full penetration welding **(7)**				
	web stiffeners	coaming webs		0,20 **(8)**	3,5	3,0	4,6	ST 260

Ch 13, Sec 5

Replace Table 1 by:

Table 1 : List of special structural detail areas

Area ref. No.	Area description	Ship type						
		All ships **(5)** see [2.2]	Ships carrying liquid cargo in bulk **(6)** see [2.3]	Liquefied gas carriers see [2.4]	Container ships see [2.5]	Bulk, ore and combination carriers see [2.6]	Ro-ro ships see [2.7]	Passenger ships see [2.8]
1	Part of side extended: • longitudinally, between the after peak bulkhead and the collision bulkhead • vertically, between $0,7T_{BAL}$ and $1,15T_{SC}$ from the baseline	X	**(7)**					
2	Part of inner side and longitudinal bulkheads in the cargo area extended vertically above half tank height, where the tank breadth exceeds 0,55B		X					
3	Double bottom in way of longitudinal and / or transverse bulkheads		X	X	X	X		
4	Double bottom in way of hopper tanks		X	X		X		
5	Lower part of transverse bulkheads with lower stools		X			X		
6	Lower part of inner side		X	X	X	X		
7	Side frames			X		X		
8	Topside tanks			X		X		
9	Upper deck			X	X	X	X	X
10	Primary supporting members		X	X		X		X
11	Upper part of inner side		X	X	X	X		
12	Longitudinal and transverse bulkheads				X		X	X
13	Racking frames						X	
14	Side and stern doors				X		X	X
15	Supports and keys			X				
16	Foundation deck			X				
17	Double side in way of transverse bulkheads			X	X			
18	Engine room				X			X
19	Deep fuel tanks				X			
20	Miscellaneous							X

(5) All types of ships with longitudinally framed sides
(6) Except liquefied gas carriers
(7) See [2.2].

Ch 13, Sec 5, Table 5

Replace the title of Table 5 by:

Table 5 : Liquefied gas carriers (Type A and Type B) with independent tanks, primarily constructed of plane surfaces - Additional special structural details

Ch 13, Sec 5, Table 6

Replace the title of Table 6 by:

Table 6 : Liquefied gas carriers (Type B) fitted with independent tanks, primarily constructed of bodies of revolution - Additional special structural details

Ch 13, Sec 5

Add the following new Table 11:

Table 11 : Passenger ships - Special structural details

Area	Area description	Structural detail description	Yielding check		Fatigue check		Reference tables in Ch 13, App 2
			Screening	Fine mesh	Simplified stress analysis	Very fine mesh	
9	Upper deck	Large openings in upper decks		X			–
		Ends of the side decks strips of the uppermost continuous deck		X			–
10	Primary supporting members	openings in webs of longitudinal girders and in webs of transverse deck beams and girders		X			–
12	Longitudinal and transverse bulkheads	Corners of openings Door openings		X			–
		Large openings in longitudinal bulkheads		X			–
		Openings in transverse bulkheads					–
14	Side and stern doors	Corners of shell doors openings		X			–
18	Engine room	Engine room casing					–
20	Miscellaneous	Atrium		X			–
		Corners of window openings		X			–

Ch 13, Sec 5, [2.4]

Replace requirement [2.4.1] by:

2.4.1 The special structural details for various hull areas relevant to ships with the service notation **liquefied gas carrier** or **LNG bunkering ship** are listed and described in:

- Tab 4 for structural details common to all liquefied gas carriers
- Tab 5 for additional structural details for type A gas carriers and type B gas carriers fitted with independent tanks, primarily constructed of plane surfaces
- Tab 6 for additional structural details for type B gas carriers fitted with independent tanks, primarily constructed of bodies of revolution
- Tab 7 and NR686, Sec 1, [18.3.11] for additional structural details for membrane type gas carriers.

When the structural arrangement in a certain area is such that the details considered in the above specified tables can not comply with corresponding requirements, specific requirements are defined by the Society on a case by case basis, depending on the arrangement adopted.

Ch 13, Sec 5, [2]

Add the following new sub-article [2.8]:

2.8 Passenger ships

2.8.1 The special structural details for various hull areas relevant to ships with the service notation **passenger ship** are listed and described in Tab 11.

When the structural arrangement in a certain area is such that the details considered in Tab 11 can not comply with corresponding requirements, specific requirements are defined by the Society on a case by case basis, depending on the arrangement adopted.

Ch 13, Sec 6, Table 3

Replace item 1) by:

Table 3 : Additional test requirements for special service ships/tanks

Item	Type of ship/tank	Structure to be tested	Type of test	Test head or pressure	Remarks
1	Liquefied gas carriers	Integral tanks	leak and structural	See Pt D, Ch 9, Sec 4	
		Hull structure supporting membrane or semi-membrane tanks	See NR686, Sec 1, [24.9]	See NR686, Sec 1, [24.9]	
		Independent tanks type A	See Pt D, Ch 9, Sec 4	See Pt D, Ch 9, Sec 4	
		Independent tanks type B			
		Independent tanks type C			

Amendments to PART C

CHAPTER 1

Ch 1, Sec 2, [2.7.7]

Insert the following new requirement [2.7.7]:

2.7.7 Engine Power Limitation (EPL) and Shaft Power Limitation (ShaPoLi) systems

a) The Overridable Engine Power Limitation (EPL) systems and Overridable Shaft Power Limitation (SHaPoLi) systems are to be type approved by the Society. Mechanical EPL systems may be considered by the Society on a case-by-case basis.

b) Where technically possible, EPL and SHaPoLi systems are to be controlled from the navigating bridge without the crew's attendance in the machinery space.

Ch 1, Sec 2, [4.1.2]

Replace Note 1 by:

Note 1: One type test will be considered adequate to cover a range of different numbers of cylinders. However, a type test of an in-line engine may not always cover the V-version. At the discretion of the Society, separate type tests may be required for the V-version. On the other hand, a type test of a V-engine covers the in-line engines, unless the bmep is higher.

Items such as axial crankshaft vibration, torsional vibration in camshaft drives, and crankshafts, etc. may vary considerably with the number of cylinders and may influence the choice of engine to be selected for type testing.

Ch 1, Sec 5, [2.5.5]

Replace item a) of the alphanumeric list by:

a) Gas turbines are to be equipped with a quick closing device (shut-down device) which automatically shuts off the fuel supply to the turbines at least where required by Tab 2, unless the FMEA proves otherwise.

Ch 1, Sec 5, [2.5]

Replace requirement [2.5.7] by:

2.5.7 Indicators, alarm and shutdown

Tab 2 indicates the minimum control and monitoring requirements for main propulsion and auxiliary turbines. Alarms can be added or omitted, taking into account the result of FMEA.

Ch 1, Sec 5, [4.2.1]

Replace reference to "NR216 Materials and Welding, Ch 1, Sec 1, [3.2]" by a reference to "NR320, Sec 1, [3.2]"

Ch 1, Sec 5, [4.3.1]

Replace reference to "NR216 Materials and Welding, Ch 1, Sec 1, [3.2]" by a reference to "NR320, Sec 1, [3.2]"

Ch 1, Sec 5, Table 1

Replace item 14 by:

Table 1 : Documents to be submitted

No.	A/I(**1**)	Item
14	A	Details of automatic safety devices together with failure mode and effect analysis (FMEA) **(2)**

Ch 1, Sec 5

Replace Table 2 by:

Table 2 : Main propulsion and auxiliary turbines

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				
			Turbine			Auxiliary	
Identification of system parameter	Alarm	Indication	Slow-down	Shut-down	Control	Stand by Start	Stop
• Control system failure	X						
• Automatic starting failure	X						
Mechanical monitoring of gas turbine							
• Speed		local					
					X		
	H			X			
• Rotor axial displacement (Not applicable to roller bearing)		local					
	H			X			
• Vibration	H **(1)**	local		X			
• Performed number of cycle of rotating part	H						
Gas generator monitoring							
• Flame and ignition failure	X			X			
• Fuel oil supply pressure	L	local					
• Fuel oil supply temperature	H	local					
• Cooling medium temperature	H	local					
• Exhaust gas temperature or gas temperature in specific locations of flow gas path		local					
	H **(1)**			X			
• Pressure at compressor inlet		local					
	L **(1)**			X			
Lubricating oil							
• Turbine supply pressure		local					
	L **(1)**			X			
• Reduction gear supply pressure		local					
	L **(1)**			X			
• Differential pressure across lubricating oil filter	H	local					
• Bearing or lubricating oil (discharge) temperature	H	local					

(1) Alarm to be activated at the suitable setting points prior to arriving the critical condition for the activation of shutdown devices.

Ch 1, Sec 6, [2.1.1]

Replace reference to “ISO 1328-1 1997" by a reference to “ISO 1328-1:1995” in the definition of “Q”.

Ch 1, Sec 6, [3.1.1]

Replace reference to “ISO 1328-1 1997" by a reference to “ISO 1328-1:1995” in the definition of “Q”.

Ch 1, Sec 6, Table 1

Replace reference to “ISO 1328-1 1997" by a reference to “ISO 1328-1:1995” in Row 2.

Ch 1, Sec 6, Table 2

Replace the Row “Q” as follows:

Table 2 : Data to be submitted for cylindrical gears

Symbol	Values		Unit	Description
	Pinion	Wheel		
Q			-	Gearing quality class according to ISO 1328-1:1995

Ch 1, Sec 6, Table 3

Replace the Row “Q” as follows:

Table 3 : Data to be submitted for bevel gears

Symbol	Values		Unit	Description
	Pinion	Wheel		
Q			-	Gearing quality class according to ISO 1328-1:1995

Ch 1, Sec 7, [2.7.1]

Replace reference to “Chapter 2" by a reference to “Chapter 3".

Ch 1, Sec 7, Table 1

Replace reference to “Ch 1, Sec 6” by a reference to “Ch 1, Sec 8” in the row “Propellers”.

Replace reference to “Ch 1, Sec 8” by a reference to “Ch 1, Sec 6” in the row “Gear”.

Ch 1, Sec 8, [1.2.6]

Delete item e) of the alphanumeric list.

Ch 1, Sec 8, [2.3.1]

Replace the term “solid propeller blade” by “propeller blade” in item b) of the alphanumeric list.

Ch 1, Sec 8, [3.1.2]

Replace the definition of symbol "A" in item a) of the alphanumeric list by:

A : 100% theoretical contact area between propeller boss and shaft, as read from plans and disregarding oil grooves (i.e. oil grooves do not need to be subtracted), in mm^2.

Replace item k) in the alphanumeric list by:

k) For the formulae given below, the material properties indicated in the following items are to be assumed:

- Modulus of elasticity, in N/mm^2:

  Cast and forged steel: E = 206000

  Cast iron: E = 98000

  Type Cu_1 and Cu_2 brass: E = 108000

  Type Cu_3 and Cu_4 brass: E = 118000
- Poisson's ratio:

  Cast and forged steel: $\nu = 0,29$

  Cast iron: $\nu = 0,26$

  All copper based alloys: $\nu = 0,33$
- Coefficient of linear expansion in mm/(mm.°C)

  Cast and forged steel and cast iron: $\alpha = 12,0\ 10^{-6}$

  All copper based alloys: $\alpha = 17,5\ 10^{-6}$.

Ch 1, Sec 9

Add the following new Articles [4] and [5]:

4 Bending vibrations

4.1 General

4.1.1 The provisions of this Article apply to the bending vibrations of propulsion systems having a transmitted power in excess of 1000 kW and:

- having a ℓ/D ratio exceeding the following value:

$$\frac{\ell}{D} = 10\left(\frac{\ln 2}{D}\right) + D^2$$

where:

ℓ : Span between the aft bearings of the propeller shaft, in m

D : Diameter of the propeller shaft, in m

or

- fitted with bearings located outboard the hull (brackets), or
- fitted with cardan shafts.

4.2 Documentation to be submitted

4.2.1 Calculations

Bending vibration calculations are to show:

- the equivalent dynamic system used for the modelling of the plant, with indication of the mass of the shafts, propeller and other rotating components, and the lateral stiffness of the bearings, including that of the oil film and that of the seating
- the natural bending frequencies
- the values of the vibratory amplitudes and bending moments in the shafting for the most significant critical speeds
- the possible restrictions of operation of the plant.

4.2.2 Particulars to be submitted

The following particulars are to be submitted with the bending vibration calculations:

- shafting arrangement with indication of:
  - the diameter and length of the shafts
  - the position of the bearings
  - the mounting characteristics of the cardan shafts
  - detailed drawings of the bearings and their seating
  - details of the bearing lubrication, including the oil viscosity
- for the propeller:
  - the diametrical and polar moments of inertia of the propeller in air and water
  - excitations (bending moments and bending forces).

4.3 Calculation principles

4.3.1 Scope of the calculations

Bending vibration calculations are to take into account:

- the stiffness of the bearings and their seatings and, where applicable, that of the lubricating oil film
- the excitations due to the propeller and cardan shafts.

Where data having a significant influence on the vibration levels cannot be determined with a sufficient degree of accuracy, parametric studies are to be carried out.

4.3.2 Criteria for acceptance of the beding vibration levels

The first shafting vibration mode is not to be excited by the first propeller blade excitation order, in the speed range between 80% and 110% of nominal speed.

Furthermore vibration induced stresses should not exceed 1,5 times the one indicated in [3.5.3] in the whole speed range.

In case the shafting is checked by means of direct calculation the allowable stresses will be established on a case by case.

4.4 Bending vibration measurements

4.4.1 General

The Society may require bending vibration measurements in the following cases:

- where the calculations indicate the possibility of dangerous critical speeds in or near the operating speed range
- where the accuracy of some data is not deemed sufficient
- where restricted speed ranges need to be verified.

Where measurements are required, a comprehensive report including the analysis of the results is to be submitted to the Society.

4.4.2 Method of measurement

When measurements are required, the method of measurement is to be submitted to the Society for approval. The type of measuring equipment and the location of the measurement points are to be specified.

5 Axial vibrations

5.1 General

5.1.1 The provisions of this Article apply to the axial vibrations of propulsion systems fitted with:

- an internal combustion engine having a power exceeding 2000 kW and a running speed of less than 200 RPM, or
- a shaft line where the power transmitted exceeds 375 kW and the L/D ratio exceeds 50

  where:

  L : Total length of the shaft line between the propeller and the thrust bearing

  D : Minimum diameter of the shaft line.

5.2 Documentation to be submitted

5.2.1 Calculations

Axial vibration calculations are to show:

- the equivalent dynamic system used for the modelling of the plant, with indication of the masses and axial stiffnesses for all the components of the system
- the natural frequencies
- the axial vibration amplitude in way of the sterntube sealing gland for the most significant critical speeds
- for engines directly connected to the shaftline, the axial vibration amplitude at the free end of the crankshaft for the most significant critical speeds
- the possible restrictions of operation of the plant.

5.2.2 Particulars to be submitted

The following particulars are to be submitted with the axial vibration calculations:

- detailed drawing of the thrust bearing and its supporting structure with indication of their flexibility
- for the propeller:
  - the thrust
  - the excitations (axial forces)
  - the damping characteristics
- for the engine:
  - the axial excitations
  - the permissible axial amplitude at the free end of the crankshaft
  - the characteristics of the axial vibration damper or detuner.

5.3 Calculation principles

5.3.1 Scope of the calculations

Axial vibration calculations are to take into account:

- the flexibility of the thrust bearing and its supporting structure
- the excitations due to the engine and to the propeller.

Where data having a significant influence on the vibration levels cannot be determined with a sufficient degree of accuracy (e.g. the flexibility of the thrust bearing and its supporting structure), parametric studies are to be carried out.

Where the plant includes an axial vibration damper or detuner, a calculation is to be carried out assuming a malfunction of the damper or detuner.

5.3.2 Criteria for acceptance of the axial vibration levels

The axial vibration force acting on the thrust bearing is not to exceed 30% of the nominal thrust.

The axial vibration amplitude is not to exceed:

- at the free end of the crankshaft, the limit recommended by the engine manufacturer
- in way of the sterntube sealing gland, the limit recommended by the sealing gland manufacturer, if any.

Where the calculations show that in the continuous operation speed range the above limits may be exceeded in the event of malfunction of the axial vibration damper or detuner, a suitable device is to be fitted to indicate the occurrence of such conditions.

Note 1: When detuners or dampers of satisfactorily proven design are used, this requirement may be waived.

5.4 Axial vibration measurements

5.4.1 General

The Society may require axial vibration measurements in the following cases:

- where the calculations indicate the possibility of dangerous critical speeds in the operating speed range
- where the accuracy of some data is not deemed sufficient
- where restricted speed ranges need to be verified.

Where measurements are required, a comprehensive report including the analysis of the results is to be submitted to the Society.

5.4.2 Method of measurement

When measurements are required, the method of measurement is to be submitted to the Society for approval. The type of measuring equipment and the location of the measurement points are to be specified.

Ch 1, Sec 10, Table 16

Replace Table footnote (4) as follows:

Table 16 : Use of metallic flange connections in piping systems (types as shown in Fig 1)

Type of media conveyed	Class of piping (see Tab 3)		
	I	II	III
(4) For cargo piping of ships having the service notation chemical tanker, IBC Code Ch. 5, 5.3 and Pt D, Ch 8, Sec 5 [3.1.4] are to be applied. For cargo piping of ships having the service notation **liquefied gas carrier** or **LNG bunkering ship**, Pt D, Ch 9, Sec 5 [8.3] is to be applied.			

Ch 1, Sec 10, [2.6.4]

Replace item e) of the alphanumeric list by:

e) Flexible hose assemblies and expansion joints constructed of non-metallic materials, which are intended for installation in piping systems for flammable media or in sea water systems where failure may result in flooding, are to be of fire-resistant type except in cases where such hoses are installed on open decks as defined in Ch 4, Sec 5, [1.5.2], item b), (10) and not used for fuel oil lines.

Fire resistance is to be demonstrated by testing in accordance with the standards specified in Tab 36 and Tab 38.

Ch 1, Sec 10, [6.2]

Replace requirement [6.2.1] by:

6.2.1 General

An efficient bilge pumping system shall be provided, capable of pumping from and draining any watertight compartment other than a space permanently appropriated for the carriage of fresh water, water ballast, fuel oil or liquid cargo and for which other efficient means of pumping are provided, under all practical conditions. Efficient means shall be provided for draining water from insulated holds.

Bilge pumping system is not intended at coping with water ingress resulting from structural or main sea water piping damage.

Ch 1, Sec 10, [6.6.7]

Add the following new item h) in the alphanumeric list:

h) The enclosures of electrical equipment for the dewatering system installed in any of the forward dry spaces are to be in accordance with requirements given in Ch 2, Sec 3, [4.1.5].

Ch 1, Sec 10, [7.1]

Replace requirement [7.1.4] by:

7.1.4 Ballast water management systems

In addition to the requirements contained in BWM Convention (2004) and the Code for Approval of Ballast Water Management Systems (BWMS Code), ballast water management systems (BWMS), where fitted, are to comply with the requirements of Ch 1, Sec 12.

Ch 1, Sec 10, [17.3.1]

Replace item a) of the alphanumeric list by:

a) The total capacity of the compressed air available for starting purpose is to be sufficient to provide, without replenishment, not less than 12 consecutive starts alternating between ahead and astern of each main engine of the reversible type, and not less than 6 consecutive starts of each main non-reversible type engine connected to a controllable pitch propeller or other device enabling the start without opposite torque.

At least 3 consecutive starts is to be possible for each engine driving electric generators and engines for other purposes. The capacity of a starting system serving two or more of the above specified purposes is to be the sum of the capacity requirements.

Ch 1, Sec 10, [18.1.3]

Add the following paragraph at the end of the requirement:

Additional requirements for the installation of onboard carbon capture and storage systems are given in *(new)* Ch 1, Sec 12.

Ch 1, Sec 10, [20.3.1]

Replace item c) of the alphanumeric list by:

c) Discharge / Reverse flow test:

1) The air pipe head is to allow the passage of air to prevent excessive vacuum developing in the tank. Reverse flow test:

- A reverse flow test is to be performed. A vacuum pump or another suitable device is to be connected to the opening of the air pipe leading to the tank. The flow velocity is to be applied gradually at a constant rate until the float gets sucked and blocks the flow, and
- The velocity at the point of blocking is to be recorded. A mention of 80% of the value recorded is to be stated in the type approval certificate.

2) Alternative to the reverse flow test:

- For pipe heads of 400 mm nominal diameter and above, as an alternative to the reverse flow test, a numerical simulation test based on computational fluid dynamics (CFD), to be carried out in conjunction with limited representative testing to establish the validity of the CFD modelling and results, may be accepted
- CFD predictions for air pipe heads can be validated against the available actual reverse flow test results of same size and type of air pipe heads
- The accuracy of the CFD modelling and the major assumptions used for the calculation are to be documented
- Mesh convergence studies are to be carried out and documented, and
- The velocity at the point of blocking is to be recorded. A mention of 80% of the value recorded is to be stated in the type approval certificate.

Ch 1, Sec 10, [20.4.2]

Replace item a) of the alphanumeric list by:

a) Where required in Tab 40, materials used for pipes, valves and other accessories are to be subjected to the following tests:

- tensile test at ambient temperature
- flattening test or bend test, as applicable
- when designed to be used at high temperatures on the basis of their high-temperature strength characteristics, a hot tensile test is to be performed on one test specimen per serie and per size, except if one of the following conditions is met:
  - the design temperature is below 200°C
  - the mechanical properties of the material at high temperature have been approved according to a recognized standard
  - the scantling of the pipes is based on reduced values of the permissible stress.

Ch 1, Sec 11, [1.1]

Add the following new requirement [1.1.4]

1.1.4 When an onboard carbon capture and storage system is installed, the ship is to comply with the requirements of *(new)* Ch 1, Sec 12.

Ch 1, Sec 11, [2.3.1]

Delete the third paragraph of requirement [2.3.1].

Ch 1, Sec 11, [2.4]

Replace requirement [2.4.6] by:

2.4.6 Control and monitoring

Alarms and indications are to be provided in accordance with Tab 3.

For ships to be granted an **AUT** additional class notation, those alarms and indications are to be provided at the centralised control position, see Pt F, Ch 3, Sec 1, [4.8.9].

Information related to exhaust gas pollution prevention device and washwater, discharge measurements is to be made available in a control station.

Ch 1, Sec 11, Table 2

Replace Table 2 as follows:

Table 2 : Documents to be submitted in case of a retrofit

No.	I/A	Document
1	I	General arrangement and Machinery general arrangement
2	A	Fire control plan
3	A	Damage control plan, damage stability booklet and tank capacity plan
4	A	Ventilation, extinction and detection
5	A	Power supply arrangement
6	A	Single line diagram of the control system
7	A	List of alarms and monitored parameters and safety systems
8	I	Test program of the control system
9	A	Ship electrical power balance
10	I	Instruction and operation manuals
11	A	Diagram of scrubber installation, fixation diagram, strength calculation for scrubber transverse supports
12	A	Structural modification (Holes and Penetrations drawing, modification of the Sea Chest, Funnel and Casing)
13	A	Diagrams of the exhaust gas pollution prevention system and exhaust gas piping
14	A	Pressure losses calculation in the exhaust line
15	A	Diagram of ancillaries system modification (compressed air, ventilation,…)
16	A	Diagram of the tanks vent system
17	A	Diagram of the bilge system
18	A	Filling up piping system for chemical products and storage of the product and preparation/handling of the product
19	I	Risk analysis (availability of essential systems of ship related to failure of exhaust gas pollution prevention system, use of chemical products)
20	A	Exhaust gas boiler modification
21	I	Test program and reports
Note 7: A: For approval ; I : For information		

Chapter 1

Insert the following new Section 12 “Onboard Carbon Capture Systems”:

Section 12 Onboard Carbon Capture and Storage Systems

1 General

1.1 Application

1.1.1 This Section applies to ships fitted with an onboard carbon capture and storage (CCS) system intended to separate the carbone dioxide (CO_2) from the exhaust gases and store it on board.

Note 1: Such ships will be assigned the additional service feature **OCC**, as defined in Pt A, Ch 1, Sec 2, [4.16].

1.1.2 This Section addresses CCS systems where CO_2 is:

- emitted from an internal combustion engine, a boiler or a fuel cell supplied with carbon-based fuel
- separated using an absorption process with amine-based chemical solvent

Note 1: Other technologies or solvents will be considered on a case-by-case basis.

- compressed / liquefied
- stored
- offloaded.

1.1.3 This Section covers the design and installation of the CCS system, with respect to ship safety. The performance of the system is not covered. In particular, the following aspects are not addressed by this Section:

- CO_2 capture rate
- quality of the captured CO_2 for later use
- possible formation and emission of polluting substances (such as nitrosamines)
- quality of the solvent (degradation)
- solvent storage capacity
- CO_2 storage capacity.

Note 1: The attention is drawn to national or international regulations on CCS systems, concerning in particular their emissions and performance.

1.2 Documentation to be submitted

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

The list of documents requested is intended as a guidance for the complete set of information to be submitted, rather than an actual list of titles.

The Society reserves the right to request the submission of additional documents if it is deemed necessary for the evaluation of the system, equipment or components.

1.2.2 In the case where a CCS system is retrofitted to an existing ship, the documents listed in Tab 2 are to be provided in addition to those referred to in [1.2.1].

Table 1 : Documents to be submitted

No.	I/A **(1)**	Document **(2)**
1		CARBON CAPTURE SYSTEM **(3)**:
	A	• General arrangement
	I	• Specification with operating parameters (temperatures, pressures)
	I	• Operating manual, including operating, troubleshooting and maintenance instruction manuals, safety data sheets and details for handling of the solvent, parts list, electrical drawings, functional block diagram, pressure and instrumentation diagrams
	I	• Test program and procedures for installation and commissioning

(1) A = to be submitted for approval ; I = to be submitted for information

(2) Diagrams are also to include, where applicable, the (local and remote) control and monitoring systems and automation systems including emergency shutdown arrangements

(3) Performance data of the CCS system need not be provided

(4) With material specification

No.	I/A **(1)**	Document **(2)**
2		EXHAUST GAS AND FLUE GAS SYSTEMS:
	A	• Diagram
	A	• Pressure loss calculation
	A	• Drawing of the exhaust gas cooler (direct contact cooler or quencher) **(4)**
	A	• Drawing of the blower, where provided **(4)**
	A	• Drawing of knock out drums, where provided **(4)**
	A	• Drawing of exhaust gas cleaning water treatment system, where provided
3		SOLVENT SYSTEM:
	A	• Diagram (including solvent filing, recovery, transfer, draining, reclaiming, sampling, discharge and tank venting)
	A	• Drawings of the absorber and desorber **(4)**
	A	• Drawings of the rich solvent / lean solvent heat exchanger **(4)**
	A	• Drawing of the reserve (clean) solvent tank and waste solvent tanks **(4)**
	A	• Drawing of buffer tanks for solvent solutions, where fitted **(4)**
	A	• Drawings of the rich solvent/ lean solvent circulating and make up pumps **(4)**
4		CO_2 SYSTEM:
	A	• Diagram
	A	• Specification and drawings of the compression and liquefaction equipment (compressors, pumps, coolers, separators) **(4)**
	A	• Drawings of the CO_2 storage tank including the safety valves and their discharge, the pump if fitted and the manifold arrangement for offloading **(4)**
	A	• Specification of the means to maintain the CO_2 tank pressure and temperature within their design range and justification of the relevant capacities
5	A	Diagram of the cooling water system, including heat exchangers and pumps **(4)**
6	A	Diagram of the desorber heating system including the reboiler and its material specification
7	A	Diagram and specification of the solvent detection system
8	A	Diagram and specification of the CO_2 detection system
9	I	Report of the risk analysis

(1) A = to be submitted for approval ; I = to be submitted for information
(2) Diagrams are also to include, where applicable, the (local and remote) control and monitoring systems and automation systems including emergency shutdown arrangements
(3) Performance data of the CCS system need not be provided
(4) With material specification

Table 2 : Additional drawings to be submitted in the case where a CCS system is retrofitted to an existing ship

No	I/A **(1)**	Document **(2)**
1	A	General arrangement and machinery arrangement of the ship showing the location of the main components of the CCS system
2	I	Longitudinal strength calculations and stability calculations covering the loading conditions assuming the CCS system in operating conditions and specifying the allowable filling level of the CO_2 storage tank **(3)**
3	I	Calculations of the local structural reinforcements in way of the main components of the CCS system
4	A	Revised electrical balance
5	A	Revised steam balance
6	A	Revised compressed air and heat balances for cooling water (if cooling fresh water is used for heat exchangers)
7	A	Revised exhaust gas arrangement in engine room and casing
8		General arrangement of the electrical components:
	A	• General layout specifying the interconnection of the major electrical components of the CCS system
	A	• Ingress protection (IP) of the electrical panels and associated devices (junction boxes, electrical motors, etc.)
	A	• Interconnection diagram or document describing the link between the CCS and the ship's alarm system

(1) A = to be submitted for approval ; I = to be submitted for information
(2) Performance data of the CCS system need not be provided
(3) The variation of the ship deadweight during the CCS operation, due to the simultaneous consumption of fuel and capture of CO_2, is to be taken into account, considering the conversion factor CF given in IMO Resolution MEPC.308 (73)

No	I/A **(1)**	Document **(2)**
9	A	List of alarms and safeties of the CCS system
10	A	Characteristics and certifications of the electrical devices added during the integration of the CCS system: electrical cables, detectors, etc.
11	A	Single line diagram showing the power electrical arrangement to supply the CCS system
12	I	Type of cables to be installed provided with the related Type Approval Certificates
13		For spaces containing CCS system components:
	A	• Diagram of the ventilation system
	A	• Diagram of the bilge system
	A	• Fire detection arrangements
	A	• Fire-extinguishing arrangements
	A	• Structural fire protection
	I	• Eye-washing showers and PPE material storage spaces
(1) A = to be submitted for approval ; I = to be submitted for information **(2)** Performance data of the CCS system need not be provided **(3)** The variation of the ship deadweight during the CCS operation, due to the simultaneous consumption of fuel and capture of CO_2, is to be taken into account, considering the conversion factor CF given in IMO Resolution MEPC.308 (73)		

1.3 Definitions

1.3.1 The carbon capture and storage (CCS) system consists of the following:

- solvent system
- separation system
- CO_2 system.

1.3.2 "Fuel" in the context of this Section means a carbon-based fuel such as oil fuel, LNG, LPG, methanol or ethanol.

1.3.3 "Fuel consumer" means internal combustion engine, boiler or fuel cell from which CO_2 present in the exhaust gases is captured.

1.3.4 "Solvent system" means all equipment necessary for the filling, storage, transfer, cooling and heating of the clean, working and waste solvent. It includes in particular:

- pumps
- heat exchangers
- tanks.

1.3.5 "Solvent" means a chemical (e.g. amine-based solvent) intended for the absorption of CO_2 or an aqueous solution thereof.

1.3.6 "Rich solvent" means the solvent which contains captured CO_2.

1.3.7 "Lean solvent" means the solvent from which CO_2 has been separated.

1.3.8 "Waste solvent" means the solvent that needs to be replaced due to degradation.

1.3.9 "Separation system" means all equipment necessary for the separation of the CO_2 from the exhaust gases emitted by the fuel consumers. It includes in particular:

- the exhaust gas cooler
- the exhaust gas blower
- the absorber
- the desorber (regenerator or stripper).

1.3.10 "CO_2 system" means all equipment necessary for:

- the compression and liquefaction of the CO_2
- the transfer and storage of the CO_2 and
- the offloading of CO_2

1.3.11 "Triple point" is the temperature and pressure at which a material exists simultaneously as a solid, liquid, and gas. For carbon dioxide, the triple point is –56,6 °C and 5,18 bar abs.

1.4 Risk analysis

1.4.1 Failure mode and effects analysis

A failure mode and effects analysis (FMEA) is to be carried out to determine the possible failures and their effects on the operation of the CCS system.

1.4.2 HAZID and HAZOP analysis

HAZID and HAZOP analysis are to be carried out for the whole CCS system, including:

- the solvent loading, storage and offloading installation and
- the CO_2 compression, liquefaction, storage and offloading installation.

The HAZID and HAZOP are to cover at least the following events:

- solvent leakage
- CO_2 leakage
- failure of a CCS system component or abnormal operation.

The HAZID and HAZOP analysis are to address:

- the flammability of the solvent
- the toxicity of the solvent
- the toxicity and the asphyxiating effect of the carbon dioxide in case of exposure of the crew members or passengers
- the availability of propulsion and main source of power, see [2.1.4].

2 Design and construction of the carbon capture and storage system

2.1 General

2.1.1 The components of the CCS system and their associated piping systems and fittings are to be of a design and construction adequate for the intended service in accordance with the provisions of Part C, Chapter 1, in particular:

- Heat exchangers are to comply with the provisions of Ch 1, Sec 3.
- Solvent and CO_2 vapour piping systems are to comply with the provisions of Ch 1, Sec 10.
- The design of the liquid CO_2 piping system is to comply with the relevant provisions of Pt D, Ch 9, Sec 5.

2.1.2 Inclinations

The CCS system is to be so designed that it can withstand the loads corresponding to the static and dynamic inclination angles specified in Ch 1, Sec 1, [2.4.1].

2.1.3 Ambient conditions

The CCS system is to be designed for the ambient conditions specified in Ch 1, Sec 1, [2.5.1].

2.1.4 Availability

The CCS system is to be so designed that the exhaust back-pressure allowed by the fuel consumer manufacturer is not exceeded over the operating range at which the fuel consumer is intended to operate. Where necessary, an exhaust gas blower is to be installed. For internal combustion engines, see Ch 1, Sec 11, [2.4.1] and Ch 1, App 7.

Note 1: Increased exhaust back pressure may affect the engine performance, in particular its specific fuel consumption.

The CCS system is to be so designed that in case of failure of a CCS system component, the normal operation of the fuel consumer can be maintained. This is to be demonstrated by the risk analysis.

2.1.5 Arrangements for solvent replacement

Where necessary, arrangements for storage and transfer are to be made to allow the replacement of the solvent, in accordance with the operating manual of the plant.

2.2 Materials

2.2.1 Materials used in the components of the CCS system containing the solvent are to be resistant to corrosion, taking into account the exhaust gas composition, the nature of the solvent and the temperature in the concerned areas. The risk of corrosion due to the presence of impurities is to be taken into account.

2.2.2 Storage tanks and pipes / piping systems for the solvent are to be made with a material compatible with the solvent, or coated with appropriate anticorrosion coating. The melting point of the material in not to be less than 925 °C.

Note 1: Materials having lower melting point may be utilized provided their use is specially considered on a case-by-case basis in relation to the risk of fire.

2.2.3 In general, copper and aluminum as well as their alloys, zinc and galvanized steel are not to be used in any component of the CCS system in contact with the solvent.

2.2.4 Materials used in the components containing liquefied CO_2 are to comply with the provisions of Pt D, Ch 9, Sec 6.

2.2.5 Materials used in CO_2 tanks and piping system are to be suitable for the lowest temperature that may occur in service, which is defined as the saturation temperature of the CO_2 at the set pressure of the automatic safety system intended to maintain the CO_2 at a pressure above the triple point.

2.3 Design and construction of the separation system

2.3.1 Welded joints of the exhaust gas cooler, absorber and desorber shells are to be made in accordance with qualified welding procedures by qualified welders. Welder's certificates, welding procedures and their qualification records are to be submitted to the Society for review.

2.4 Design and construction of the solvent filling, storage, transfer, cooling and heating systems

2.4.1 General

The requirements of the present sub-article apply to storage tanks and piping systems containing the solvent. They also apply to the tank and piping systems intended for the storage and transfer of waste solvent

Regardless of design pressure and temperature, piping systems containing solvent are to comply with the requirements applicable to class I piping systems. Vent and drain pipes, irrespective of the service temperature, belong to class III.

2.4.2 Leakage prevention and containment

The solvent filling, storage tank and transfer system are to be arranged so that any leakage will be contained and prevented from making contact with heated surfaces. All tank pipes or other tank penetrations are to be provided with manual closing valves attached to the tank. In cases where such valves are provided below top of tank, they are to be arranged with quick acting shutoff valves which are to be capable of being remotely operated from a position remaining accessible in the event of solvent leakages.

2.4.3 Protection against high or low temperatures

The solvent storage tank is to be protected from excessively high or low temperatures applicable to the particular concentration of the solvent solution. Depending on the operational area of the ship, this may require the fitting of heating and/or cooling systems.

2.4.4 Integral tanks

The solvent may be stored in integral tanks provided they are coated with appropriate anti-corrosion coating.

Solvent tanks are to be segregated from accommodation, cargo spaces containing cargoes which react with the solvent in a hazardous manner as well as any food stores, oil tanks and fresh water tanks by cofferdams, void spaces, pump rooms, empty tanks or other similar spaces.

2.4.5 Independence of piping systems

The solvent piping and venting systems are to be independent of other ship service piping and/or systems.

2.4.6 Prevention of contamination by the solvent

Means, such as pH or pressure monitoring, are to be provided to detect any contamination of the water cooling or heating system or steam heating system by the solvent through heat exchangers.

2.4.7 Use of electric heaters

When electric heaters are used to supply heat to the desorber, a safety temperature switch is to be fitted in order to avoid excessive heating. It is to be:

- independent from the automatic temperature control sensor
- designed to cut off the electrical power supply in the event of excessive temperature
- provided with manual reset.

2.4.8 Pipe connections

As far as practicable, e.g. except for the flange connections that connect to tank valves, the piping systems are to be joined by welding.

The following connections are to be screened and fitted with drip trays to prevent the spread of any spillage where they are installed:

a) Detachable connections between pipes (flanged connections and mechanical joints, etc.)

b) Detachable connections between pipes and equipment such as pumps, strainers, heaters, valves

c) Detachable connections between equipment mentioned in item b).

2.5 Design and construction of the CO_2 separation system

2.5.1 Exhaust gas cooling and treatment

Exhaust gases are to be suitably cooled and treated so that their temperature and contaminant content (in particular SOx and NOx) are within the range required for the CO_2 absorption process.

The discharge water from the exhaust gas cooling system is to meet the relevant quality criteria laid down in IMO Resolution MEPC.340 (77): 2021 Guidelines for exhaust gas cleaning systems.

2.5.2 Heating system

The capacity of the rich solvent heating system is to be within the range required for the CO_2 desorption process.

2.6 Design of the CO_2 compression, liquefaction and storage systems

2.6.1 CO_2 piping

Regardless of design pressure and temperature, piping systems containing gaseous CO_2 are to comply with the requirements applicable to Class I piping systems.

Remotely closable valves are to be provided where necessary to isolate a section of the CO_2 piping system in case of leakage.

2.6.2 Liquid CO_2 storage tanks

CO_2 storage tanks are to comply with the provisions of:

- Pt D, Ch 9, Sec 4 for the tank design
- Pt D, Ch 9, Sec 7 for tank pressure and temperature control
- Pt D, Ch 9, Sec 17, [21], for tank pressure control and monitoring and safety valve arrangement.

In particular, the following requirements are to be considered:

a) The pressure and temperature of CO_2 at the triple point depend on its purity. Where the CO_2 is stored at a pressure and temperature close to the triple point, the set pressure of the tank instrumentation is to be properly adjusted in order to prevent the tank contents from changing from the liquid to the solid state.

b) With the exception of tanks designed to withstand the critical pressure of CO_2, one of the following means are to be provided to maintain the tank pressure and temperature within their design range at all times:
   - reliquefaction of CO_2 vapours
   - liquid CO_2 cooling
   - pressure accumulation.

c) Venting of the CO_2 vapours is not an acceptable means to maintain the tank pressure and temperature within their design range, except in emergency situations.

2.6.3 Compressed CO_2 storage tanks

Tanks intended for the storage of high pressure compressed CO_2 are to comply with the design principles given in Ch 4, Sec 15, [4.1.3].

3 Arrangement and installation of the solvent components

3.1 Solvent tanks and piping system

3.1.1 Location of the solvent piping systems

The solvent 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 open deck, away from passageways, ventilation inlets and outlets and from any opening to accommodation, service spaces or control stations and the tank venting system is to be arranged to prevent entrance of water into the tank for solvents.

3.1.2 Drip trays

Drip trays are to be fitted in way of the solvent system components where leakage may occur. They are to be provided with leak detection arrangements and with drain pipes which lead to dedicated drain tank. Drain tanks are to be fitted with a high level alarm. In case this dedicated drain tank is an integral tank, it is to comply with the requirements of [2.4.4].

3.1.3 Monitoring and alarms

The storage tank is to be provided with level monitoring arrangements and high/low level alarms. Additionally, high and/or low temperature alarms or temperature monitoring are also to be provided.

3.2 Absorbers

3.2.1 A common absorber may be used by several engines provided that:

- a remotely operated and effective isolation device with means for leakage detection is provided on each engine exhaust line, in order to prevent exhaust gases from an engine in operation to penetrate into an engine not in operation, which could cause corrosion damage and result in exhaust gases entering the engine compartment
- where necessary a forced ventilation is installed in accordance with Ch 1, Sec 11, [2.4.1].

3.3 Solvent leakage detection

3.3.1 Except where the liquid spill detectors required for the drip trays (see [3.1.2]) are proved to be sufficient by the risk analysis, permanently installed solvent vapour detectors are to be fitted in all enclosed spaces where a leakage from the solvent system is likely to occur, as evidenced by the risk analysis.

3.3.2 The detection of solvent liquid or vapour leakage is to activate an alarm and the automatic closing of an isolating valve located outside the space where the leakage has occurred.

3.3.3 The solvent vapour detectors are to be located in areas where the solvent may accumulate.

3.3.4 Two portable solvent vapour detection equipment are to be available on board the ship.

3.4 Bilge system

3.4.1 Bilge lines from spaces containing a potential source of solvent leakage are to be independent from bilge lines serving other spaces.

3.4.2 Bilge water from spaces containing a potential source of solvent leakage is to be retained on board in dedicated holding tanks for subsequent discharge to reception facilities.

3.5 Ventilation

3.5.1 Enclosed spaces where solvent storage tanks are installed are to be served by an effective mechanical ventilation system of the extraction type providing not less than 6 air changes per hour. This ventilation system is to be independent from the ventilation systems serving accommodation, service spaces, or control stations. The ventilation system is to be capable of being controlled from outside the space. A warning notice requiring the use of such ventilation before entering the space is to be provided outside the compartment adjacent to each point of entry.

3.5.2 The provisions of [3.5.1] also apply to the following spaces, if normally entered.

a) spaces adjacent to the integral solvent storage tanks and containing possible leak points (e.g. manhole, fittings) from these tanks

b) spaces containing solvent piping systems, unless they have fully welded joints.

3.5.3 Where the solvent storage tank is located within the engine room, a separate ventilation system, as per [3.5.1] is not required when the general ventilation system for the space providing not less than 6 air changes per hour is arranged so as to provide an effective movement of air in the vicinity of the storage tank and is maintained in operation continuously except when the storage tank is empty and has been thoroughly ventilated.

3.5.4 The exhausts of the ventilation systems required in [3.5.1] to [3.5.3] are to be located at least 3m away from inlets for other ventilation systems and from normal passageways.

3.6 Fire safety

3.6.1 Applicable requirements for spaces intended for the storage or handling of solvent are listed in:

- Ch 4, Sec 3, [3.3] for fire detection arrangements
- Ch 4, Sec 3, [7] for fire-extinguishing arrangements
- Ch 4, Sec 5 for fire integrity requirements.

4 Arrangement and installation of the CO_2 system components

4.1 CO_2 tanks

4.1.1 CO_2 tank location

CO_2 tank location is to comply with the requirements of Pt D, Ch 9, Sec 2, [4] as applicable to type 3G ships.

CO_2 tank may be installed on the open deck, in a dedicated compartment or in the cargo area of tankers or offshore supply vessels. Where the CO_2 tank is installed in an enclosed space, the access is to be arranged only from the open deck and the access door is to open outwards.

4.1.2 CO_2 tank venting

Discharge piping from safety relief valves are to be designed so that they prevent clogging by dry ice formation upon safety release. Where arrangements are made to avoid dry ice formation, it should be demonstrated that the outlet flow velocity does not reach the critical speed (sonic velocity). Protective screens are not to be fitted to the outlets of relief valve discharge piping.

4.1.3 Longitudinal strength and stability

The impact of the liquid stored in CO_2 tank on the ship's longitudinal strength and stability is to be taken into account as indicated in Pt B, Ch 3, App 2, [1.2.19].

4.2 CO_2 vapour detection

4.2.1 CO_2 concentration monitoring

Spaces containing CO_2 tanks, CO_2 compression and liquefaction equipment and other enclosed spaces where CO_2 could accumulate are to be fitted with continuous monitoring for CO_2 build-up.

4.3 Ventilation

4.3.1 Spaces containing CO_2 tanks, CO_2 compression and liquefaction equipment and other enclosed spaces where CO_2 could accumulate are to be continuously ventilated with minimum six air changes per hour such that any release of CO_2 will be effectively dispersed in order to prevent the formation of a low oxygen atmosphere. The ventilation system serving such spaces is to be independent mechanical ventilation of the extraction type.

4.3.2 Where the spaces referred to in [4.3.1] may be entered in normal operation, the ventilation capacity is to be automatically increased to 10 air changes per hour in case of CO_2 leakage detection.

5 Personnel protection

5.1 Protective equipment

5.1.1 For the protection of crew members, the ship is to have on board personnel protective equipment suitable for solvent handling. The number of personnel protective equipment carried on board is to be appropriate for the number of personnel engaged in regular handling operations or that may be exposed in the event of a failure; but in no case is there to be less than two sets available on board.

5.1.2 Personnel protective equipment is to consist of:

- low temperature- and solvent-resistant protective clothing, boots, gloves and tight-fitting goggles and
- two self-contained breathing apparatus.

5.2 Emergency equipment

5.2.1 Eyewash and safety showers are to be provided, the location and number of these eyewash stations and safety showers are to be derived from the detailed installation arrangements.

6 Certification and surveys at works

6.1 General

6.1.1 Certification and workshop inspections are to be performed on:

- the various components of CCS system
- the materials used for their manufacture.

6.2 Type approval

6.2.1 The following CCS components are to be of a type approved by the Society:

- Solvent system:
  - Hoses, see Ch 1, Sec 10, [20.2]
- CO_2 system:
  - Pumps, see Pt D, Ch 9, Sec 5, [13.2]
  - Expansion bellows, see Pt D, Ch 9, Sec 5, [13.4]
  - Hoses, see Pt D, Ch 9, Sec 5, [11.7].

6.3 Inspection and testing

6.3.1 The CCS components are to be inspected and tested at works in accordance with the requirements of Tab 3.

Table 3 : Inspection and testing for the CCS system components

Item	Tests for the materials		Inspections and tests for the product		
	Tests required	Type of material certificate	During manufacturing (NDT)	After completion	Type of product certificate
EXHAUST GAS SYSTEM AND SEPARATION SYSTEM					
Exhaust gas (direct contact) cooler shell			Magnetic particle or liquid penetrant testing **(1)**	Ch 1, Sec 10, [20.5.5]	C
Exhaust gas blower				Ch 1, Sec 10, [20.5.5]	C
Absorber shell	Chemical composition	W	Magnetic particle or liquid penetrant testing **(1)**		C
Desorber shell	Chemical composition	W	Magnetic particle or liquid penetrant testing **(1)**		C
Pipes, valves and fittings	Requirements of Ch 1, Sec 10, Tab 40 applicable to a class III piping system are to be complied with				
SOLVENT SYSTEM					
Heat exchangers	Ch 1, Sec 3, [9.1.3]	C		Ch 1, Sec 10, [20.5.3]	C
Independent tanks	Chemical composition	C			
Pumps	• Chemical composition **(2)** • Material tests as per Ch 1, Sec 10, [20.4.2]	C		Pressure test as per Ch 1, Sec 10, [20.5.5]	C
Pipes, valves and fittings	Requirements of Ch 1, Sec 10, Tab 40 applicable to a class I piping system are to be complied with				
Flexible hoses				Pressure test as per Ch 1, Sec 10, [20.5.6]	C
CO_2 SYSTEM - VAPOUR					
Compressors	• Chemical composition **(2)** • Material tests as per Ch 1, Sec 10, [20.4.2]	C		Pressure test as per Ch 1, Sec 10, [20.5.5]	C
Pipes, valves and fittings	Requirements of Ch 1, Sec 10, Tab 40 applicable to a class I piping system are to be complied with				
CO2 SYSTEM - LIQUID					
Condensers, heat exchangers and other equipment of the liquefaction plant	• Chemical composition **(2)** as per Pt D, Ch 9, Sec 6 • Material tests as per Pt D, Ch 9, Sec 6	C	NDT as per Pt D, Ch 9, Sec 5, [9.3] **(3)**	Pressure test as per Pt D, Ch 9, Sec 4, [10.6]	C
Storage tank	• Chemical composition as per Pt D, Ch 9, Sec 6 • Material tests as per Pt D, Ch 9, Sec 6, [5.6]	C	NDT as per Pt D, Ch 9, Sec 6, [5.6]]	Pressure test as per Pt D, Ch 9, Sec 4, [10.6]	C
Safety valves	• Chemical composition **(2)** as per Pt D, Ch 9, Sec 6 • Material tests as per Pt D, Ch 9, Sec 6	C		Pressure test and set pressure verification as per Pt D, Ch 9, Sec 5, [13.3.3]	C
Liquefied CO_2 Pumps	• Chemical composition **(2)** as per Pt D, Ch 9, Sec 6 • Material tests as per Pt D, Ch 9, Sec 6	C		Pressure test as per Pt D, Ch 9, Sec 5, [13.2]	C
Expansion bellows	• Chemical composition as per Pt D, Ch 9, Sec 6 • Material tests as per Pt D, Ch 9, Sec 6	C		Pressure test as per Pt D, Ch 9, Sec 5, [13.5]	C
Offloading hoses			NDT as per Pt D, Ch 9, Sec 5, [9.3] **(3)**	Pressure test as per Pt D, Ch 9, Sec 5, [11.7.5]	C
Pipes, valves and fittings	Requirements of Pt D, Ch 9, Sec 5, [9]; Pt D, Ch 9, Sec 5, [12] and Pt D, Ch 9, Sec 5, [13], as applicable, are to be complied with				

(1) To be performed on welded joints selected according to manufacturer's plan
(2) For parts in contact with the fluid
(3) For welded joints

(existing) Ch 1, Sec 12, [1.1]

Replace the requirement [1.1.1] by the following requirements [1.1.1] and [1.1.2]:

1.1.1 Installation

Requirements for the installation of ballast water management systems (BWMS), are given in Articles [2] to [4]:

- Ch 4, Sec 3, [3.3] for fire detection arrangement in spaces containing a ballast water management system
- Ch 4, Sec 6, [7] for fire-extinguishing arrangements for ballast water management rooms
- Ch 4, Sec 5 for fire integrity requirements applicable to ballast water management room (BWMR) and to spaces intended for the storage of liquid or solid chemicals for BWMS.

1.1.2 Certification

Requirements for the certification of ballast water management systems (BWMS) are given in Article [5].

(existing) Ch 1, Sec 12, Table 3

Replace item 7 by:

Table 3 : List of documents to be submitted

No.	I/A	Document
7	I	BWMS safety and manual operating containing chemical injection procedures, alarm systems, measures in case of emergency, etc. Equipment manuals for major components of the BWMS.

(existing) Ch 1, Sec 12

Replace Table 6 by:

Table 6 : Safe locations for venting

Nature of the discharged gas	Concerned BWMS category	Origin of the discharge or vent	Acceptable safe locations of the discharge or vent outlet on the open deck
Inert gas or nitrogen product enriched air	In-line (categories 3a and 3b) and in-tank (categories 3c and 8) de-oxygenation BWMS	Protection devices installed on the ballast tanks, nitrogen or inert gas generators, nitrogen buffer tank (if any)	• Not within 3 m of areas traversed by personnel • Not within 6 m of air intakes for machinery (engines and boilers) and all ventilation inlets/outlets.
	In-line ozone injection BWMS (categories 7a and 7b)	Oxygen generator	
Oxygen-enriched air	In-line and in-tank de-oxygenation BWMS (categories 3a and 8)	Nitrogen generator	• Outside of hazardous area • Not within 3 m of any source of ignition and from deck machinery, which may include anchor windlass and chain locker openings, and equipment which may constitute an ignition hazard • Not within 3 m of areas traversed by personnel • Not within 6 m of air intakes for machinery (engines and boilers) and all ventilation inlets.
	In-line ozone injection BWMS (categories 7a and 7b)	Protection devices or vents from oxygen generator, compressed oxygen vessel, the ozone generator and ozone destructor devices	
(4) The areas on open deck, or semi-enclosed spaces on open deck, within 3 m of the outlets are to be categorized hazardous area zone 1 plus an additional 1,5 m surrounding the 3 m hazardous area zone 1 is to be categorized hazardous area zone 2. Electrical apparatus located in the above hazardous areas zone 1 and zone 2 is to be suitable for at least IIC T1.			

Nature of the discharged gas	Concerned BWMS category	Origin of the discharge or vent	Acceptable safe locations of the discharge or vent outlet on the open deck
Hydrogen by-product enriched gas	In-line full flow electrolysis BWMS (category 4), in-line side-stream electrolysis BWMS (category 5) and in-line injection BWMS using chemical which is stored onboard (category 6)	Hydrogen de-gas arrangement (when provided)	• Not within 5 m of any source of ignition and from deck machinery, which may include anchor windlass and chain locker openings, and equipment which may constitute an ignition hazard • Not within 3 m of areas traversed by personnel • Not within 5 m of air intakes from non-hazardous enclosed spaces. **(1)**
Gas from O_3 destructor device (ODS)	In-line ozone injection BWMS (categories 7a and 7b)	ODS fulfilling the following conditions: • the ODS are duplicated; and • the manufacturer justified that the quantity of consumable (activated carbon) used by the ODS is sufficient for the considered life cycle of the BWMS • ozone detection is arranged in the vicinity of the discharge outlet from the vent outlet of the ODS to alarm the crew in case the ODS is not working.	The safe locations defined for oxygen-enriched air apply
		ODS not fulfilling one of the above conditions	• Outside of hazardous area • Not within 3 m of any source of ignition • Not within 6 m of areas traversed by personnel • Not within 6 m of air intakes for machinery (engines and boilers) and all ventilation inlets.
(4) The areas on open deck, or semi-enclosed spaces on open deck, within 3 m of the outlets are to be categorized hazardous area zone 1 plus an additional 1,5 m surrounding the 3 m hazardous area zone 1 is to be categorized hazardous area zone 2. Electrical apparatus located in the above hazardous areas zone 1 and zone 2 is to be suitable for at least IIC T1.			

(existing) Ch 1, Sec 12

Delete Table 9.

(existing) Ch 1, Sec 12

Add the following Table 10 and Table 11:

Table 10 : Documentation and information to be submitted for type approval of BWMS

No.	Documentation and information to be submitted	Approval status **(1)**
1	BWMS specifications / Limitations	I
2	Dedicated technical manual of the BWMS	I
3	General drawings of the BWMS	A
4	General Arrangement	A
5	Main Piping diagram	A
6	Main Electrical diagram	A
7	List of components	I
8	Manufacturer's procedures for production check and production tests	I
9	Manufacturer's procedures for onboard installation checks, onboard installation tests and installation commissioning procedures	I
(1) A = For approval ; I = For information		

No.	Documentation and information to be submitted	Approval status **(1)**
10	Type approval certificates of the BWMS	I
11	Pressure vessels: Documents and information according to Sec 3, Tab 5	See Sec 3, Tab 5
12	Storage tanks for chemicals substances: detailed drawings	A
13	Piping systems: Documents according to Sec 10, Tab 1 and Sec 10, Tab 2	See Sec 10, Tab 1 and Tab 2
14	Electrical power and control cabinets: detailed drawings / diagrams with list of components	A
	Sensors and valve actuators:	
15	• detailed drawings / diagrams with location	A
16	• list and reference of type approval	I
17	Electrical cables: list and reference of type approval	I
(1) A = For approval ; I = For information		

Table 11 : Tests for BWMS to be carried out during manufacturing and witnessed by the Society

Equipment to be tested	Tests to be carried out
BWMS	Functional tests: • normal operations • forced operations • test of fault alarms • test of bypass alarms • test of remote starting/stop
Pressure vessels and their fittings	Pressure test (see Sec 3, [9.3.2]) Water tightness test
Skid piping and relevant fittings	Pressure test (see Sec 10, [20.5]) Tightness test
Valves for fresh water and backwash	Pressure test (see Sec 10, [20.5]) Tightness test Functional test
Chemical storage tank	Hydraulic test
Sensors and valve actuators	Functional test

(existing) Ch 1, Sec 12, [2]

Replace sub-article [2.1] by:

2.1 General requirements

2.1.1 Maximum treatment rated capacity

In case the maximum capacity of the ballast pump(s) exceeds the maximum treatment rated capacity (TRC) of the BWMS specified in the TAC issued by the Flag Administration, there should be a limitation on the BWMP giving a maximum allowable flow rate for operating the ballast pump(s) that is not to exceed the maximum TRC of the BWMS.

Additionally, in case the TRC is exceeded the system shall give an alarm which is to be recorded.

2.1.2 By-pass or override arrangements

a) The BWMS is to be provided with bypass or override arrangement to effectively isolate it from any essential ship system to which it is connected.

b) Any by-pass or override operation is to trigger an audible and visual alarm and these events are to be automatically recorded in control equipment. This requirement is also applicable to gravity ballast pipes.

c) Where the ship's ballast pump flow rates need to be limited in order to ensure operation of the BWMS within the limits of the BWMS TAC, the arrangement of the bypasses or overrides of the BWMS is to be consistent with the approved Operation Maintenance and Safety Manual by the Flag Administration's type approval.

(existing) **Ch 1, Sec 12, [4]**

Replace sub-articles [4.2] and [4.3] by:

4.2 BWMS involving the generation of a dangerous gas

4.2.1 Gas detection equipment is to be fitted in the spaces where dangerous gas could be present, and an audible and visual alarm is to be activated both locally and at the BWMS control station in the event of leakage.

The gas detectors are to be located as close as possible to the BWMS components where the dangerous gas may accumulate.

For flammable gases and explosive atmosphere including but not limited to H_2, the construction, testing and performance of the gas detection devices is to be in accordance with IEC 60079-29-1:2016, IEC 60079-29-2:2015, IEC 60079-29-3:2014 and / or IEC 60079-29-4:2009, as applicable.

Where other hazards are considered like toxicity, asphyxiation, corrosive and reactivity hazards, a recognized standard acceptable to the Society is to be selected with due consideration of the specific gases to be detected and due consideration of the performance of the detection device with regards to the specific atmosphere where it is used.

4.2.2 In spaces where inert gas generator systems are fitted (BWMS categories 3b and 3c) or nitrogen generators are fitted (BWMS categories 3a and 8), at least two oxygen sensors are to be positioned at appropriate locations, as required by Ch 4, Sec 15, [13.2.4], item e), 4), to alarm when the oxygen level falls below 19%. The alarms are to be both audible and visual and are to be activated:

- inside the space
- at the entry into the space
- inside the BWMS control station.

For BWMS categories 7a and 7b, at least two oxygen sensors are to be positioned at appropriate locations in the following spaces:

- spaces where ozone generators are fitted
- spaces where ozone destructors are fitted
- spaces where ozone piping is routed

to alarm when the oxygen level rises above 23%. The alarms are to be both audible and visual and are to be activated at the following locations:

- inside the space
- at the entry into the space
- inside the BWMS control station.

Automatic shutdown of the BWMS is to be arranged when the oxygen level rises above 25%. Audible and visual alarms independent from those specified in the preceding paragraph are to be activated prior to this shutdown.

4.2.3 For BWMS In-line side-stream ozone injection categories 7a and 7b, at least one ozone sensor is to be provided at the vicinity of the discharge outlet to the open deck from the ozone destructors addressed in Tab 6 to alarm when the ozone concentration level rises above 0,1 ppm. The alarms are to be both audible and visual and are to be activated in the BWMS control room. In addition, at least two ozone sensors are to be positioned at appropriate locations in the following spaces:

- spaces where ozone generators are fitted
- spaces where ozone destructors are fitted
- spaces where ozone piping is routed

to alarm when the ozone concentration level rises above 0,1 ppm. The alarms are to be both audible and visual and are to be activated at the following locations:

- inside the space
- at the entry into the space
- inside the BWMS control station.

Automatic shutdown of the BWMS is to be arranged when the ozone concentration measured from one of the two sensors inside the space rises above 0,2 ppm.

4.2.4 Inside double walled spaces or pipe ducts constructed as the special safeguard for the purpose of [4.3.1] sensors are to be provided for the detection of H_2 leakages (BWMS categories 4, 5 and 6 when relevant) or O_2 leakages (BWMS categories 7a and 7b) or O_3 leakages (BWMS categories 7a and 7b). The sensors are to activate an alarm at the high level settings and automatic shutdown of the BWMS at the high-high level settings described in above [4.2.1] to [4.2.3].

Note 1: As an alternative to the sensor for the gas detection, monitored under-pressurization inside the double walled spaces or pipe ducts may be provided with an automatic alarm and shutdown of the BWMS in case of loss of the under-pressurization. The monitoring can be achieved either by monitoring the pressure inside the double walled spaces or pipe ducts or by monitoring the exhaust fan.

4.2.5 For in-line full flow electrolysis BWMS (category 4), in-line side-stream electrolysis BWMS (category 5) and in-line injection BWMS using chemical which is stored on board (category 6): the hydrogen de-gas arrangement (when provided) is to be provided with redundant ventilation fans and redundant monitoring of the ventilation system.

In addition the ventilation fan is to be certified explosion proof and have spark arrestor to avoid ignition sources to enter the ventilation systems whereas remaining H2 gas may be present in dangerous concentrations.

Audible and visual alarms and automatic shutdown of the BWMS are to be arranged for respectively high and high-high levels of H_2. The open end of the hydrogen by-product enriched gas relieving device is to be led to a safe location on the open deck. Refer to [4.3.10].

4.2.6 The open ends of inert gas or nitrogen gas enriched air (BWMS categories 3a, 3b, 3c and 8) or oxygen-enriched air (BWMS categories 3a, 7a, 7b and 8) are to be led to a safe location on the open deck. Refer to [4.3.10].

4.3 Piping conveying dangerous gas or liquid

4.3.1 Where the piping is conveying active substances, by-products or neutralizers that are containing dangerous gases or dangerous liquids as defined respectively in [1.3.3] and [1.3.4], the following requirements are to be satisfied.

Requirement [4.3.2] to [4.3.9] is applicable to the injection lines conveying the dangerous gas or dangerous liquids but not applicable to the ballast water lines where the dangerous gas or dangerous liquids are diluted.

Note 1: The IMO reports issued during the basic and final approval procedures of the BWMS that make use of active substances (G9 Guideline) may be used for assessing the hazards that could be expected from the media conveyed by the BWMS piping.

4.3.2 Irrespective of design pressure and temperature, the piping is to be either of Class I (without special safeguard) or Class II (with special safeguard) as required by Ch 1, Sec 10, Tab 3. The selected materials, the testing of the material, the welding, the non-destructive tests of the welding, the type of connections, the hydrostatic tests and the pressure tests after assembly on board are to be as required in Ch 1, Sec 10, [2] to Ch 1, Sec 10, [5]. Mechanical joints, where allowed, are to be selected in accordance with Ch 1, Sec 10, Tab 18.

For piping class II with special safeguards conveying dangerous gas like hydrogen (H_2), oxygen (O_2) or ozone (O_3), the special safeguards are to be either double walled pipes or pipe duct. For piping class II with special safeguards conveying dangerous liquids, other special safeguards may be considered like shielding, screening, etc.

Plastic pipes may be accepted after due assessment of the dangerous gas or dangerous liquids conveyed inside. When plastic pipes are accepted, the requirements of Ch 1, App 3 apply.

4.3.3 The length of pipe and the number of connections are to be minimised.

4.3.4 Inside double walled space or pipe ducts constructed as the special safeguard for the purpose of [4.3.2] are to be equipped with mechanical exhaust ventilation leading to a safe location on the open deck. Refer to [4.3.10].

4.3.5 The routing of the piping system is to be kept away from any source of heating, ignition and any other source that could react hazardously with the dangerous gas or liquid conveyed inside. The pipes are to be suitably supported and protected from mechanical damage.

4.3.6 Pipes carrying acids are to be arranged so as to avoid any projection on crew in case of a leakage.

4.3.7 H_2 by-product enriched air vent pipes (BWMS categories 4, 5 and 6) or O_2 enriched air vent pipes (BWMS categories 3a, 7a, 7b and 8) or O_3 piping (BWMS categories 7a and 7b) are not to be routed through accommodation spaces, services spaces and control stations.

4.3.8 O_2 enriched air vent pipes (BWMS categories 3a, 7a, 7b and 8) are not to be routed through hazardous areas unless arranged inside double walled pipes or pipe ducts constructed as the special safeguard for the purpose of [4.3.2] and provided with suitable gas detection as described in [4.2.4] and mechanical exhaust ventilation as described in [4.3.4].

4.3.9 The routing of H_2 by-product enriched air vent pipes (BWMS categories 4, 5 and 6) or O_2 enriched air vent pipes (BWMS categories 3a, 7a, 7b and 8) is to be as short and straight as possible. When necessary, horizontal portions may be arranged with a minimum slope in accordance with the manufacturer's recommendation.

4.3.10 Safe locations

Safe locations referred to in [4.2.1] are to comply with the provisions of Tab 6.

(existing) Ch 1, Sec 12, [5]

Replace sub-article [5.1] by:

5.1 Type approval and design review

5.1.1 BWMS are to be of a type approved by the Society. For this purpose:

a) They are to be type approved by the Administration according to IMO Code for approval of ballast water management systems (BWMS Code, Resolution MEPC.300(72)).

Note 1: It should be noted that some flag Authorities request the IMO Type Approval to be issued on their behalf.

b) Their design is to comply with the Rules, in particular with the requirements of:

- Sec 3 for pressure vessels
- Sec 10 for piping
- Ch 2, Sec 15 for the type approval tests of electrical components
- Ch 3, Sec 3 for the computer-based systems

  Note 2: In general, monitoring functions of BWMS belongs to system category I under the application of Ch 3, Sec 3. However, in case a bypass valve is integrated in the valve remote control system, the bypass valve belongs to the system category II Ballast transfer remote control system.
- Ch 3, Sec 6 for the type approval tests of automation systems.

The relevant documentation to be submitted is listed in Tab 10.

The list of documents requested is intended as a guidance for the complete set of information to be submitted, rather than an actual list of titles.

The Society reserves the right to request the submission of additional documents if it is deemed necessary for the evaluation of the system, equipment or components.

Replace sub-article [5.3] by:

5.3 Inspection and testing

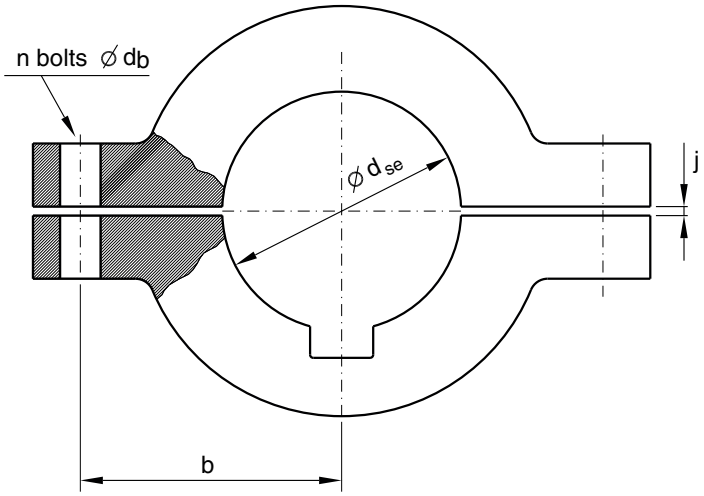
5.3.1 The BWMS and its components are required to be inspected by the Society at the manufactory (Society Certificate (C)) including pressure vessels, piping class I or II, filters, switchboards, etc.

5.3.2 The tests listed in Tab 11 are to be carried out and witnessed by the Society.

Ch 1, Sec 13

Replace Figure 2 by:

Figure 2 : Bolted tillers



Ch 1, Sec 15, [1.1]

Replace requirement [1.1.2] by:

1.1.2 Additional class notations

Where one or more of the following additional notations:

- **REF-CARGO**
- **REF-CONT**
- **REF-STORE**

is requested, the requirements of Part F, Chapter 7 are to be complied with, as applicable.

Ch 1, Sec 16, [2.2]

Replace the requirements [2.2.1] and [2.2.2] by:

2.2.1 Turbochargers are to ensure containment in the event of a rotor burst. This means that, in case of a rotor burst, no part may penetrate the casing of the turbocharger or escape through the air intake. For documentation purposes (test/calculation), it is to be assumed that the discs disintegrate in the worst possible way.

2.2.2 For category B and C turbochargers, containment is to be documented by testing. A generic range of turbochargers may be deemed to ensure containment based on testing of one specific unit. Testing of a large unit is preferred as this is considered conservative for all smaller units in the generic range. In any case, it is to be documented (e.g. by calculation) that the selected test unit really is representative for the whole generic range.

Note 1: A generic range means a series of turbochargers which are of the same design, but scaled to each other.

Ch 1, Sec 16, [2.3]

Delete requirement [2.3.1].

Replace (existing) requirement [2.3.2] by:

2.3.2 Where the disc of category C turbochargers is connected to the shaft with interference fit, calculations are to be performed to substantiate safe torque transmission during all relevant operating conditions such as maximum speed, maximum torque and maximum temperature gradient combined with minimum shrinkage amount.

Ch 1, Sec 16, [3]

Replace the title of the Article [3] by:

3 Certification, inspection and testing

Ch 1, Sec 16, [3.1]

Replace requirement [3.1.1] by:

3.1.1 Category B or C turbochargers are to be type tested according to the present sub-article.

Ch 1, Sec 16, [3.2]

Replace requirement [3.2.1] by:

3.2.1 Category B and C turbochargers inspections and testings as well as their associated certificates are to be done in accordance with Tab 5.

Ch 1, App 1, [5.2.1]

Replace item b) of the alphanumeric list by:

b) equivalent alternating stress σ''_V in way of journal fillet:

$$\sigma''_V = \pm\sqrt{(\sigma_{BG} + \sigma_{add})^2 + 3\tau_G^2}$$

Ch 1, App 6, [1.1]

Replace requirement [1.1.1] by:

1.1.1 This Appendix applies to the approval of alloy steel which has a minimum specified tensile strength greater than 800 N/mm2, but less than 950 N/mm^2 intended for use as intermediate shaft material.

Ch 1, App 6, [1.3.1]

Replace the reference to "NR216, Ch 5, Sec 2, Tab 1" by a reference to "NR216, Ch 5, Sec 3, Tab 1" in the second paragraph.

Ch 1, App 6, [1.4.1]

Replace the reference to "NR216, Ch 5, Sec 1, [1.10.3]" by a reference to "NR216, Ch 5, Sec 1, [10.3.1]".

CHAPTER 2

Ch 2, Sec 3, [4.1]

Add the following new requirement [4.1.5]:

4.1.5 This requirement applies to ships with service notation **bulk carrier**, **ore carrier** or **combination carrier**, as described in Pt A, Ch 1, Sec 2, [4.3] and provided with a dewatering system (see Ch 1, Sec 10, [6.6.7]). The enclosures of electrical equipment for the dewatering system installed in any of the forward dry spaces are to provide protection to IPX8 standard for a water head equal to the height of the space in which the electrical equipment is installed for a time duration of at least 24 hours.

Ch 2, Sec 3, [10.7]

Replace the title of sub-article [10.7] by:

10.7 Specific ships or installations

Ch 2, Sec 3, [10.7.1]

Add the following item at the end of the bulleted list:

- ships arranged with ballast water management systems, see *(existing)* Ch 1, Sec 12, [2.6].

Ch 2, Sec 10, [2.2]

Replace requirement [2.2.2] by:

2.2.2 Enclosures for slip ring assemblies is to ensure at least a degree of protection IP23.

Ch 2, Sec 11, [6.5.8]

Replace the second paragraph by:

Air inlet may be from the open air or, when in lockers and boxes, from another space.

Ch 2, Sec 14, [2.5]

Delete requirement [2.5.3].

CHAPTER 3

Ch 3, Sec 1, [1.4]

Replace requirement [1.4.1] by:

1.4.1 The automation systems and components, as indicated in Ch 2, Sec 15, [2], are to be type approved according to the applicable requirements of these Rules and in particular those stated in this Chapter.

Case by case approval may also be granted at the discretion of the Society, based on submission of adequate documentation and subject to the satisfactory outcome of any required tests.

Ch 3, Sec 6, [2.2.1]

Delete the last two paragraphs of requirement [2.2.1].

Ch 3, Sec 6, Table 1

Replace Rows "4a", "4b" and "4c" of Table 1 as follows:

Table 1 : Type tests

No.	Test	Procedure **(6)**	Test parameters	Other information
4a	Electric A.C. power supply variations	–	COMBINATION Voltage variation permanent / Frequency variation permanent + 6% / + 5% + 6% / – 5% – 10% / – 5% – 10% / + 5% Voltage transient (1,5s) / Frequency transient (5s) + 20% / + 10% – 20% / – 10%	• verification of the specified action of the equipment on loss and restoration of supply in accordance with the system design • verification of possible corruption of programme or data held in programmable electronic systems, where applicable • the time of 5 minutes may be exceeded if the equipment under test needs a longer time for start up, e.g. booting sequence • for equipment which requires booting, one additional power supply interruption during booting to be performed.
4b	Electric D.C. power supply variations	–	Voltage tolerance continuous: ± 10% Voltage cyclic variation: 5% Voltage ripple: 10% Electric battery supply: • +30% to –25% for equipment connected to charging battery or as determined by the charging/ discharging characteristics, including ripple voltage from the charging device • +20% to –25% for equipment not connected to the battery during charging	• verification of the specified action of the equipment on loss and restoration of supply in accordance with the system design • verification of possible corruption of programme or data held in programmable electronic systems, where applicable • the time of 5 minutes may be exceeded if the equipment under test needs a longer time for start up, e.g. booting sequence • for equipment which requires booting, one additional power supply interruption during booting to be performed.
4c	Pneumatic and hydraulic power supply variations	–	Pressure: ± 20% Duration: 15 minutes	• verification of the specified action of the equipment on loss and restoration of supply in accordance with the system design • verification of possible corruption of programme or data held in programmable electronic systems, where applicable • the time of 5 minutes may be exceeded if the equipment under test needs a longer time for start up, e.g. booting sequence • for equipment which requires booting, one additional power supply interruption during booting to be performed.

CHAPTER 4

Ch 4, Sec 1, [2.1.2]

Replace the reference to "IMO MSC.1/Circ.1002." by a reference to "IMO Circular MSC/Circ.1002, as amended."

Ch 4, Sec 3, [3.1.1]

Add the following items d) and e) in the alphanumeric list.

d) spaces containing an inert gas generator or an ozone generator

e) spaces intended for the storage or handling of solvent (as defined in *(new)* Ch 1, Sec 12, [1.3.5]) on board ships fitted with an onboard carbon capture system (OCC).

Ch 4, Sec 3, [3.3]

Delete requirement [3.3.1].

Ch 4, Sec 3, [4]

Insert the following new Sub-article [4.6]:

4.6 Protection of cabin balconies on passenger ships

4.6.1 A fixed fire detection and fire alarm system complying with the requirements of Ch 4, Sec 15 is to be installed on cabin balconies to which Ch 4, Sec 2, [2.2.4] applies, when furniture and furnishings on such balconies are not defined in Ch 4, Sec 1, [3.38.1], items a), b), c), f) and g).

Ch 4, Sec 3

Delete Articles [9] and [10].

Ch 4, Sec 5, [1.3.3]

Replace item b) 2) (11) of the alphanumeric list by:

- *(11) Auxiliary machinery spaces, cargo spaces, cargo and other oil tanks and other similar spaces of moderate fire risk*

  Cargo oil tanks

  Cargo holds, trunkways and hatchways

  Refrigerated chambers

  Oil fuel tanks (where installed in a separate space with no machinery)

  Shaft alleys and pipe tunnels allowing storage of combustibles

  Auxiliary machinery spaces as in category (10) which contain machinery having a pressure lubrication system or where storage of combustibles is permitted

  Oil fuel filling stations

  Spaces containing oil-filled electrical transformers (above 10 kVA)

  Spaces containing turbine and reciprocating steam engine driven auxiliary generators and small internal combustion engines of power output up to 110 kW driving generators, sprinkler, drencher or fire pumps, bilge pumps, etc.

  Closed trunks serving the spaces listed above

  Spaces intended for the storage or handling of solvent (as defined in *(new)* Ch 1, Sec 12, [1.3.5]) on board ships fitted with an onboard carbon capture system (OCC).

Replace item b) 2) (14) of the alphanumeric list by:

- *(14) Other spaces in which flammable liquids are stowed*

  Paint lockers

  Store-rooms containing flammable liquids (including dyes, medicines, etc.)

  Laboratories (in which flammable liquids are stowed)

  Spaces where the storage of liquid or solid chemicals for ballast water management systems is intended if flammable products are stored

  Note 2: Only chemical injection (cat.6 as per *(existing)* Ch 1, Sec 12, Tab 1), in-line flocculation (cat.2 as per *(existing)* Ch 1, Sec 12, Tab 1) and technologies using neutralizer injection (cat.4, 5, 6 and 7 as per *(existing)* Ch 1, Sec 12, Tab 1) require chemical or additive storage.

  Spaces where oxygen is stored or produced.

Ch 4, Sec 5, [1.3.4]

Replace item b), 2), (7) of the alphanumeric list by:

- *(7) Other machinery spaces*

  Electrical equipment rooms (auto-telephone exchange, air-conditioning duct spaces)

  Spaces as defined in Ch 4, Sec 1, [3.28], excluding machinery spaces of category A.

  Spaces dedicated to urea or sodium hydroxide solution tanks for selective catalytic reduction (SCR) systems, exhaust gas recirculation (EGR) systems or exhaust gas cleaning systems (EGCS), when separated from the engine room

  Ballast Water Management Rooms (BWMR) not containing oil-fired inert gas generators (i.e. for ballast water management systems other than category 3b and 3c according to *(existing)* Ch 1, Sec 12, Tab 1)

  Spaces intended for the storage or handling of solvent (as defined in *(new)* Ch 1, Sec 12, [1.3.4]) on board ships fitted with an onboard carbon capture system (OCC).

Replace item b), 2), (9) of the alphanumeric list by:

- *(9) Service spaces (high risk)*

  Galleys, pantries containing cooking appliances, paint lockers, lockers and store-rooms having areas of 4 m^2 or more, spaces for the storage of flammable liquids, saunas and workshops other than those forming part of the machinery spaces.

  Spaces where the storage of liquid or solid chemicals for ballast water management systems is intended if flammable products are stored or if the area of the space is above 4m^2.

  Note 2: Only chemical injection (cat.6 as per *(existing)* Ch 1, Sec 12, Tab 1), in-line flocculation (cat.2 as per *(existing)* Ch 1, Sec 12, Tab 1) and technologies using neutralizer injection (cat.4, 5, 6 and 7 as per *(existing)* Ch 1, Sec 12, Tab 1) require chemical or additive storage.

  Spaces where oxygen is stored or produced.

Ch 4, Sec 5, [1.4.3]

Replace item b), 2), (7) of the alphanumeric list by:

- *(7) Other machinery spaces*

  Electrical equipment rooms (auto-telephone exchange, air-conditioning duct spaces)

  Spaces as defined in Ch 4, Sec 1, [3.28], excluding machinery spaces of category A.

  Spaces dedicated to urea or sodium hydroxide solution tanks for selective catalytic reduction (SCR) systems, exhaust gas recirculation (EGR) systems or exhaust gas cleaning systems (EGCS), when separated from the engine room.

  Ballast Water Management Rooms (BWMR) not containing oil-fired inert gas generators (i.e. for ballast water management systems other than category 3b and 3c according to *(existing)* Ch 1, Sec 12, Tab 1)

  Spaces intended for the storage or handling of solvent (as defined in *(new)* Ch 1, Sec 12, [1.3.5]) on board ships fitted with an onboard carbon capture system (OCC).

Replace item b), 2), (9) of the alphanumeric list by:

- *(9) Service spaces (high risk)*

  Galleys, pantries containing cooking appliances, saunas, paint lockers and store-rooms having areas of 4 m^2 or more, spaces for the storage of flammable liquids, and workshops other than those forming part of the machinery spaces.

  Spaces where the storage of liquid or solid chemicals for ballast water management systems is intended if flammable products are stored or if the area of the space is above 4 m^2.

  Note 2: Only chemical injection (cat.6 as per *(existing)* Ch 1, Sec 12, Tab 1), in-line flocculation (cat.2 as per *(existing)* Ch 1, Sec 12, Tab 1) and technologies using neutralizer injection (cat.4, 5, 6 and 7 as per *(existing)* Ch 1, Sec 12, Tab 1) require chemical or additive storage.

  Spaces where oxygen is stored or produced.

Ch 4, Sec 5, [1.5.2]

Replace item b), 2), (7) of the alphanumeric list by:

- *(7) Other machinery spaces*

  Electrical equipment rooms (auto-telephone exchange and air-conditioning duct spaces)

  Spaces as defined in Ch 4, Sec 1, [3.28], excluding machinery spaces of category A.

  Spaces dedicated to urea or sodium hydroxide solution tanks for selective catalytic reduction (SCR) systems, exhaust gas recirculation (EGR) systems or exhaust gas cleaning systems (EGCS), when separated from the engine room.

  Ballast Water Management Rooms (BWMR) not containing oil-fired inert gas generators (i.e. for ballast water management systems other than category 3b and 3c according to *(existing)* Ch 1, Sec 12, Tab 1)

  Spaces intended for the storage or handling of solvent (as defined in *(new)* Ch 1, Sec 12, [1.3.5]) on board ships fitted with an onboard carbon capture system (OCC).

Replace item b), 2), (9) of the alphanumeric list by:

- *(9) Service spaces (high risk)*

  Galleys, pantries containing cooking appliances, saunas, paint lockers and store-rooms having areas of 4 m^2 or more, spaces for the storage of flammable liquids, and workshops other than those forming part of the machinery spaces.

  Spaces where the storage of liquid or solid chemicals for ballast water management systems is intended if flammable products are stored or if the area of the space is above 4 m^2.

  Note 3: Only chemical injection (cat.6 as per *(existing)* Ch 1, Sec 12, Tab 1), in-line flocculation (cat.2 as per *(existing)* Ch 1, Sec 12, Tab 1) and technologies using neutralizer injection (cat.4, 5, 6 and 7 as per *(existing)* Ch 1, Sec 12, Tab 1) require chemical or additive storage.

  Spaces where oxygen is stored or produced.

Ch 4, Sec 6, [4.5]

Add the following requirement [4.5.2]:

4.5.2 Spaces intended for the storage or handling of solvent onboard ships fitted with an onboard carbon capture system (OCC)

Spaces intended for the storage or handling of solvent (as defined in *(new)* Ch 1, Sec 12, [1.3.5]) on board ships fitted with an OCC are to be provided with one of the following fixed fire-extinguishing system:

- a fixed high-expansion foam fire-extinguishing system complying with the provisions of Ch 4, Sec 15 and using a foam concentrate suitable for extinguishing amine-based solvent fires, or
- a fixed pressure water-spraying fire-extinguishing system complying with the provisions of Ch 4, Sec 15.

Ch 4, Sec 6, [4.7.3]

Replace item a) of the alphanumeric list by:

a) *The fire hazard portions of internal combustion machinery*. In multi-engine installations, at least two sections are to be arranged.

Ch 4, Sec 9, [2.1]

Replace requirement [2.1.1] by:

2.1.1 *General arrangement plans shall be permanently exhibited for the guidance of the ship's officers, showing clearly for each deck the control stations, the various fire sections enclosed by A class divisions, the sections enclosed by B class divisions together with particulars of the fire detection and fire alarm systems, the sprinkler installation, the fire-extinguishing appliances, means of access to different compartments, decks, etc. and the ventilating system, including particulars of the fan control positions, the position of dampers and identification numbers of the ventilating fans serving each section, and the position of fuel oil quick-closing valve remote control and fuel oil pump stops,* or, for ships assigned with the additional service feature **CNGfuel**, **LNGfuel**, **LPGfuel**, **methanolfuel**, **ammoniafuel** or **LFPfuel**, position of the fuel supply closing valve and fuel supply pumps or compressor stops.

Alternatively, at the discretion of the Society, the aforementioned details may be set out in a booklet, a copy of which shall be supplied to each officer, and one copy shall at all times be available on board in an accessible position.

Plans and booklets shall be kept up to date; any alterations thereto shall be recorded as soon as practicable. Description in such plans and booklets shall be in the language or languages required by the Society. If the language is neither English nor French, a translation into one of those languages shall be included.

In addition, instructions concerning the maintenance and operation of all the equipment and installations on board for the fighting and containment of fire shall be kept under one cover, readily available in an accessible position.

The graphical symbols for the fire control plan are to be in accordance with IMO Resolution A.952(23) and table 3 of IMO Resolution A.1116(30) where the symbols for a specific item are differently expressed in IMO Resolutions A.952(23) and A.1116(30).

Replace requirement [2.1.3] by:

2.1.3 *In ships carrying more than 36 passengers, plans and booklets required by [2.1.1] shall provide information regarding fire protection, fire detection and fire extinction* including*:*

- ship's keel laying date and application of the SOLAS Convention and amendments
- which additional fire safety measures, if any, were applied
- dates and description of any modifications to the ship which in any way alter its fire safety.

Insert the following new requirement [2.1.7]:

2.1.7 For ships assigned with the additional service feature **LNGfuel** or **CNGfuel** with an ESD-protected machinery space, where fitted in line with the requirements of NR529, the emergency shutdown push buttons are to be shown.

Ch 4, Sec 11, [1.3.1]

Replace the term "fully segregated" by "segregated".

Ch 4, Sec 11, [4.5.3]

Replace Note 1 by:

Note 1: "High fire risk spaces" means machinery spaces of category A, ro-ro spaces, cargo holds where fixed fire-fighting systems are required (See Ch 4, Sec 6, [6.1]), galleys, pantries containing cooking appliances, laundry with drying equipment, spaces where oxygen is stored or produced, spaces in which flammable liquids or gases are stored, battery rooms and workshops.

Ch 4, Sec 15, [6.1]

Replace requirements [6.1.1] and [6.1.2] by:

6.1.1 Fixed pressure water-spraying fire-extinguishing systems

Fixed-pressure water-spraying fire-extinguishing systems for machinery spaces and cargo pump-rooms shall be approved by the Society based on IMO Circular MSC.1/Circ.1165, as amended.

6.1.2 Equivalent water-mist fire-extinguishing systems

Water-mist fire-extinguishing systems for machinery spaces and cargo pump rooms shall be approved by the Society based on IMO Circular MSC.1/Circ.1165, as amended.

Replace requirement [6.1.4] by:

6.1.4 Fixed water-based fire-fighting systems for ro-ro spaces, vehicle spaces and special category spaces

Fixed water-based fire-fighting systems for ro-ro spaces, vehicle spaces and special category spaces shall be approved by the Society based on IMO Circular MSC.1/Circ.1430, as amended.

Amendments to PART D

CHAPTER 1

Ch 1, Sec 1, [1.1]

Add the following new requirement [1.1.3]:

1.1.3 Additional guidance for arrangement and structural assessment is provided in NI640 Guidance Note for Structural Assessment of Passenger Ships and Ro-ro Ships.

Ch 1, Sec 4

Replace Table 1 by:

Table 1 : Electrical equipment permitted in closed ro-ro cargo spaces

No.	Space description	Electrical equipment	Hazardous area
1	Closed ro-ro cargo spaces except areas under item 3	Electrical equipment complying with one of the following types of protection may be considered: a) any type that may be considered for zone 0 b) certified intrinsically safe apparatus Ex(ib) c) simple electrical apparatus and components (e.g. thermocouples, photocells, strain gauges, junction boxes, switching devices), included in intrinsically-safe circuits of category "ib" not capable of storing or generating electrical power or energy in excess of limits stated in the relevant rules, and acceptable to the appropriate authority d) certified flameproof Ex(d) e) certified pressurised Ex(p) f) certified increased safety Ex(e) g) certified encapsulated Ex(m) h) certified sand filled Ex(q) i) certified specially Ex(s) j) cables sheathed with at least one of the following: • a non-metallic impervious sheath in combination with braiding or other metallic covering • copper or stainless steel sheath (for mineral-insulated cables only)	Zone 1
2	Exhaust ventilation ducts	As stated under item 1	Zone 1
3	On condition that the ventilation system is so designed and operated as to provide continuous ventilation of the cargo spaces at the rate of at least 10 air changes per hour whenever vehicles are on board: • areas above a height of 450 mm from the deck • areas above a height of 450 mm from each platform for vehicles, if fitted, without openings of sufficient size permitting penetration of petrol gases downward • areas above platforms for vehicles, if fitted, with openings of sufficient size permitting penetration of petrol gases downward	Electrical equipment complying with one of the following types of protection may be considered: a) any type that may be considered for zone 1 b) tested specially for zone 2 (e.g. type "n" protection) c) pressurised, and acceptable to the appropriate authority d) encapsulated, and acceptable to the appropriate authority e) the type which ensures the absence of sparks and arcs and of "hot spots" during its normal operation (minimum class of protection IP55) f) cables sheathed with at least a non-metallic external impervious sheath	Zone 2

CHAPTER 2

Ch 2, Sec 2, [6.1]

Replace requirement [6.1.1] by:

6.1.1 A single loading condition complying with the following criteria is to be selected from the loading manual:

- the resulting draught is equal to the scantling draught, as far as practicable
- the resulting still water bending moment is at least equal to 95% of the maximum permissible still water bending moment ($M_{sw\text{-}max}$)
- the ship is homogeneously loaded, as far as practicable
- the cargo holds are loaded up to their top, as far as practicable
- the minimum ballast water is carried.

CHAPTER 6

Ch 6, Sec 2, [1.1.6]

Replace the last paragraph by:

An assessment of the initial stability (GM_o) for compliance with the relevant intact stability requirements taking into account the free surface effect caused by liquids contained by the gutter bars is to be undertaken on:

- tankers having cargo tanks exceeding 60% of the vessel's maximum beam at midships regardless of gutter bar height
- ships without deck camber
- ships where the height of the installed gutter bars exceeds the camber.

CHAPTER 7

Ch 7, Sec 2, [2.1.5]

Add the following new item g) in the alphanumeric list:

g) Paint lockers, regardless of their use, cannot be located above the tanks and spaces defined in item a).

Ch 7, Sec 2, [3.7.1]

Replace the last paragraph by:

An assessment of the initial stability (GM_o) for compliance with the relevant intact stability requirements taking into account the free surface effect caused by liquids contained by the gutter bars is to be undertaken on:

- tankers having cargo tanks exceeding 60% of the vessel's maximum beam at midships regardless of gutter bar height
- ships without deck camber
- ships where the height of the installed gutter bars exceeds the camber.

CHAPTER 8

Ch 8, Sec 3, [2]

Insert the following new sub-article [2.1]:

2.1 Location of paint lockers

2.1.1

IBC CODE REFERENCE: Ch 3, 3.2.1

Paint lockers, regardless of their use, cannot be located above the cargo area.

Ch 8, Sec 15, [4.3]

Replace requirement [4.3.1] by:

4.3.1 Lining approved for use with acids

IBC CODE REFERENCE: Ch 15, 15.11.2

"Lining" is an acid-resistant material that is applied to the tank or piping system in a solid state i.e. not spray on.

The requirement for the elasticity of a lining to be not less than the supporting boundary plating is to prevent debonding at the interface between the lining and the lined surface.

CHAPTER 9

Ch 9, Sec 4, [4.3.1]

Replace the formula of "S_2" by:

$$S_2 \geq 2{,}5\sqrt{Rt}$$

Ch 9, Sec 4, [8.3.4]

Replace item b) of the alphanumeric list by:

b) The net section modulus Z, in cm^3, and the net web thickness t_w, in mm, of ordinary stiffeners subjected to lateral pressure are to be checked according to Pt B, Ch 7, Sec 5, [1.1] considering:

$P = p_{IGC}$

$$C_s = C_t = \min\left[0{,}75\,;0{,}37\left(\frac{R_m}{R_{eH}}\right)\right]$$

where:

p_{IGC} : Internal lateral pressure, in kN/m^2, as defined in [3.3.2] item e)

Ch 9, Sec 4, [11.1]

Replace requirement [11.1.2] by:

11.1.2 *If the cargo temperature at atmospheric pressure is below –10°C, a complete secondary barrier shall be provided as required in [2.3]. The secondary barrier shall be designed according to [2.4].*

Ch 9, Sec 5, [4.1.4]

Add the following paragraph at the end of requirement [4.1.4]:

The expression "duct" means to include the equipment enclosure required in Ch 9, Sec 16, [4.3] (e.g. GVU enclosure) as well as the structural pipe duct intended to contain any release of gas from inner pipe or equipment. The term "structural pipe duct" means an outer duct forming part of a structure such as a hull structure or superstructure or deck house, where permitted, other than gas valve unit rooms.

Ch 9, Sec 5, [11.6]

Replace requirement [11.6.4] by:

11.6.4 *All emergency shutdown valves shall be of the "fail-closed" type (see [13.3.1] and Ch 9, Sec 18, [3.2]),* i.e. emergency shutdown valves are to close automatically in case of fire (due to loss of actuating power).

Ch 9, Sec 5, [12.1]

Add the following new requirement [12.1.6]:

12.1.6 A Society certificate is to be provided for the raw material of parts of valves or pumps that will be in direct contact with cargo and with a working temperature below –55°C.

Ch 9, Sec 5, [13.5]

Replace requirement [13.5.4] by:

13.5.4 *In double wall gas-fuel piping systems, the outer pipe or duct shall also be pressure tested to show that it can withstand the expected maximum pressure at gas pipe rupture.*

The expression "duct" means to include the equipment enclosure required in Ch 9, Sec 16, [4.3] (e.g. GVU enclosure) as well as the structural pipe duct intended to contain any release of gas from inner pipe or equipment. The term "structural pipe duct" means an outer duct forming part of a structure such as a hull structure or superstructure or deck house, where permitted, other than gas valve unit rooms.

The expression "maximum pressure at gas pipe rupture" is the maximum pressure to which the outer pipe or duct is subjected after the inner pipe rupture and for testing purposes it is the same as the design pressure used in [4.1.4].

Ch 9, Sec 6, [4.1]

Replace requirement [4.1.1] by:

4.1.1 The use of high manganese austenitic steel for cryogenic service may be permitted in accordance with IACS Recommendation No.169.

Refer also to IMO Circular MSC.1/Circ.1599: Interim guidelines on the application of high manganese austenitic steel for cryogenic service.

Ch 9, Sec 16, [4.3]

Add the following new requirement [4.3.2]:

4.3.2 The gas valve unit rooms are to be:

a) gastight toward other enclosed spaces

b) equipped with mechanical exhaust ventilation having a capacity of at least 30 air changes per hour and arranged to maintain a pressure less than the atmospheric pressure, and

c) able to withstand the maximum built-up pressure arising in the room in case of a gas pipe rupture, as documented by suitable calculations taking into account the ventilation arrangements.

CHAPTER 10

Ch 10, Sec 1, Table 1

Replace the row "Stability" as follows:

Table 1 : Applicable requirements

Item	Greater than or equal to 500 GT	Less than 500 GT
Stability	• Part B • Ch 10, Sec 2	• NR566 • Ch 10, Sec 2

CHAPTER 11

Ch 11, Sec 5, [3.2.1]

Replace the last paragraph by:

In spaces such as under deck passageways, bosun's locker, hospital and pump room, the public address system may not be required.

CHAPTER 12

Ch 12, Sec 4

Replace Table 1 and Table 2 as follows:

Table 1 : Electrical equipment permitted in special category spaces above the bulkhead deck

No.	Description of spaces	Electrical equipment	Hazardous area
1	Areas at less than 450 mm above the deck or platforms for vehicles, if fitted, without openings of sufficient size permitting penetration of petrol gases downward	Electrical equipment complying with one of the following types of protection may be considered: a) any type that may be considered for zone 0 b) certified intrinsically safe apparatus Ex(ib) c) simple electrical apparatus and components (e.g. thermocouples, photocells, strain gauges, junction boxes, switching devices), included in intrinsically-safe circuits of category "ib" not capable of storing or generating electrical power or energy in excess of limits stated in the relevant rules, and acceptable to the appropriate authority d) certified flameproof Ex(d) e) certified pressurised Ex(p) f) certified increased safety Ex(e) g) certified encapsulated Ex(m) h) certified sand filled Ex(q) i) certified specially Ex(s) j) cables sheathed with at least one of the following: • a non-metallic impervious sheath in combination with braiding or other metallic covering • copper or stainless steel sheath (for mineral insulated cables only)	Zone 1
2	Exhaust ventilation ducts	As stated under item 1.	Zone 1
3	• areas above a height of 450 mm from the deck • areas above a height of 450 mm from each platform for vehicles, if fitted, without openings of sufficient size permitting penetration of petrol gases downward • areas above platforms for vehicles, if fitted, with openings of sufficient size permitting penetration of petrol gases downward	Electrical equipment complying with one of the following types of protection may be considered: a) any type that may be considered for zone 1 b) tested specially for zone 2 (e.g. type "n" protection) c) pressurised, and acceptable to the appropriate authority d) encapsulated, and acceptable to the appropriate authority e) the type which ensures the absence of sparks and arcs and of "hot spots" during its normal operation. For installation, in compliance with Pt C, Ch 4, Sec 13, [2.2.2], a minimum class of protection IP55 is acceptable as an alternative f) cables sheathed with at least a non-metallic external impervious sheath	Zone 2

Table 2 : Electrical equipment permitted in special category spaces below the bulkhead deck

No	Description of spaces	Electrical equipment	Hazardous area
1	Special category spaces	Electrical equipment complying with one of the following types of protection may be considered: a) any type that may be considered for zone 0 b) certified intrinsically safe apparatus Ex(ib) c) simple electrical apparatus and components (e.g. thermocouples, photocells, strain gauges, junction boxes, switching devices), included in intrinsically-safe circuits of category "ib" not capable of storing or generating electrical power or energy in excess of limits stated in the relevant rules, and acceptable to the appropriate authority d) certified flameproof Ex(d) e) certified pressurised Ex(p) f) certified increased safety Ex(e) g) certified encapsulated Ex(m) h) certified sand filled Ex(q) i) certified specially Ex(s) j) cables sheathed with at least one of the following: • a non-metallic impervious sheath in combination with braiding or other metallic covering • copper or stainless steel sheath (for mineral insulated cables only)	Zone 1
2	Exhaust ventilation ducts	As stated under item 1	Zone 1

CHAPTER 13

Ch 13, Sec 1, [1.1]

Add the following new requirement [1.1.3]

1.1.3 The additional service feature **EOC** may be assigned in accordance with Pt A, Ch 1, Sec 2, [4.13.1] only to:

- ships greater than 90m in length assigned the service notation **dredger**
- ships greater than 65m in length assigned the service notation **hopper dredger**, **hopper unit**, **split hopper dredger** or **split hopper unit**.

CHAPTER 15

Ch 15, Sec 5, [2.1]

Replace requirement [2.1.1] by:

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

The list of documents requested is intended as a guidance for the complete set of information to be submitted, rather than an actual list of titles.

The Society reserves the right to request the submission of additional documents regarding unconventional design or where deemed necessary for the evaluation of the system, equipment or components.

Where the length is less than 24 m, the Society may give exemptions to the documents to be submitted.

Ch 15, Sec 6, [6.1.9]

Replace "0,085 m^2" by "0,075 m^2" in item b) of the alphanumeric list.

Amendments to PART E

CHAPTER 1

Ch 1, App 1, Fig 15

Replace the title of Figure 15 by:

Figure 15 : Procedure for estimating bollard pull at P_{Total} when $\alpha_{BP} < 0,97$ or $\alpha_{BP} > 1,03$

Ch 1, App 1, [9.6.1]

Replace item b) in the alphanumeric list by:

b) if $\alpha_{BP} > 1,03$

the curve is shifted vertically by multiplying the curve with α_{BP} to match the data points, as depicted in Fig 15. It is to be demonstrated that the applicable hull structure and stability requirements are complied with.

CHAPTER 8

Ch 8, Sec 4, [2]

Delete the sub-article [2.6].

Amendments to PART F

CHAPTER 3

Ch 3, Sec 1, [1.2]

Replace requirements [1.2.1], [1.2.2] and [1.2.3] by:

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

1.2.2 For ships of less than 500 gross tonnage and with a propulsive power of less than 1 MW, the requirements laid down in [4], except [4.1.3], do not apply.

Diesel engines installed on ships are to be equipped with:

a) Indicators, as detailed below:
- for auxiliary engine of 1000 kW and above:
  The requirements laid down in Pt C, Ch 1, Sec 2, Tab 4; Pt C, Ch 1, Sec 2, Tab 5 and Pt C, Ch 1, Sec 2, Tab 6 apply
- for propulsion engine or auxiliary engine with a power less than 1000 kW:
  - lubrication oil pressure indication
  - fresh water temperature indication.

The indicators are to be fitted at the centralised control position.

b) Alarms, as detailed below:
- for auxiliary engine of 1000 kW and above:
  The requirements laid down in Pt C, Ch 1, Sec 2, Tab 4; Pt C, Ch 1, Sec 2, Tab 5 and Pt C, Ch 1, Sec 2, Tab 6 apply
- for propulsion engine or auxiliary engine with a power less than 1000 kW:
  - lubrication oil low pressure alarm
  - very low lubricating oil pressure alarm
  - overspeed alarm.

The alarms are to be visual and audible at the centralised control position.

c) Automatic control, as detailed below:
- for auxiliary engine of 1000 kW and above:
  The requirements laid down in Pt C, Ch 1, Sec 2, Tab 4; Pt C, Ch 1, Sec 2, Tab 5 and Pt C, Ch 1, Sec 2, Tab 6 apply
- for propulsion engine or auxiliary engine with a power less than 1000 kW:
  - shut-down on very low lubricating oil pressure
  - shut-down on overspeed.

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

Ch 3, Sec 1, [1.2.4]

Replace the term "cargo ships of less than 1600 tons gross tonnage" by "cargo ships of less than 1600 gross tonnage".

Ch 3, Sec 1, [4.8]

Add the following new requirement [4.8.9]:

4.8.9 For exhaust gas treatment systems, alarms and indications required in Pt C, Ch 1, Sec 11, [2.4.6] are to be available at the centralised control position.

Ch 3, Sec 2, [1.2]

Replace requirement [1.2.1] by:

1.2.1 Exemptions mentioned in Ch 3, Sec 1, [1.2] may also be considered for the additional class notation **AUT-CCS**.

Ch 3, Sec 3, [1.2]

Replace requirement [1.2.2] by:

1.2.2 Ship of less than 1600 gross tonnage and fishing ships of less than 75 metres in length are exempted from the requirements in [3.1.2].

CHAPTER 4

Replace the Title of Chapter 4 as follows:

CHAPTER 4 INTEGRATED AND DIGITAL SYSTEMS

Chapter 4

Replace Section 3 “Communication System (SYS-COM)” by the following Section 3 “Ship-Shore Communication (ASYNC-COM)”:

Add the following new Section 4 “Data Infrastructure (DATA-INFRA)”:

Section 3 Ship-Shore Communication (ASYNC-COM)

1 General

1.1 Application

1.1.1 The additional class notation **ASYNC-COM** may be assigned, in accordance with Pt A, Ch 1, Sec 2, [6.5], to ships equipped with asynchronous communication systems which can ensure transfer of data between the ship and the shore.

The additional class notation **ASYNC-COM** is complemented by the suffix **-R** when the communication systems are redundant.

1.1.2 The requirements for the assignment of the additional class notation **ASYNC-COM** are given in Article [2]. The additional requirements for the assignment of the suffix **-R** are given in Article [3].

1.1.3 The scope of the notations **ASYNC-COM** and **ASYNC-COM-R** is limited to the functioning of the ship-shore communication system in the geographic area covered by communication network(s) with which the onboard communication device(s) can exchange data. The geographic area is to be specified by the applicant as per [1.3].

1.1.4 The requirements of this Section are not applicable for:

- the remote control over the computer based systems of categories II and III as defined in Pt C, Ch 3, Sec 3
- the remote control over the autonomous ships and unmanned surface vessels (USV) as defined in NI641 and NR681 respectively
- the shipborne communication equipment listed in IMO SOLAS Chapter IV.

1.1.5 The requirements of this Section do not address the cyber security, for which reference is made to NR659 Rules on Cyber Security for the Classification of Marine Units.

1.2 Definitions

1.2.1 The following general definitions are used in the present Section:

- Asynchronous communication: a communication designed to transmit and receive time-insensitive data for non-real-time applications where the timing of the data creation and consumption may be different, i.e. receiver sends a response, and the sender sends the next data without waiting for the response.
- Communication management software: a software, used for communication, that consists of a data management agent and a data transport agent.
- Connected system: an onboard system which depends on the ship-shore communication in order to perform its function.
- Data management agent: a software for the control and transport of data between data transport agents.
- Data transport agent: a software installed on both ship and shore collecting and sending data to the data management agent, or receiving data from the data management agent.
- Essential ship functions: functions essential for propulsion, steering and safety of the ship.
- External communication provider: a provider of information transmission services between communication devices and terrestrial networks.
- Function: a defined objective or characteristic action of a system or component (see ISO/IEC/IEEE 24765 Systems and software engineering - Vocabulary).
- Redundant system: a system capable to maintain its function following a single failure, this can be achieved by the installation of multiple redundant components or by the use of alternative means to perform the function.
- Ship-shore communication system: a computer-based system designed to provide a data communication between the on-shore and shipboard servers. The system includes at least one communication device, a communication management software and a gateway to the ship's network.
- Traffic quota: amount of data which can be transferred over a specified period of time.

1.3 Documentation to be submitted

1.3.1 The documents to be submitted for granting additional class notations **ASYNC-COM** or **ASYNC-COM-R** are listed in Tab 1.

Table 1 : Documents to be submitted

No.	A/I **(1)**	Description
1	I	User manual, installation manual, functional description, and maintenance manual of ship-shore communication system on board, including the communication devices
2	I	List of onboard communication devices as a part of ship-shore communication system
3	I	Type Approval Certificates or Test Certificates for equivalent standards as per [2.2.1]
4	A	Diagram presenting the integration between the ship-shore communication system and the ship's network. The diagram can be a network topology with communication devices, communication management software, gateways
5	A/I	Documentation as required in Pt C, Ch 3, Sec 3 for the computer based systems used within the ship-shore communication system
6	I	List of data to be transmitted via the ship-shore connection with description and with a data priority level to be specified as per [2.1.3]
7	I	Management policy for bandwidth utilisation, data priority and traffic optimisation
8	A	Onboard functional test programme including the data sets for a test transmission
9	I	Templates of the transmission logs and the procedure for accessing the logs
10	I	Recovery procedure for the onboard components of the ship-shore communication system that can be executed without a remote intervention via a communication device
11	I	Network bandwidth calculation specifying the overall maximum capacity of the communication system and the capacity allocated to the connected system
12	I	Network traffic load analysis for the minimum throughput required for the connected system and other onboard traffic consumers, if any
13	I	Subscription details for the external communication service per communication device specifying the throughput and availability
14	I	Antenna arrangement plan with the transmission frequencies
15	I	Diagrams for power supply and sensor inputs, if applicable, for the onboard ship-shore communication system
16	I	Description of the geographic coverage by each communication device
17	A	FMEA of the ship-shore communication system, as applicable **(2)**
18	A	FMEA test programme for the ship-shore communication system, as applicable **(2)**
19	I	Description of the redundant geographic coverage and a small scale chart presentation of the area, which is the overlap of the coverages provided for each communication device, as applicable **(2)**

(1) A = for approval ; I = for information

(2) For granting additional class notation **ASYNC-COM-R**

Note 1: Further documentation may be requested for approval or for information by the Society on a case by case basis

2 Notation ASYNC-COM

2.1 General requirements

2.1.1 The ship is to be equipped with a ship-shore asynchronous communication system providing regular data transfers sufficient to support the operation of a specific connected system.

2.1.2 A communication management software is to be implemented on board and is to be appropriately configured to handle the ship network's throughput on all dedicated communication devices. A communication management software is to be provided with means to:

- manage priority level for data transfer
- manage traffic quota based on amount of data transferred by an application, application category or user group
- provide information on communication system status, including the connectivity, communication device availability, estimated transfer rate.

2.1.3 Appropriate priority levels are to be set up for the data transferred, so that essential ship functions are not altered, and that sufficient bandwidth remains available for the critical ship usage.

2.1.4 Data transport agent is to apply a bandwidth management policy which corresponds to each communication device in use subject to its operational limits. The identifier and transmission status of the used communication device are to be fed into the data transport agent as inputs.

2.1.5 Communication management software is to log the transmissions with a timestamp and store the following meta data:

- communication device in use
- compression percentage
- priority tag for the data package

- estimated bandwidth availability at the time of transmission
- transmission attempt count
- ship shore communication latency with the first shore node
- transmission protocol (e.g. Server Message Block (SMB), File Transfer Protocol (FTP), Message Queuing Telemetry Transport (MQTT) asynchronous message service)
- IP address of the node initiating transmission
- message queuing information, if applicable.

2.1.6 The communication management software is to provide a separate log of the outages per communication device with a duration.

2.1.7 In no case, the operation or a failure of the onboard communication system are to result in:

- a disruption of services providing the essential ship functions on board
- compromised reception and transmission of distress messages and other communications covered by the Rules and/or Statutory regulations (e.g. digital cordless telephone (DCT), public address).

2.1.8 The communication devices are to be provided on board with the means of a software recovery without the need for a remote intervention requiring such communication devices.

2.1.9 If a shore database is used by the communication management software to store the data produced by the vessel, a status of the storage is to be regularly transmitted to the vessel and at least monthly. The status message is to include the time span of the stored data, which meets the requirements to the data quality and integrity identified for the connected system.

2.1.10 In case of a shore database failure which prevents data exchange with the vessel for a period, duration of which can compromise the data quality and integrity identified for the connected system, or in the event of a loss of the previously replicated data, the communication management software is to provide a notification to an operator on board the vessel.

2.2 Components

2.2.1 Components for ship-shore communication systems are to be type approved and tested according to Pt C, Ch 3, Sec 6. Test certificates for conformity to an equivalent standard including, but not limited to, IEC 60945 may be considered.

2.2.2 Components for ship-shore communication systems are to be tested and installed according to the environmental categories (EC code) as defined in Pt C, Ch 2, Sec 1, [3.29].

2.2.3 Case by case approval may also be granted at the discretion of the Society, based on the submission of adequate documentation and subject to the satisfactory outcome of any required tests.

2.2.4 The design, construction, commissioning and maintenance of computer based systems where they depend on software for the proper achievement of the ship-shore communication functions are to be in accordance with Pt C, Ch 3, Sec 3 requirements and are to comply at least to the requirements for Category I systems for hardware and software.

2.3 Onboard testing

2.3.1 During the initial installation survey, functional tests are to be performed and demonstrated to the Surveyor in accordance with the onboard functional test programme. .

2.3.2 As far as practicable, functional tests are to be performed in the expected condition of ship's operation:

- functional test of a connected system involving the corresponding data transfers with the shore
- all intended data producers connected
- if the same communication device is used for other types of communication, such a parallel usage is to be maintained without intentional disruptions throughout the test.

2.3.3 A test dataset is to be provided to check the communication management software independently from the connected system. The dataset is to include the files with the size, compression and encryption representing the range of the permitted data types and the maximum throughput for which the communication management software is designed. The dataset can be provided by the manufacturer of the communication software or by the integrator of the overall ship-shore communication system including the communication devices.

2.3.4 A test dataset is to be provided to check the ship-shore communication system in transmissions for the connected system. The dataset is to include the files of the size, compression and encryption representing the range of the data types generated by the connected system and the maximum throughput required by the connected system. The communication test data is to be provided by manufacturer of the connected system.

2.3.5 During the onboard test witnessed by a Surveyor of the Society, the system is to be operated to demonstrate the transfer capability on each communication device including:

- two-way transmission of the test datasets described in [2.3.3] and in [2.3.4] between the ship and the shore
- generation of a transmission log.

2.3.6 During the onboard test, a Surveyor of the Society is to:

- check the transmission schedule in the communication management software
- check the transmission log to confirm that the test data is transferred in an order established by the priority.

2.3.7 Where the communication system is not sufficiently separated to meet the requirements of [2.1.7] based on the review of the network diagram, the Society may request to perform a network broadcast storm testing.

3 Additional requirements for notation ASYNC-COM-R

3.1 General

3.1.1 The communication system is to be arranged with redundant communication devices. The communication devices are to:

- provide an equivalent total geographic coverage
- overlap the restricted geographic region where the connected system is to use the ship-shore communication.

3.1.2 In the event of a failure of the communication device in use, a notification is to be produced on the navigating bridge, the transition to the redundant communication device is to be automatic and without any intervention from the operator. As a minimum two redundant communication devices are to be running at a time.

3.1.3 Notifications for a failure of the automatic commutation function and of each communication device is to be provided on the navigating bridge.

3.1.4 Each communication device is to be supplied with an independent Uninterruptible Power Supply system (UPS) providing a sufficient capacity for 30 minutes of operation following a loss of the main power supply.

3.1.5 The antenna arrangement of the communication devices is to prevent any interference with the other transmitting and receiving equipment including the channel overlap and is to prevent a simultaneous masking of the signal path for all redundant communication devices at a time on any ship's heading.

3.1.6 Each communication device is to be protected against an inadvertent shutdown by an operator.

3.1.7 Failure Mode and Effect Analysis (FMEA) is to document any common elements and cross-connections between the communication devices. The FMEA is to be top-down and is to provide a conclusion about the effect on the ship-shore communication function from a single point failure. The FMEA is to demonstrate the fault ride through capabilities and the overall redundancy of the ship-shore communication system. The FMEA is to take into account the independence of the corresponding external networks and inputs from the ship's sensors, e.g. heading indicators such as gyros. The perimeter of the analysis for the onboard installation can extend till the gateway to the ship's network, excluding the gateway itself.

3.1.8 For **ASYNC-COM-R** a loss of all components installed in the same fire sub-division from fire is accepted by design, the single failures studied in the FMEA may exclude the fire in the compartment with the equipment.

3.1.9 For **ASYNC-COM-R** for components below the bulkhead deck, a loss of all components installed in the same watertight compartment from flooding is accepted by design, the single failures studied in the FMEA may exclude the flooding in the compartment with the equipment.

3.1.10 FMEA tables can be prepared based on the requirements of IEC 60812:2018 and the example in the Tab 2 with the following columns adapted to the redundant ship-shore communication:

- the final effect of a single failure is given as the resultant status of the ship-shore communication (loss of function occurred or not)
- severity and probability columns are not required as the target configuration is redundant and as the probability of a single failure is not to be the subject of the study.

3.1.11 FMEA is to include a test programme designed to confirm the fault detection, protection and redundant functions by simulating applicable single failures of the components.

3.2 Onboard installation and testing

3.2.1 During the onboard test witnessed by a Surveyor of the Society, the functions of the redundant design are to be checked according to the FMEA test programme, including:

- alarms in the event of failures
- automatic switching of the communication device in use
- alarm for UPS in a by-pass mode
- UPS endurance testing to confirm the available charge capacity.

Table 2 : Example of a FMEA table for the additional class notation ASYNC-COM-R

SYSTEM:	VSAT (Very Small Aperture Terminal)
SUB-SYSTEM:	ACU (Antenna Control Unit)
CONFIGURATION OF COMMUNICATION SYSTEM:	VSAT and FBB running simultaneously, FBB in hot standby, VSAT is the primary
DRAWING REFERENCE:	

FMEA ID	Component name Location and ID	Failure mode and Cause	Immediate local effect	Effect on other redundant groups and other systems	Global effect on Communication	Detection and Indication to Operator	Means of Protection and Mitigation	Reference to FMEA validation testing
ACU1	Model name, Antenna Control Unit (ACU) Instrument room ACU-abc1	Loss of heading input due to a loose cable or a failure of the gyro feeding the signal	No effect propagation to other systems, failure effects contained within the perimeter of the VSAT communication system	If there is no heading input due to the failure, alarms are indicated on the ACU display. Antenna switches to gyro-free mode automatically	Changeover to the secondary satellite communication system FBB (Fleet Broad Band) within 30 seconds. A traffic management policy applied according to the criticality, the transmission for the category X bandwidth consumers is maintained without disruptions	A visual and audible notification in the onboard portal of the communication system	Automatic changeover switch between VSAT and FBB	Test No 3 "Loss of Gyro Signal"

Section 4 Data Infrastructure (DATA-INFRA)

1 General

1.1 Scope and application

1.1.1 The additional class notation **DATA-INFRA** is assigned, in accordance with Pt A, Ch 1, Sec 2, [6.5], to ships fitted with onboard data infrastructures complying with the requirements of this Section.

Data infrastructures consist of data assets, technologies, organizations and data management processes, which ensure reliable data collection, transmission, storage, control, sharing and availability to multiple data consumers, as defined in [2].

Note 1: Data consumers can be smart functions. For smart functions definition and requirements, refer to Rule Note NR675.

The additional class notation **DATA-INFRA** may be complemented by the suffix **-STAND**, when the data infrastructure supports international standards or norms, which are ensuring a higher level of interoperability with other systems, and complies with additional requirements given in Articles [6], [9] and [10].

Note 2: By ensuring access to a wide variety of ship data, data infrastructures are an enabler to ship digitalization and a support for the implementation of visualization, analytics, augmented decision making or operations optimization.

Note 3: Reliability and interoperability of data infrastructures along with by cyber security and data quality framework, are essential for the implementation of new technologies onboard ships.

1.1.2 The scope of the data infrastructure is to be specified by the following documentation:

- Infrastructure description, defined in [4.1], which includes systems and boundaries definition, along with specification of supported data standards.
- Data Producer Inventory, defined in [4.2], with the list of collected ship data.
- Data Consumer Inventory, defined in [4.3], with the list of expected data consumers and, when applicable, supported smart functions.

1.1.3 This Section does not apply to, or supersede requirements for:

- systems for which a direct control is to be ensured (e.g. automation systems)
- systems already covered by other requirements such as IEC 61162 network (navigation network)
- systems already covered by other additional class notations (e.g. **AUT-IMS**, **SYS-IBS**).

Note 1: However, these systems (e.g. automation) may be interfaced with the data infrastructure to ensure digitalization and access to these data by data consumers.

1.1.4 This Section does not cover:

- Cyber security for which reference is made to NR659 “Rules on cyber security for the classification of marine units”.
- Remote control (only telemetry systems are covered). Therefore data infrastructure for autonomous or remote-controlled ships, are not covered.
- Ship functions which require a (near) real time access to data.
- Data processing related to a dedicated usage, algorithm specifications, data consumers or any dedicated application or use of these data.
- Other onboard ship network and ship-shore communication devices.

Note 1: See Article [2] for the definition of “other onboard systems”.

1.2 Type approval

1.2.1 For component, sub-systems or devices requested to be type approved product, the Type Approval scheme is described in Rule Note NR320 “Certification Scheme of Materials and Equipment for the Classification of Marine Units”, and consists of the following steps:

- documentation review
- type testing
- issuance of Type Approval Certificate.

1.2.2 Any significant modification to the data infrastructure is to be notified to the Society, and a new approval is to be carried out.

Note 1: A significant modification is a modification which influences the functionality and/or the safety of the system.

2 Definitions

2.1 General

2.1.1 The following general definitions are used in this Section:

- Data consumer:

  User interface, system or tool that uses data.
- Data pipeline:

  Set of data processing elements where the output of one element is the input of the next one. Buffer storages are usually placed between elements.
- Data producer:

  Device, sensor, user interface, automation, service that collect data on board.
- Edge computing:

  Distributed computing paradigm that brings computation and data storage closer to the sources of data in order to improve response times and save network bandwidth.
- Fault tolerance:

  Refer to the ability of an IT system (hardware, software or power sources) to continue operating without interruption when one or more components fail.
- High availability:

  Refer to the capacity to minimize the downtime of a system in case of critical failure.
- Interoperability:

  Ability of two or more systems, or components, to exchange information and to use the information that has been exchanged. Different levels of interoperability can be defined though the Levels of Conceptual Interoperability Model (LCIM):
  - Level 0: no connection between devices
  - Level 1: technical level, a physical connectivity is established allowing bits and bytes to be exchanged
  - Level 2: syntactical level, data can be exchanged in standardized formats, (i.e. the same protocols and formats are supported)
  - Level 3: semantic level, not only data but also its contexts (i.e. information) can be exchanged. The unambiguous meaning of data is defined by common reference models.
- Local Area Network (LAN):

  Physical or virtual computer network that interconnects devices within a limited area (e.g. machinery room, ship...).
- Metadata:

  Data defining and describing other data.
- MODBUS:

  Data communication protocol. MODBUS supports communication to and from multiple devices connected to the same cable, or Ethernet network.
- MQTT (Message Queuing Telemetry Protocol):

  Standard messaging protocol for the Internet of Things (IoT). It is designed as a lightweight publish/subscribe messaging transport that enables remote devices connection with a small code footprint and minimal network bandwidth.

Note 1: Internet of Things (IoT) means physical objects with sensors, processing capabilities and software that allow connectivity and data exchange with other devices and system over the Internet or communication networks.

- Other onboard (devices):

  Refers to ship systems or devices which are not part of, but are connected to, the data infrastructure covered by this Section.

Note 2: As stated in [1.1.4], the requirements of this Section do not apply to other onboard systems.

- Purposely installed (devices):

  Refer to ship systems or devices in the scope of the data infrastructure as defined in this Section.
- Server:

  Computer that manages access to centralized resources or services within a network.
- Service Level Agreement (SLA):

  Commitment between a service provider and a client which specifies the service provided, with respect to different measurable aspects (e.g. availability, performance...). In particular, a Data Quality Service Level Agreement (DQ SLA), is an agreement that specifies data consumers expectations in term of data validity rules (e.g. completeness, timeliness...), and the corresponding target or level of acceptability. Service provider supports are usually part of the SLA (e.g. response time, action...).
- Service Level Definition (SLD):

  Specification of the service provided, with respect to different measurable aspects.
- TCP/IP:

  Set of communication protocols used on the Internet or similar computer networks.

- Telemetry:

  Collection of measurements or other data at remote points and their automatic transmission to a receiving equipment for monitoring.

- Programmable Logic Controller (PLC):

  Industrial computer adapted for the control of process.

- Zigbee:

  Communication protocol defined in IEEE 802.15.4 and used for wireless connection.

2.2 Data Infrastructures

2.2.1 Data infrastructures are usually constituted by:

- One or more acquisition LAN, which perform the collection and transfer of data.
- Ship network, which enables data transfer from acquisition LAN to end server.

Note 1: Data infrastructures are usually connected to an other on board ship network.

- Ship-shore communication system, which enables transfer of data from ship to shore.

Note 2: Data infrastructures are usually connected to an other on board ship-shore communication system.

- Data server, which can be cloud, shore or ship based. The server hosts data, supports multiple functionalities such as control, sharing and availability to data consumer.
- Data management policies or organisation: policies or organisation ensuring proper data sharing, maintenance, quality assurance and uniform data management.

Note 3: Data infrastructures should be supported by qualified organizations, process and technologies to ensure data quality management and access to reliable data (refer to [10.3]).

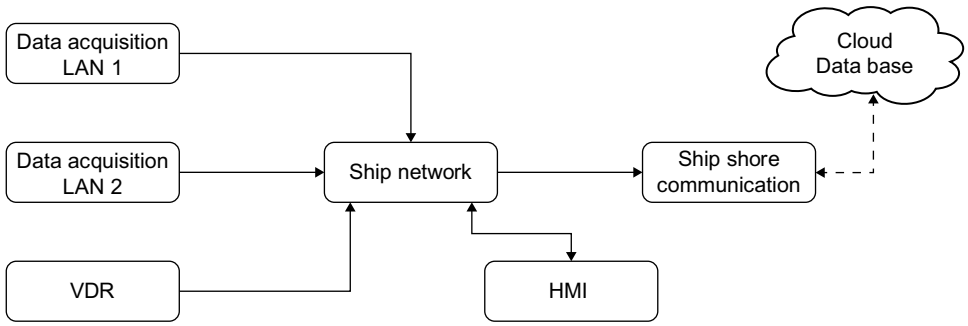
- Human Machine Interface (HMI), which enables access to data, information, visualization or analytics may be provided.

2.3 Acquisition LAN

2.3.1 For the purpose of this Section, the term "acquisition LAN" refer to devices, and to the corresponding Local Area Network, designed to collect or share data from different data producers and that may ensure their transmission to a server.

Multiple acquisition LAN, provided by different manufacturers may be fitted on a single ship (see Fig 1).

Figure 1 : example of multiple data acquisition LAN



2.3.2 The acquisition LAN is usually constituted by:

- Data logger: network device fitted with computational capabilities, internal storage and acting as a gateway to connect different types of networks or devices.
- Purposely installed network devices which ensure data transfer and communication (e.g. "L2 switch", "Zigbee to TCP/IP Modbus Gateway"...).
- Data producers, which can be:
  - purposely installed (e.g. sensors)
  - other on board systems (e.g. Alarm Monitoring System, PLC...).
- Devices interconnection (e.g. RJ45, radio waves...).
- Power sources.

Note 1: The acquisition LAN may be very simple, for example when data infrastructure only collect data from existing other on board system such as Alarm Monitoring Systems (AMS).

2.4 Data logger

2.4.1 A data logger is usually constituted by:

- Data acquisition interface, which ensures acquisition of data from various data sources (i.e. analogue / digital, batch / streaming).
- Gateway, which ensure the interface and data flow between different networks.
- Internal storage capability, which ensures temporary data storage, for recovery in case of data infrastructure failure.
- Embedded data processing capabilities.
- Data communication and network capabilities.
- Administration management functions.

3 Documentation to be submitted

3.1 General

3.1.1 The documents to be submitted for granting additional class notation **DATA-INFRA** or **DATA-INFRA-STAND** are listed in Tab 1.

Further documentation may be requested for approval or for information by the Society on a case-by-case basis.

Table 1 : Documents to be submitted

No.	A/I **(1)**	Description	References in the Section
INFRASTRUCTURE DESCRIPTION			
1	I	Infrastructure definition: - Data infrastructure SLD - Data Quality SLD - Supported standards	[4.1]
2	I	Data Producer Inventory	[4.2]
3	I	Data Consumer Inventory	[4.3]
4	A	Architecture	[4.4]
5	I	Data quality framework	[10.3]
SHIP NETWORK AND COMMUNICATION			
6	I	Bandwidth calculation **(2)**	[8.1]
INSTALLATION AND TESTING			
7	I	Ship-shore communication subscription	[11.2]
8	A	Testing protocols	
9	I	Onboard documentation: - User's manual - Installation manual - Maintenance manual - Sensors maintenance plan	
10	I	Identification of personnel in charge of network management and maintenance	

(1) A = for approval ; I = for information
(2) On request of the Society

4 Infrastructure description

4.1 General

4.1.1 Objectives and boundaries

A general description of the data infrastructure is to be provided, with overall goals and objectives for the ship, or ship management.

Description of systems covered by the data infrastructure, with identification of the boundaries between purposely installed system, and other on board systems are to be provided (see Fig 2).

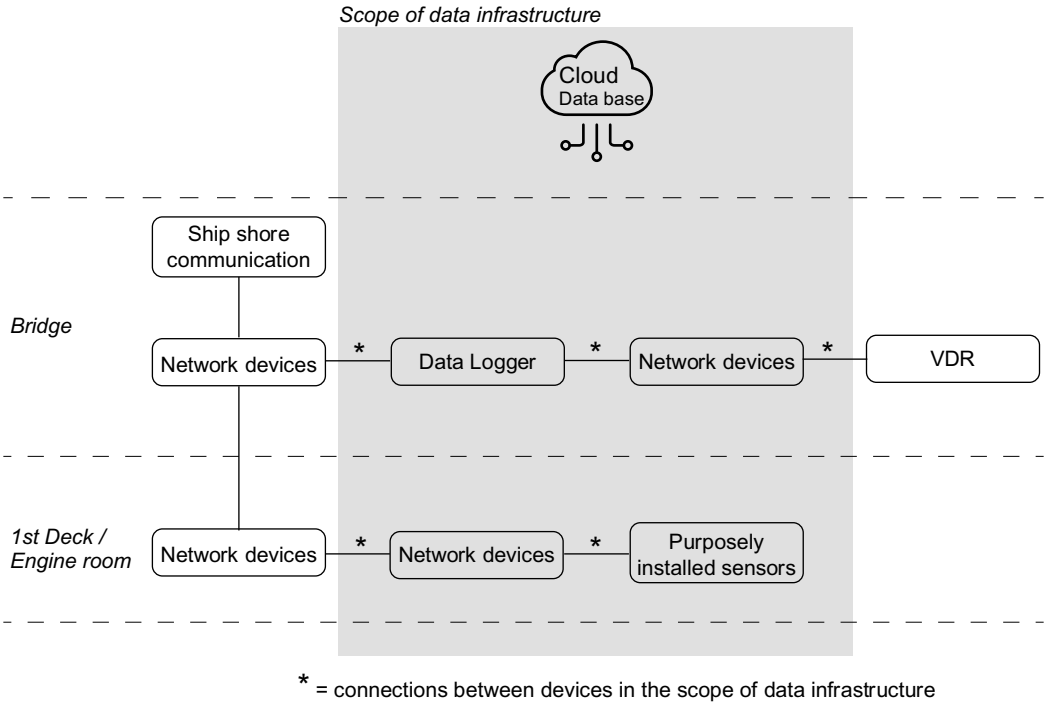
The data infrastructure usually relies on other on board ship network devices, or on other on board ship-shore communication system, for the transmission of data.

Note 1: Other on board devices, are outside the scope of the data infrastructure as defined in this document.

However, depending on the architecture the manufacturer may add additional devices in order to support the data infrastructure. In that case following are to be submitted:

- documentation on additional ship network devices, if any,
- documentation on additional ship-shore communication devices, if any.

Figure 2 : Example of data infrastructure boundary diagram



4.1.2 Data infrastructure Service Level Definition (SLD)

A data infrastructure Service Level Definition (SLD) is to be provided with the list of indicators qualifying the expected performance or reliability of the data infrastructure.

The data infrastructure SLD is a manufacturer input, therefore the list of indicators, along with corresponding targets, are the responsibility of the manufacturer. An example of data infrastructure SLD is given in Tab 2.

Note 1: When applicable, indicators are to be monitored by the infrastructure, refer to [10.4].

Note 2: The SLD may be considered as a basis for Service Level Agreement between the data infrastructure manufacturer and the Owner.

Note 3: When services do not meet targets, customer support, remediation processes, responsibilities and escalation plan (e.g."IT team support", then "software manager") should be defined.

Table 2 : Example of data infrastructure SLD

Topic	Measure	Metric	Target
System Performance	Average time for database access or data producers	Response time	• page display < 2 s • analytic display < 5 s
	Data retention time	Estimated storage time for database, backup and log. Based on a 20% growth	• 5 years
	Data latency (or freshness)	Average latency between data producer and availability in the data base	• for sensors: 15min
	Timestamp accuracy	Average latency between data producer and data time stamping	• for sensors: 1ms
Reliability	Server database availability	Monthly uptime (%): $\frac{\text{Maximum available minutes} - \text{Downtime}}{\text{Maximum available minutes}}$	• 99%
	Back up frequency	Frequency	• once a day
	Recovery time	Expected time to recover the system from catastrophic failure	• 24h

Table 3 : Example of DQ SLD

DQ Dimension	Business Rule	Measure	Target
Completeness	• Database fields should be complete	% of displayed values that are not “Null” or “NaN”	> 90%
Uniqueness	• IDs should be unique for a data element	% of unique element	> 95%
Validity	• Data element (physical sensor values) should be inside the sensor “range” defined in metadata	% of values inside sensor range	> 85%
	• Data element should be of the correct type	% of value with the correct ‘type’	> 80%
	• Data element should be of the correct format	% of correct format	> 77%
	• Transmission error should be as low as possible	% of message transmission error	> 80%
Currency	• Data element (sensor) present in the database has been refreshed during the last 6h	% of element not refreshed	> 85%
Timeliness	• Data element timestamp should be correct	% without incorrect or missing timestamp	> 90%
Accuracy	• Sensor value should not present a slope or a drift in values (not physical behavior)	% of value with a drift in the median value (over the past 2month)	> 90%
	• Sensors calibration should be up to date	% of sensors calibrated	> 95%

4.1.3 Data Quality Service Level Definition (DQ SLD)

Data Quality Service Level Definition (DQ SLD) is to be provided with the list of data quality dimensions setting up the expected quality of data. Corresponding targets are to be specified (and business rules when available).

The DQ SLD is a manufacturer input and therefore the list of dimensions covered, along with corresponding targets, is the responsibility of the manufacturer. An example of DQ SLD is provided in Tab 3.

Note 1: The DQ SLD is part of data management (refer to [10]).

Note 2: When applicable, indicators are to be monitored by the infrastructure, refer to [10.4].

4.1.4 Data standards

For the assignment of the notation **DATA-INFRA-STAND**, data standards supported by the data infrastructure are to be specified and comply with additional requirements given in [6], [9] and [10].

4.2 Data producer inventory

4.2.1 An inventory of the data producers in the scope of acquisition LAN is to be provided (see Tab 4), with:

- data producers, with indication of:
  - name with ID
  - “purposely installed” (e.g. sensors) or “other on board systems” (e.g. automation system, “organization logbook”)
  - on board location, when applicable.
- list of data collected and transferred, with indication of:
  - data ID
  - data or parameter description
  - data type
  - data unit
  - calibration period, for purposely installed data sources
  - sampling time with signal feature (e.g. instant, average, maximum...).

4.3 Data consumer inventory

4.3.1 A general inventory of expected data consumer is to be provided (see Tab 5). Inventory may include but is not limited to:

- data consumer name
- type of data consumer (e.g. visualization, analytics, models for optimization...)
- corresponding smart function, when applicable

Note 1: smart function are defined in NR675, Sec 1.

- general description.

Table 4 : Example of Data Producer Inventory

Data producer and #ID	Purposely installed / Other onboard system	Onboard location	Data	Data ID	Data type	Unit	Source calibration period	Sampling time / Signal feature
Sensor #ME1	Purposely installed	Engine room Main diesel generator Generator Rotor shaft						
			bearing temperature	254032_temp	scalar	°C	yearly	15min / maximum
AMS #AMS34	Other onboard system	Bridge						
			latitude	lat	scalar	geodetic system	Not Applicable	5min / instant
			longitude	long	scalar	geodetic system	Not Applicable	5min / instant
Noon reports #report2	Other onboard system	Bridge						
			Noon reports content	org_2	string	Not Applicable	Not Applicable	event driven / instant

Table 5 : Example of data consumer inventory

Data consumer	Visualization / Analytics / Models	Smart function (see NR675)	Description
Current vessel position	Visualization	–	Display current vessel position (AIS) on a world map
Vessels voyages	Visualization / Analytics	–	Display vessel past voyage on a world map. Detailed information on previous voyages are accessible
Swell	Visualization / Analytics	–	Swell height, swell direction, swell spectra
Diesel Engine Analysis	Visualization / Analytics	MH	Diesel engine RPM and efficiency analysis
Noon report visualization	Visualization	–	(Read) access to noon report

4.4 Architecture

4.4.1 Data flow

The data-flow architecture is to be submitted (see Fig 3), with:

- A general data flowchart, from data producers to intermediate and final repositories. When applicable, data consumers may be considered.

Note 1: It is recommended to indicate general database architecture (e.g. Data Warehouse, Data Lakes...) with specification of the product/API used (e.g. Kafka, Mongo DB...).

- Short description of data processing (e.g. “max aggregate) or API request (e.g. “PUSH”).

4.4.2 Acquisition LAN

A detailed scheme or diagram detailing the acquisition LAN is to be provided (see Fig 4), with:

- identification of data producers:
  - purposely installed
  - other on board systems connected to data infrastructure

Note 1: Data producers are detailed in the Data Producer Inventory

- identification of network devices:
  - purposely installed (e.g. data logger, switch…)
  - other on board network devices at the interface of the acquisition LAN
- connection between different devices, with indication of physical connection, direction of the communication (bidirectional or one way), and protocol (e.g. Modbus Ethernet TCP / RJ45, Zigbee / Wi Fi…)
- power sources.

Note 2: It is to be noted that each solution may differ from one to another, therefore a clear definition of data flow and infrastructure is to be provided with identifications of boundaries between purposely installed devices and other on board systems.

Figure 3 : Example of data flow

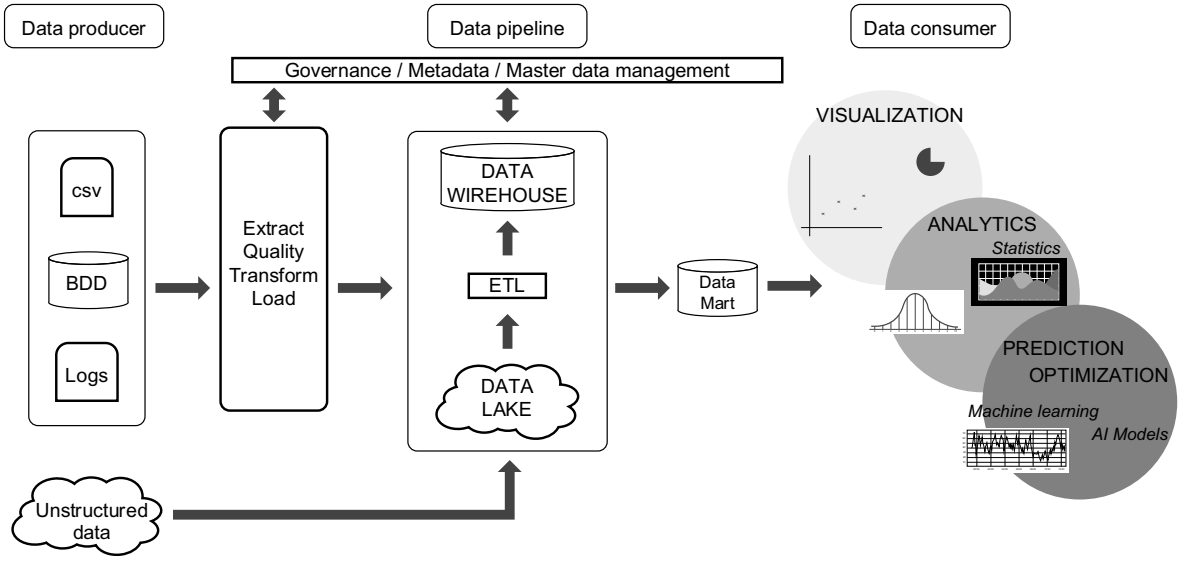
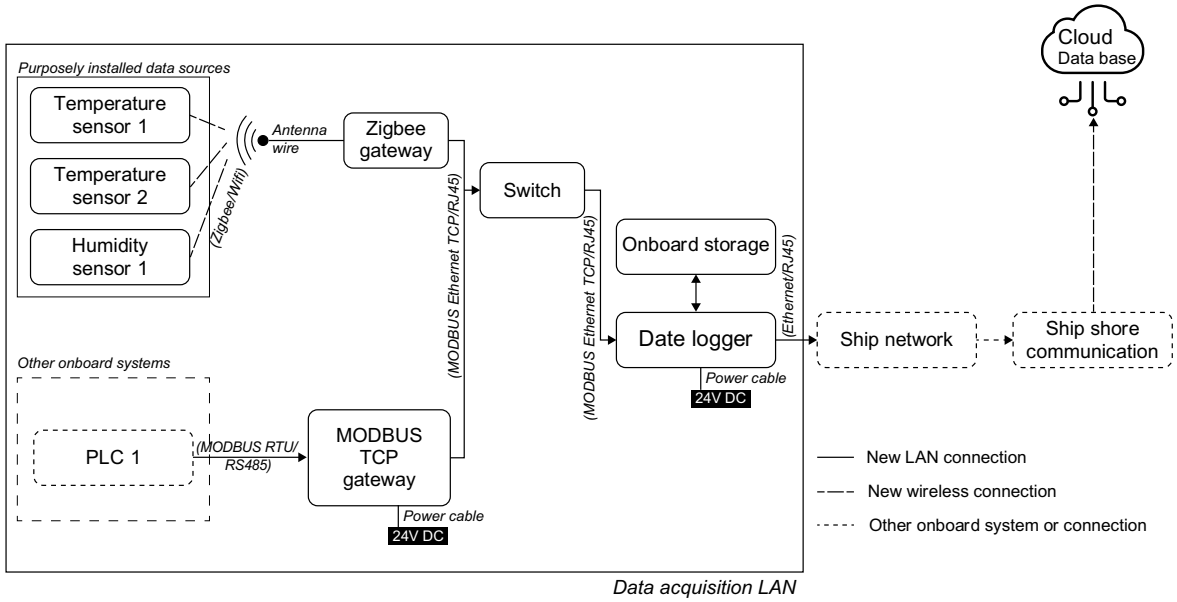


Figure 4 : example of acquisition LAN architecture



4.4.3 Data logger specifications

Technical documentation of the data logger is to be provided, with:

- general description
- connectivity specification:
  - number of ports with indication of the connection type (e.g. RJ45, Wi-Fi 5GHz …)
  - supported protocols (e.g. TCP/IP, MODBUS/IP, MODBUS RS485, HTTPS...)
  - maximum number of devices that can be connected, when applicable
  - maximum input rate under which the equipment can perform its functions
- power supply
- data processing functions (e.g. “max”, ”min”...).

4.4.4 Data server specifications

General description of server capability is to be provided. Technical documentation is to be provided, that may include, but is not limited to, the following:

- connectivity specification
- power supply, when applicable
- processing performance (e.g. number of source, response time...) for request-response services for data input, data output, and streaming services may be requested by the Society on a case-by-case basis.

4.4.5 On board storage specifications

On board storage capacity, with estimation of the maximum time of on board storage is to be provided, based on a common ship usage and at full use of the available inputs. Expected scalability (refer to [5.1.3]) of the data infrastructure is to be considered in the calculation (e.g. 20% increase).

4.4.6 Purposely installed network or ship-shore communication devices specification

When additional devices are added by the data infrastructure manufacturer to the ship network or to the ship-shore communication system, they are in the scope of this section and their documentations are to be submitted.

5 Requirements for acquisition LAN

5.1 General

5.1.1 Component, sub-systems or devices

Acquisition LAN devices, data logger components or subsystems are to be type approved products (as indicated in Pt C, Ch 2, Sec 15, [2]). They are to be approved on the basis of the applicable requirements of the Rules and in particular the ones defined in Part C, Chapter 3.

Note 1: All sensors, transmitters and data processing equipment already used within the scope of notations **AUT-UMS**, **AUT-CCS**, **AUT-PORT** and **AUT-IMS** may be used in the scope of Data Infrastructure.

5.1.2 Data communication links

Data links are to comply with following requirements:

- Characteristics of data link are to prevent overloading in any operational condition of system.
- Data link are to be self-checking, detecting failures on the link itself and data communication failures on nodes connected to the link. Detected failures are to initiate an alarm.

Especially, wireless data links are to comply with following requirements:

- Recognized international wireless communication system protocols are to be employed, incorporating message integrity: fault prevention, detection, diagnosis, and correction so that the received message is not corrupted or altered when compared to the transmitted message
- The internal wireless system within the vessel are to comply with the radio frequency and power level requirements of International Telecommunication Union and flag state requirements.

  Consideration should be given to system operation in the event of port state and local regulations that pertain to the use of radio-frequency transmission prohibiting the operation of a wireless data communication link due to frequency and power level restrictions.

5.1.3 Scalability

The acquisition LAN is to be designed and the corresponding devices are to be chosen, in order to ensure as far as possible scalability, such as: input/output channel expansion, increase of storage capability, computational resources, compatibility between devices, support of multiple data transmission protocols.

Scalability is to be considered at the design stage.

5.1.4 Availability

High availability of the data infrastructure is to be ensured, especially:

- supporting software are to be fault tolerant
- acquisition LAN devices are to restart automatically (i.e. without intervention of personnel) after loss of power supply or interruption
- in case of a device communication loss, re-initialization and re-establishment of the connection is to be automatically performed.

Note 1: Availability of the data infrastructure may be part of the infrastructure SLD (e.g. 99,9% availability).

5.1.5 Network separation

The acquisition LAN and the corresponding devices are to be separated from ship's essential services networks.

5.1.6 Separation with other on board systems

In no case, the presence of purposely installed devices (e.g. data logger, gateway...) for the collection of other on board systems data are to impact the availability, the functionality or to interfere with these other on board systems.

Especially, purposely installed collection devices used to collect information, and the corresponding supervision interface, are to use strong separated and safe logical environments (e.g. separated virtual machines). So that the system is not to be able to alter the origin data, software or hardware, purposefully or not purposefully.

Risk analysis or technical specification may be requested by the Society on a case-by-case basis, to justify the separation with other on board systems. Especially, purposely installed collection devices are to be located, and mounted, at a distance from the other on board systems, in order to avoid any perturbation of the other on board systems or instrumentation.

5.1.7 Back-up

Acquisition LAN devices (e.g. data logger...) are to be able to recover from backup.

Procedures for diagnostic, re-installation and restoration of equipment, system or solution are to be available on board to the attention of responsible personnel.

5.1.8 Integrated system

Integrated systems are to comply with requirements stated in Pt C, Ch 3, Sec 3, [8].

5.2 Data producer

5.2.1 Purposely installed sensors design

Sensors are to be approved on the basis of the applicable requirements of this Section and of Part C, Chapter 3.

Sensors characteristics (e.g. precision, range, accuracy…) are to be appropriate with regard to the physical parameter to be monitored, and when applicable to the data consumers (e.g. optimization model).

Note 1: Sensors metadata should be available in the information model (refer to [10].

Note 2: When the data infrastructure aims to support data-driven data consumers, the requirements of stakeholders in charge of algorithms development are to be considered during sensor selection, and data infrastructure design (e.g. sampling time). Indeed sensors characteristics such as precision or range may have an impact on models, on the confidence interval of the prediction... thus limiting performances (e.g. numbers of false negatives).

5.2.2 Purposely installed sensor location

Sensors are to be located such as they provide a reliable measurement of the physical parameter to be monitored. Manufacturers or international standards specifications are to be considered.

Note 1: The position of sensors with regard to the physical parameter to be monitored is the responsibility of the designer and it should be confirmed after installation during deployment phase by the mean of inspections or measurements..

The sensors are to be selected and installed in such a way that a periodical on-site recalibration can be carried out.

5.2.3 Purposely installed sensor calibration

Sensor calibration information or certificate are to be available in the data infrastructure or integrated. This is part of the information model (refer to [10]).

5.2.4 Purposely installed sensors on board identification

Sensors are to be installed with permanent means of identification.

5.3 Data logger

5.3.1 Computer based system

Data loggers are computer based systems and are to comply with requirements of Pt C, Ch 3, Sec 3, as Category I system.

In addition, the following documentation is to be submitted for information:

- software functional description and associated hardware description
- test program for on board tests, including wireless network testing.

5.3.2 Functions

Data loggers computational resources and internal memory are to be sufficient to ensure data acquisition, network connectivity, and to support functions listed in [6]:

- management functions
- communication and data input / output functions
- data processing functions
- data storage and buffering functions
- log management functions.

5.3.3 Continuity of operation

Data loggers are to be able to detect and handle the loss or interruption of communication (e.g. timeout), and to ensure continuous operation of data acquisition and data storage, without loss or overwritten of data.

5.3.4 Integrity

Data loggers are to ensure integrity of recorded information. The process for writing data or files is to be at system level.

Administration profiles, or operators profiles are not to have other access right than read only.

Operators with backup rights, are not to have read access rights.

5.3.5 Alarm & status reporting

Data loggers are to be fitted with a status reporting interface with indication of the system status (e.g. normal, abnormal).

Detected failures are to initiate an alarm. A no-fault condition is to be positively indicated (e.g. green LED lighted).

5.3.6 Connection to ship network

When data loggers are connected to the ship network, a wired, Ethernet interface which enables a minimum transmission rate of 100 Mbps (fast Ethernet), is to be provided.

5.3.7 Direct access

An on board direct connection to data logger is to be provided (e.g. console port) for debugging or maintenance purpose.

5.3.8 Buffering

Data logger are to be provided with non-volatile, buffering storage capacity of sufficient size (e.g. EEPROM) to avoid loss of collected data during network issue.

5.3.9 Temperature conditions

The device is to be able to work safely up to an ambient temperature of 45°C. A minimum of two cooling units are to be arranged to maintain design temperature.

5.3.10 On board storage

An on board data storage unit with removable medium and able to store the following data for a minimum of 30 days is to be provided:

- management data, as listed in [6.4]
- collected data, based on a full usage of acquisition LANs, as listed in [6.4]
- error log, as listed in [6.5].

The storage is to be:

- located in a safe place (e.g. no extreme temperature...)
- visually identifiable with appropriate color code:
  - central storage unit containing data is to be visually identifiable (e.g. orange box)
  - removable data storage location is to be visually identifiable (e.g. black arrow with safety message).

Procedure for emergency extraction or records are to be available on board with detailed information and identification of the location of the equipment on board

Note 1: Depending of the architecture, the on board storage may be an external unit, integrated in the data logger or in the server.

6 Data logger functions

6.1 Administration management functions

6.1.1 Configuration management

Configuration management of the data logger is to be allowed. It is to be accessible through human interface (e.g. HTTP access, local access...)

6.1.2 System clock management

Data logger is to be fitted with clock management function capability, and is to be synchronized with UTC.

Note 1: UTC time synchronization of the data logger through Network Time Protocol (NTP) is to be preferred.

When input data do not have UTC timestamp, the data logger is to provide UTC timestamp.

Note 2: Other solution that provide UTC timestamp at server may be considered by the Society on a case-by-case basis.

In case of loss of UTC synchronization, an alarm is to be raised and logged.

Note 3: Refer to [10] for time management definition.

6.2 Input / output communication functions

6.2.1 Errors detections

When applicable, application protocols are to integrate means to ensure message integrity and detect transmission errors (e.g. “tokens”...).

6.2.2 Proprietary solutions

In case of proprietary solutions, general specification of protocols, data types, format, naming, error codes... are to be available.

6.2.3 Additional requirements for DATA-INFRA-STAND

For the assignment of the notation **DATA-INFRA-STAND**, standardized solutions are to support at least one of the following protocols and data exchange formats:

- ISO 19847 and ISO 19848 standards for format and transmission of shipboard machinery or equipment data
- OPC UA as relay of IEC 61162 sentences, when interfacing with Maritime navigation and radio communication equipment and systems, and ISO 19847.

Other solution may be considered by the Society on a case-by-case basis.

6.3 Data processing functions

6.3.1 Processing functions supported by the data logger are to be listed for information.

When data logger enables the deployment of expert system, such as Machine Learning algorithm this is to be clearly specified.

Note 1: Data processing may also be performed on other acquisition LAN device (edge computing) to reduce volume of data transfered across the network and increase reliability of information.

6.3.2 For the assignment of the notation **DATA-INFRA-STAND**, standardized solutions are to be able to support "calculation data" field specified in ISO 19848.

6.4 Data storage and buffering functions

6.4.1 The data logger is to be able to log the following data in the on board storage:

- device management data, such as:
  - history of access, with username and date time
  - history of changes to software (e.g. data management, software parameters change, data format, database…)
- data to be transmitted, in order to prevent loss of data during network or communication issues, such as:
  - raw data
  - processed data, as described in [6.3].

6.5 Error log management functions

6.5.1 Failure detection

Data loggers are to be self-checking and be able to detect faults, malfunctions or interruptions of its different parts. Especially, they are to be able to detect the following:

- loss of power supply, or low battery
- loss of communication or network failures
- software abnormal operation
- processor failure (e.g. overheating)
- failure of data collection interface
- failure of on board storage device (e.g. access)
- on board storage capacity nearly complete or over reading (e.g. warning at 90% full storage)
- loss of UTC synchronization.

6.5.2 Error logging

Data logger are to be able to log:

- errors listed in [6.5.1]
- transmission errors (e.g. header error, checksum error...)
- sensor faults (e.g. data out of range, data remaining constant...)

Note 1: Sensors faults (e.g. missing value, low or no batteries, calibration expired, above/below range, slope exceed, constant value, detection limit, spatial or internal inconsistencies…) are part of the data quality framework (see [10.3]).

- other element identified in the data quality framework, see [10.3].

Note 2: Depending of the architecture, data quality may be handled at different part of the data flow.

Sufficient information (e.g. datetime, system...) are to be available in the log to enable reconstruction, review and examination of the time sequence of operations.

Logs are to be recorded in a way that can be easily analyzed by standard log analysis system.

6.5.3 Log transmission and access

Data loggers are to be able to access logs for inspections or surveys, and to transmit logs to other systems.

Note 1: it is recommended that data loggers support external error logging, for example by the mean of SYSLOG protocol (refer to RFC5424).

7 Ship network configuration

7.1 General

7.1.1 Ship network is to be appropriately designed and configured to provide sufficient bandwidth to data infrastructure and data consumers.

7.1.2 Network administration and management software is to be configured with appropriate priority level for the data infrastructure and corresponding data consumers.

In no case, the presence of the data infrastructure and corresponding data consumers, is to lead to congestion, or failure of the ship network or disruption of on board services.

Note 1: Network management software should be provided with means to:

- manage data transfer priority level,
- provide information on communication system status (e.g. connectivity, estimated transfer rate...),
- identify network congestion, leak and manage traffic (e.g. delay, packet loss, timeouts...) such as bandwidth monitoring, ping analysis...
- log error and provide analysis tools.

7.2 On board data visualization

7.2.1 When a Human Machine Interface (HMI) is fitted on board to ensure the access on board to data consumers for the use of authorized person, it is to comply with applicable requirements of Pt C, Ch 3, Sec 3.

7.2.2 Time lag between data acquisition and displayed data is to be indicated on the HMI.

Note 1: for example by indicating the time of the last displayed data.

7.3 On board data server

7.3.1 When a server is installed on board, the server is to be appropriately designed to provide sufficient input/output processing performance to handle data volume based on the estimated usage of acquisition LANs.

7.3.2 When server reliability or performance relies on specific environmental conditions (e.g. room temperature), this is to be clearly specified. The server is to be installed in a place where these environmental conditions are ensured.

7.3.3 Depending of the architecture, data loggers may be integrated in the server. In that case, requirements for data logger apply (refer to [5.3] and [6]).

8 Ship-shore communication configuration

8.1 General

8.1.1 The ship-shore communication system is to be appropriately designed and configured to handle stable and reliable data transfer.

A bandwidth calculation report, demonstrating that ship-shore communication subscription is sufficient to ensure reliable transmission of data, or to support data consumers, may be requested by the Society on a case-by-case basis.

8.1.2 Communication management software is to be appropriately configured with proper priority level and traffic quota regarding data infrastructure and corresponding data consumers. Communication management software is to be able to provide information on the communication status and to log communication errors for further investigations.

In no case the presence of the data infrastructure is to lead to failure or congestion of the communication system. Especially it must not:

- lead to disruption of essential services on board
- endanger the reception and transmission of distress messages and other communications covered by the Rules and/or Statutory regulations (e.g. digital cordless telephone (DCT), public address).

9 Server

9.1 General

9.1.1 Data management function

The data server is to be provided with means to access and manage (e.g. creation, suppression...) data. Especially:

- access to collected data, to metadata are to be provided, with filtering capability
- data model (refer to [10.1]) and corresponding information model (e.g. UML diagram) are to be supported
- synchronization with UTC is to be ensured
- alias management function is to be supported.

9.1.2 Access right management and logging

Access right management is to be defined (e.g. read, write) for different roles: administrators, users, data consumers...

When coming from authorized sources, modification to the data base or data model are to be logged in the system with datetime and information on modification performed.

9.1.3 Input-Output

Server input and output functions capability are to be specified:

- request-response data transport service (e.g. REST API such as HTTP, HTTPS...)
- streaming data service (e.g. Broker and Publisher functions of MQTT Protocol)
- file transport service (e.g. FTP, SFTP...).

9.1.4 Additional requirements for DATA-INFRA-STAND

For the assignment of the notation **DATA-INFRA-STAND**, standardized solutions are to support at least one of the following protocols and data exchange formats:

- ISO 19847 and ISO 19848 standards for format and transmission of shipboard machinery or equipment data
- OPC UA as relay of IEC 61162 sentences, when interfacing with Maritime navigation and radio communication equipment and systems, and ISO 19847.

Other solution (e.g. API) may be considered by the Society on a case by case basis.

9.1.5 Backup

Database are to be regularly backup to ensure recovery in case of lost data.

Note 1: Backup frequencies and recovery time may be part of the data infrastructure SLD.

Backup files are to be stored on a storage medium separated from database storage medium.

Note 2: Implementation of RAID array (Redundant Array of Independent Disk) technology may be considered to improve the reliability of manage storage area.

10 Data management

10.1 Data model

10.1.1 A data model is to be defined to ensure interoperability between connected systems, with definition of an ontology (data property, object property) and metadata. The model is to be implemented at different levels of data infrastructure (e.g. data source, data logger, server...) and documented.

Note 1: Data model may rely on existing data standards (e.g. ISO 16848, RFC 8428 (SenML)...) for improved interoperability.

Ontology is to be specified, with definition of data properties and object properties (e.g. Unified Modeling Language diagram).

10.1.2 A data catalog with specification of data naming rules is to be provided.

Note 1: For standardized solutions, a data catalog is to be specified to support ISO 19848 Data Channel definition.

10.1.3 For the assignment of the notation **DATA-INFRA-STAND**, standardized solutions are to support ISO 19847, ISO 19848 or IEC 61162 as applicable.

10.2 Data format

10.2.1 Data exchange format used in data infrastructure are to be specified (e.g. XML, CBOR...). Those formats are to support the data model specified in [10.1].

10.2.2 For the assignment of the notation **DATA-INFRA-STAND**, standardized solutions are to comply with requirements of ISO 19847 or ISO 19848. Especially, they are to be able to export data under XML format with standard character encoding (e.g. UTF-8, ASCII...).

Note 1: it is recommended to support also JSON or CSV formats.

10.3 Data quality framework

10.3.1 A data quality framework is to be implemented to ensure the reliability of data. A general description of the data quality framework is to be provided.

Note 1: This description, may include, but is not limited to:

- general data quality strategy (e.g. scope, objectives...), where data quality target or maturity assessment may be specified
- definition of business rules and corresponding data quality rules
- description of data quality monitoring and assessment framework, with
  - data quality dimensions (e.g. completeness, timeliness...) monitored with corresponding metric and acceptability thresholds
  - tools or processes, for data quality inspection and monitoring (e.g. on line KPI, manual inspection...)
  - tools or processes, for reporting data quality performances and data quality incidents
  - tool or processes for the investigation of data that does not comply with quality criteria (e.g. root cause analysis)
  - integration policies for data that does not comply with quality criteria (e.g error correction, error flagging, cleansing...)
- sustainment process or change management
- data standards that may be existing international or company standards. Naming rules should be specified
- when applicable, Service Level Agreement (SLA) for data integrated from an external data supplier.

10.3.2 Time management

Definition of the timestamp accuracy is to be provided (e.g. latency). Indeed, the definition of what is considered as the 'current' (or 'now') value in the database is to be specified with regard to the context and capabilities of the data infrastructure.

Note 1: For example, a system 1 composed by a sensor which send messages over RS485 to a data logger with NTP synchronization, and timestamp the data at the reception of the message on the data logger will have an average uncertainty around 1ms. On the other end, a system 2 which relies on satellite communication and timestamp the data directly in the cloud server, will have an average uncertainty that may be around 15min.

Note 2: Definition of the average time (or relative error) between the data producer and the time stamp may be part of the DQ SLD.

10.4 Monitoring

10.4.1 Performance monitoring

The data infrastructure (e.g. server, database...) is to be able to monitor performance. Especially, the indicators specified in the data infrastructure SLD (refer to [4.1.2]) are to be monitored.

10.4.2 Data quality monitoring

The indicators specified in the DQ SLD (refer to [4.1.3]) are to be monitored.

10.4.3 SLD report

The data infrastructure is to be able to generate a report, which provides an overview data infrastructure SLD and DQ SLD indicators on a given period, with indication of the monitored values and their corresponding targets. The summary should display the worst indicator condition recorded on an aggregated period of time (e.g. worst indicator recorded for each quarter). When a threshold has been exceeded it is to be specified in the report.

Note 1: When exceeding thresholds, it is recommended to indicate actions taken in response.

11 Installation and testing

11.1 Data logger type approval

11.1.1 Data loggers are subject to acceptance testing. Acceptance tests are generally to be carried out at the manufacturer's facilities before the shipment of the equipment, when requested.

Testing protocols are to be agreed with the Society prior to testing, and are to include, but are not limited to:

- testing as described in Pt C, Ch 3, Sec 6, [3]
- test of data logger functions described in [6].

11.2 On board testing

11.2.1 Ship-shore communication subscription is to be checked, and is to be in accordance with documentation.

11.2.2 The documentation listed in Tab 1, items 9 and 10 is to be available on board.

11.2.3 Testing protocols are to be such that, tests are to be performed in the expected conditions of operations of the ship:

- All data producers are to be connected.
- The network bandwidth is to be restraint to simulate the other ship system usage. The priority level are to be correctly defined.
- Ship-shore communication is to be restraint to simulate the other ship system usage. The priority level are to be correctly defined.

11.2.4 A complete test program is to be submitted, and testing protocols are to be agreed with the Society prior to testing.

The testing protocols are to include, but are not limited to:

- General testing to be carried out to check that data producers can be accessed. Check of main hardware and software functionalities with all systems integrated are to be performed.
- The system is able to monitor data infrastructure SLD and Data Quality SLD, and to produce the SLD report.
- Black out is to be simulated to demonstrate capability of data infrastructure to restart automatically.
- Data flow is implemented from data source to final data base server. Synchronization between systems repositories is to be checked.
- Acquisition LAN testing:
  - data acquisition and wireless communications are to be tested according to Pt C, Ch 3, Sec 6, [4]
  - for analog sensors, signal calibration, tip set point adjustment are to be performed
  - sensors and equipment calibration are to be checked

    Record of calibration and maintenance are to be checked, by the mean of data infrastructure or integrated.
  - UTC synchronization of data logger is ensured.

- Human Machine Interface (on board) testing:
  - HMI is able to display on board data
  - HMI is able to provide information on time lag (e.g. acquisition time of the last displayed data).
- On board data storage and backup testing:
  - data listed in [6.4] are available on board
  - system is able to recover from backup.
- Errors simulation (refer to [6.5.1]):
  - corresponding alarm is raised and displayed on board
  - data listed in [6.5] are logged in the system
  - error log can be inspected on board.
- Data server:
  - collected data are available with correct timestamp
  - data stored in the server are same as data recorded on board
  - information model and metadata are accessible
  - server is able to answer to data request, with filtering, aggregation capability.

CHAPTER 5

Replace the Title of Chapter 5 by:

CHAPTER 5 MONITORING EQUIPMENT

Chapter 5

Add the following new Section 3 “Real-Time Carbon Intensity Indicator (CII-REALTIME)”:

Section 3 Real-Time Carbon Intensity Indicator (CII-REALTIME)

1 General

1.1 Application

1.1.1 The additional class notation **CII-REALTIME** addresses the digital solutions which collect the data for the IMO Data Collection System (DCS) and calculate the continuous Carbon Intensity Indicator (CII) defined in [1.2.1]. Data collection from the ship and the access to the data by the users on board and on shore through the dedicated digital interfaces are covered.

1.1.2 The additional class notation **CII-REALTIME** may be assigned to a ship, in accordance with Pt A, Ch 1, Sec 2, [6.6], when two digital solutions are implemented for the ship as follows:

a) an onboard computer based system, further referred to as CII Onboard Digital Solution (CII ODS), performing onboard the collection of data necessary for the calculation of the Continuous CII, defined in [1.2.1], based on manual inputs. CII ODS is to be available for the onboard users to monitor regularly the Continuous CII and to obtain a relevant decision-support;

b) a shore digital solution, further referred to as CII Shore Digital Solution (CII SDS), is available for the shore users to monitor regularly the Continuous CII and to obtain a relevant decision-support based on the data acquired from the CII ODS.

Calculations of the Continuous CII, defined in [1.2.1], are to be performed in at least one of the two digital solutions, CII ODS or CII SDS.

The corresponding computer based system and the shore digital solution are to comply with the requirements of this Section.

1.1.3 The CII Onboard Digital Solution (CII ODS) is to be of a type approved by the Society as per [1.3] and is to comply with the requirements of [2], [4], [5].

The CII Shore Digital Solution (CII SDS) is to be of a type approved by the Society as per [1.3] and is to comply with the requirements of [3], [4], [5].

1.1.4 The assignment of the additional class notation excludes any verification of the IMO Data Collection System (DCS) and Carbon Intensity Indicator (CII) under the scope of MARPOL Annex VI Regulations and is not to be construed as a statutory certification.

1.1.5 The additional class notation is assigned independently from the IMO DCS verification activities.

1.2 Definitions

1.2.1 The following definitions are used in the present Section:

- Carbon Intensity Indicator (CII): a ship's performance indicator by which it is possible to measure the carbon intensity of the ship for a calendar year, as defined in the IMO Guidelines listed in [2.2.5].
- Continuous CII: a ship's carbon intensity indicator which is calculated for a period of time between the commencement of a calendar year and the exact time defined by the system or the operator. Continuous CII is based on available IMO DCS data without extrapolation.
- Bunker Delivery Note (BDN): a document issued by a party supplying bunkers to a receiving ship. The BDN is to comply with MARPOL Annex VI.
- Digital solution: a computer based system that incorporates functions for collection, transmission, analysis and visualisation of data, as well as the relevant calculations.
- Reporting period: a calendar year from 1 January to 31 December inclusive.

1.3 Type approval of CII ODS and CII SDS

1.3.1 The CII ODS and the CII SDS are to be type approved in accordance with the Society's type approval scheme described in Rule Note NR320, which consists of the following steps:

- documentation review
- type test of software functionalities for deployment on board and on shore, if applicable;
- issuance of Type Approval Certificate.

1.3.2 When the CII ODS and the CII SDS require a specific software configuration or the definition of installation parameters, they are to be identified and listed with indication of their values or settings in the documentation submitted to the Society.

1.3.3 The Type Approval of the CII ODS and the CII SDS is to reference the requirements (e.g. IMO MEPC Circulars) used for the evaluation.

1.3.4 The type tests and relevant datasets are to be prepared by the Applicant. The Boundary dataset as per [1.3.5] and Scenario datasets as in [1.3.6] to [1.3.8] are to be provided.

1.3.5 The Boundary dataset is to include the required CII and the CII Rating boundaries calculated for each category of ships listed below as per the Tab 1 based on the applicable regulations as listed in [2.2.5].:

a) Bulk carrier

b) Gas carrier 65,000 DWT and above

c) Gas carrier less than 65,000 DWT

d) Tanker

e) Container ship

f) General cargo ship

g) Refrigerated cargo carrier

h) Combination carrier

i) LNG carrier 100,000 DWT and above

j) LNG carrier less than 100,000 DWT

k) Ro-ro cargo ship (vehicle carrier)

l) Ro-ro cargo ship

m) Ro-ro passenger ship

n) Cruise passenger ship.

Table 1 : Boundary test dataset

2019 Reference CII:	
Vessel type:	

CII values	2024	2025	2026
Inferior CII Rating boundary			
Upper CII Rating boundary			
Required CII			
Lower CII Rating boundary			
Superior CII Rating boundary			

1.3.6 Scenario datasets are to be developed , as per Tab 2, for the three types of vessels subject to correction factors as defined in IMO Guidelines listed in [2.2.5]. A Scenario dataset is to include a simulated record of activities and consumption for a duration of 1 calendar year with a resolution of not less than 1 day and is to include:

a) consumption of more than one fuel type;

b) activities subject to voyage exemptions and with correction factors, e.g. ship-to-ship transfers of fuel;

c) electrical power consumption subject to correction factors, e.g. power supply for refrigerated containers.

1.3.7 A collection of Scenario datasets is to cover:

a) all types of fuels covered by the applicable regulations, including:
- diesel or gas oil
- light fuel oil (LFO)
- heavy fuel oil (HFO)
- propane and butane liquefied petroleum gas (LPG)
- liquefied natural gas (LNG)
- methanol
- ethanol.

b) all types of exemptions and activities eligible for correction factors.

1.3.8 A collection of Scenario datasets is to be submitted, as per Tab 2, with a calculation of:

a) CII and the corresponding Rating

b) Continuous CII and the corresponding Rating.

Table 2 : Scenario test dataset

	Attained Indicator / Rating					
	Continuous CII with correction factors		CII			
			with correction factors	without correction factors		
Vessel type	until 1 July 2024	until 1 October 2024	2024	2024	2025	2026
Tanker						
Gas carrier or LNG carrier						
Ship carrying refrigerated containers						

1.3.9 The Society is to verify the test datasets used by the calculation. When the test datasets including the simulated entries and the corresponding calculation results are considered satisfactory, the Society endorses the test datasets.

1.3.10 When the calculation can be performed by the CII ODS and by the CII SDS, the Society is to perform the verification of the calculation results described for the CII ODS and for the CII SDS.

1.4 Documentation to be submitted

1.4.1 The documentation to be submitted for granting the notation **CII-REALTIME** is listed in Tab 3.

Table 3 : Documents to be submitted

No.	A/I **(1)**	Description
1	I	Type Approval Certificate of the CII ODS and the CII SDS
2	I	List of the reporting regulations (e.g. IMO MEPC Circulars) to be complied with by the CII ODS and the CII SDS
3	I	Ship Energy Efficiency Management Plan (SEEMP) Part II and Part III specifying the data collection and reporting for CII
4	A/I	Documentation as required in Pt C, Ch 3, Sec 3 for the computer based systems forming the CII ODS
5	I	List of computer based systems involved in onboard functions to calculate Continuous CII. For each system, the list is to include: a) functional designation b) manufacturer
6	I	Description of the CII SDS architecture with functional diagrams, data flow, process description, location of the hosting servers
7	I	Description of the communication method between the CII ODS and the CII SDS including the data transfer procedures
8	I	Manual describing the coordinated use of the CII ODS and the CII SDS in the framework of the IMO DCS reporting by each type of user and describing the overall digital reporting process where the perimeter for the application is defined
9	A	Description of the methods used for calculating the Continuous CII and models used to estimate the fuel consumption
10	I	Description of the data transfer procedures to send the CII data ashore for reporting and database sharing purpose
11	I	Table listing the types of user accounts with corresponding access rights
12	I	List of manual data entries in the digital interface of the CII ODS described in [2.1]
13	A	Templates of reports generated as described in [2.2.1]
14	I	List of alerts and notifications generated for onboard and shore users
15	I	Test datasets as described in [4.1]
16	I	Test program for onboard tests (including wireless network testing) in the scope of [5]
(1) A = to be submitted for approval ; I = to be submitted for information **Note 1:** Further documentation may be requested for approval or for information by the Society on a case by case basis		

2 CII Onboard Digital Solution (CII ODS)

2.1 Requirements to inputs

2.1.1 Means of a manual entry for the following fuel consumption and fuel storage data are to be provided:

a) Tank soundings or fuel flow meter measurements

b) Custody Transfer Measurement System (CTMS) readings for the quantity of the liquefied gas in storage, if applicable

c) BDN information

d) Type and characteristics of the fuel consumed

e) Status of measuring equipment, e.g. operational, out of order, out of calibration validity period

f) Selected technique for soundings, e.g. manual dip tape, tank radar, gauging sensor

g) Comments from the users.

2.1.2 Means of a manual entry for the following voyage related data are to be provided:

a) Departure and arrival: time and the location as a port name or geographic coordinates

b) Mass of the transported cargo

c) Distance travelled

d) Activity status information such as ballast voyage, laden voyage, etc.

2.1.3 Means of a manual entry for the direct CO_2 emission measurements, if a direct CO_2 measurement system is available on board. The direct CO_2 emission measurements are to be used as one of the independent models for estimating the fuel consumption, if the measurement system is available.

2.2 Requirements to functions

2.2.1 The CII ODS is to provide the following dashboards and reports:

a) a dashboard with Continuous CII estimate and applicable energy efficiency statistics based on available data presented as a daily trend of Continuous CII over a period specified by the user

b) a report generation for Continuous CII with summaries of bunker transfers and voyages

c) a dashboard for data discrepancy alerts for the inconsistencies detected

d) a CII report for a past closed reporting period, if data is available.

2.2.2 The CII ODS is to provide the following functions:

a) indicate the last date and UTC time of synchronisation with the database of the CII SDS and maintain a log of such synchronisations

b) export data to non-encrypted delimited text file easily readable on a PC

c) store a minimum of 5 years of the CII related manual entries and the calculation results

d) generate notifications for crossing the boundaries and the margins of the boundaries of the CII Ratings. Boundary margins are typically to be set at ≥ 5%.

2.2.3 The CII ODS is to be configured to the ship specific parameters, which are to be accessible in a single aggregated presentation in the digital user interface.

2.2.4 When the calculation is performed by the CII ODS, the CII ODS is to provide the following functions:

a) provide comparison of the present fuel consumption to the historical data

b) calculate the fuel consumption based on independent models and provide an automatic comparison between the estimates produced by these models.

2.2.5 The CII ODS is to be configured to produce reports according to the reporting requirements (e.g. IMO MEPC Circulars) indicated in the Type Approval Certificate. The corresponding regulation and the version of the CII ODS software are to be displayed to users. The CII ODS is to comply with the applicable IMO Guidelines such as:

- Guidelines on operational carbon intensity indicators and the calculation methods (CII Guidelines, G1)
- Guidelines on the reference lines for use with operational carbon intensity indicators (CII reference line guidelines, G2)
- Guidelines on the operational carbon intensity reduction factors relative to reference line (CII reduction factor guidelines, G3)
- Guidelines on the operational carbon intensity rating of ships (CII rating guidelines, G4)
- Interim Guidelines on correction factors and voyage adjustments for CII Calculations (CII Guidelines, G5)
- Guidelines for administration verification of ship fuel oil Consumption data and operational carbon intensity (IMO Resolution MEPC.348(78)).

2.2.6 Access to the CII ODS is to be password protected and all users are to be identified, as a minimum with their names and their roles, when logged in. Each write action for the comments for the onboard records is to be digitally signed when completed by an authorized signature.

2.2.7 Means of encrypted data exchange with the CII SDS are to be provided. The exchanges are to be daily and done automatically.

2.2.8 The CII ODS is to have a test mode which:

- allows filling records for a reporting period with a simulated test dataset from a database file
- is clearly indicated in the user interface when active
- does not compromise the normal operational entries
- generates the same type of outputs as the normal operational mode
- exports to an external portable storage device the test outputs resultant from processing the test dataset.

3 CII Shore Digital Solution (CII SDS)

3.1 Requirements to functions

3.1.1 Means of automatic encrypted data exchange with the CII ODS are to be provided.

3.1.2 Means of access to the tabulated summaries and trends are to be provided for the users, which are to include the representatives of the Shipowner, Independent Verifier and Charterer as a minimum.

3.1.3 For the minimum user groups described in [3.1.2], the access hierarchy is to be provided in the following order:

a) Shipowner as a top user

b) Independent Verifier

c) Charterer.

3.1.4 The CII SDS functions are to include:

- items available for the CII ODS as described in [2.2.1], [2.2.2] and [2.2.3]
- granting a full or a partial access to the data as per the access hierarchy
- submitting the reported data for approval between the users as per the access hierarchy
- approval or rejection of the reported data between the users as per the access hierarchy.

3.1.5 When the calculation is performed by the CII SDS, the CII SDS is to provide the following functions:

a) provide comparison of the present fuel consumption to the historical data

b) calculate the fuel consumption based on independent models and provide an automatic comparison between the estimates produced by these models.

3.1.6 When the calculation is performed by the CII ODS and by the CII SDS, the CII SDS is to provide the following functions in addition to [3.1.5]:

a) the results of the calculations presented by the CII SDS are to indicate whether each calculation was done by the CII ODS or by the CII SDS

b) provide alerts to the top user in the access hierarchy, in case any discrepancy is detected between the values of Continuous CII calculated by the CII ODS and by the CII SDS.

3.1.7 Access to the CII SDS is to be password protected and all users are to be identified with a name, a position and an organisation, when logged in. Each write action for the comments for the onboard records, approval, granting of a full or a partial data access and submission to another user is to be digitally signed when completed by an authorized signature.

3.1.8 The reports generated by the CII SDS are to comply with the applicable regulations listed in [2.2.5].

3.1.9 The reports generated by the CII SDS are to indicate the digital signature and comments from the last approver.

3.1.10 The CII SDS is to have a test mode which:

- handles the test outputs from the CII ODS
- is clearly indicated in the user interface when active
- does not compromise the normal operational entries
- generates the same type of outputs as in the normal operational mode.

4 Test datasets

4.1 Information to be submitted

4.1.1 Test datasets are to be provided by the Applicant in a format readable by the CII ODS in test mode. Each test dataset is to cover a time span of 1 calendar year. Each test dataset is to include:

a) ship's specific configuration for measurements of fuel quantity stored and transferred

b) type of ship and particular parameters as required to perform the CII calculation

c) voyages information, including speeds, distances and passage times

d) at least one bunker transfers for 90% of the fuel capacity each

e) CII calculation results attained and the corresponding nearest CII Rating boundaries

f) Continuous CII calculation results for each day of the time span in the test dataset

g) if the vessel is eligible for type specific exemptions or reduced coefficients for certain activities (e.g. shuttle tanker performing a ship-to-ship transfer), at least one operation of such kind

h) identification of the specific CII-related IMO regulations with which the dataset is designed to comply.

4.1.2 Other test datasets can be added in the Data Verification on request of the Applicant.

4.2 Verification

4.2.1 The Society is to verify the test datasets used by the calculation for the particular ship on which the CII ODS is planned for installation. When the test datasets including the simulated entries and the corresponding calculation results are considered satisfactory, the Society endorses the test datasets, a copy of which is to be available on board in a tabulated paper or digital format.

4.2.2 When the calculation can be performed by the CII ODS and by the CII SDS, the Society is to perform the verification of the calculation results described in [4.2.1] for the CII ODS and for the CII SDS.

5 Initial Survey

5.1 CII Onboard Digital Solution (ODS)

5.1.1 Onboard function tests are to be witnessed by a Surveyor of the Society, including wireless network testing, if applicable.

5.1.2 During the onboard test witnessed by a Surveyor of the Society, the system is to be operated to:

a) create manual entries as described in [2.1.1], [2.1.2] and [2.1.3]

b) generate reports and access dashboards as described in [2.2.1]

c) demonstrate integration into the ship's communication network, including wireless network testing where applicable

d) when calculations can be done by the CII ODS, load the endorsed test datasets described in [4] into the CII ODS in a test mode, confirm that the results obtained from the CII ODS are identical to those stated in the endorsed test dataset calculation outputs

e) check the Type Approval Certificate with regards to the applicable CII-related IMO Guidelines and confirm the software version.

5.2 CII Shore Digital Solution (SDS)

5.2.1 During the remote test witnessed by a Surveyor of the Society, the CII SDS is to be accessed by means of an external Internet connection to:

a) obtain access for each type of the user categories described in [3.1.3]

b) confirm availability of the items described in [3.1.4]

c) when calculations can be done by the CII SDS, load the endorsed test datasets sent from the CII ODS in a test mode; confirm if the results obtained from the CII SDS are identical to those stated in the endorsed test dataset calculation outputs as described in [4]

d) check the Type Approval Certificate with regards to the applicable CII-related IMO Guidelines and confirm the software version.

CHAPTER 6

Ch 6, Sec 1, [1.4.1]

Add the following item at the end of the bulleted list:

- Workshops other than those forming part of machinery spaces
  - Workshops other than those forming part of machinery spaces are enclosed workshops that are separated from the engine room with bulkheads, which may include access doors of the equivalent acoustic insulating properties as the bulkhead. Workbenches and workstations located inside the machinery space are not to be considered as "workshops other than those forming part of machinery spaces".

Ch 6, Sec 2, Table 1

Replace table footnotes (1), (3) and (4) as follows:

Table 1 : Noise level requirements

Locations	LAeq,T in dB(A)		
	grade = 1	grade = 2	grade = 3
(1) Equipment switched on but not in use. **(3)** Measurement carried out with a microphone windscreen. **(4)** A tolerance of 5 dB(A) may be accepted for measurements at less than 3 m from a ventilation inlet/outlet.			

Ch 6, Sec 3, Table 1

Replace table footnotes (2), (3) and (4) as follows:

Table 1 : Noise level requirements for ships from 1600 GT to 10000 GT

Locations	LAeq,T in dB(A)		
	grade = 1	grade = 2	grade = 3
(2) Equipment switched on but not in use. **(3)** Measurement carried out with a microphone windscreen. **(4)** A tolerance of 5 dB(A) may be accepted for measurements at less than 3 m from a ventilation inlet/outlet.			

Ch 6, Sec 3, Table 2

Replace table footnotes (2), (3) and (4) as follows:

Table 2 : Noise level requirements for ships greater than 10000 GT

Locations	LAeq,T in dB(A)		
	grade = 1	grade = 2	grade = 3
(2) Equipment switched on but not in use. **(3)** Measurement carried out with a microphone windscreen. **(4)** A tolerance of 5 dB(A) may be accepted for measurements at less than 3 m from a ventilation inlet/outlet.			

CHAPTER 7

Ch 7, Sec 1, [1.1.3]

Replace the first paragraph by:

The additional class notations **REF-CARGO** and **REF-STORE** may be completed by the following:

CHAPTER 8

Ch 8, Sec 3, Symbols

Replace the definition of "Q_{peak}" and "Q_r" by:

Q_{peak} : Maximum of the response torque Q_r , in kN·m, see Tab 3

Q_r : Response torque along the propeller shaft line, in kN.m

Replace the definition of "σ_{ref}" by the following definition of "σ_{ref1}":

σ_{ref1} : Reference stress, in MPa:

$$\sigma_{ref1} = 0,6\ \sigma_{0,2} + 0,4\ \sigma_u$$

Ch 8, Sec 3, Table 3

Replace "Q_r" by "Q_{peak}" in the first column.

Ch 8, Sec 3, [1.4.5]

Replace item b) of the alphanumeric list by:

b) Spindle torque, Q_{sex}

The maximum spindle torque due to a blade failure load acting at 0,8R is to be determined. The force that causes blade failure typically reduces when moving from the propeller centre towards the leading and trailing edges. At a certain distance from the blade centre of rotation, the maximum spindle torque will occur (Fig 6 illustrates the spindle torque values due to blade failure loads across the entire chord length). This maximum spindle torque is to be defined by an appropriate stress analysis or using the equation given below:

$$Q_{sex} = \max(C_{LE0.8}; 0,8C_{TE0.8})C_{spex}F_{ex}$$

where:

C_{spex} : Coefficient to be taken equal to:

$$C_{spex} = C_{sp}C_{fex} = 0,7\left(1 - \left(\frac{4EAR}{Z}\right)^3\right)$$

without being taken less than 0,3

C_{sp} : non-dimensional parameter taking account of the spindle arm

C_{fex} : non-dimensional parameter taking account of the reduction of the blade failure force at the location of the maximum spindle torque

Ch 8, Sec 3, [1.6]

Replace the sub-article title by:

1.6 Controllable pitch propeller and built-up propeller

Delete requirement [1.6.1].

Replace existing requirements [1.6.3], [1.6.4] and [1.6.5] by:

1.6.3 Blade bolts and flanges

Blade bolts and flanges are to withstand the bending moment M_{bolt}, in kN·m, considered about the bolt pitch circle axis, or another relevant axis for not circular flanges, parallel to the considered root section:

$$M_{bolt} = F_{ex}\left(0,8\frac{D}{2} - r_{bolt}\right)$$

where:

r_{bolt} : Radius from the shaft centreline to the blade bolt plan, in m.

Blade bolt pre-tension is to be sufficient to avoid separation between the mating surfaces, applying the maximum forward and backward ice loads defined in [1.4.2].

The maximum stresses of blade flange, crank carrier and hub due to the load induced by M_{bolt} are to remain below the corresponding yield strengths.

Separate means, e.g. dowel pins, are to be provided between the blade and blade carrier in order to withstand the spindle torque resulting from blade failure (Q_{sex}) or ice interaction (Q_{smax}), whichever is greater.

The rule diameter d_{dp} of the dowel pins, in m, is given by the following formula:

$$d_{dp} = 66\sqrt{\frac{Q_s - Q_{fr}}{PCD \cdot i \cdot \sigma_{0,2}}}$$

where:

PCD : Pitch circle diameter of the dowel pins, in mm

i : Number of pins

Q_s : Spindle torque, in kN·m, equal to:

Q_s = max (1,3 Q_{smax} ; Q_{sex})

Q_{fr} : Friction between connected surfaces:

Q_{fr} = 0,33 Q_s

Alternative values of Q_{fr}, according to reaction forces due to F_{ex} or F_f or F_b whichever is relevant, utilising a friction coefficient equal to 0,15 may be used, provided they are approved by the Society.

1.6.4 Components of the pitch control system

Components of controllable pitch mechanisms are to be designed to withstand the blade failure spindle torque Q_{sex} and the maximum blade spindle torque Q_{smax}.

The blade failure spindle torque Q_{sex} is not to lead to any consequential damages.

Fatigue strength is to be considered for the parts transmitting the spindle torque Q_s from the blades to a servo system, considering Q_s acting on one blade.

The maximum spindle torque amplitude Q_{samax} is defined by:

$$Q_{samax} = \frac{Q_{sb} + Q_{sf}}{2}$$

where:

Q_{sb}, Q_{sf} : Spindle torques due, respectively, to ice backward and forward forces.

The formula given in [1.4.2] item g) may be used to determine Q_{sb} and Q_{sf}.

1.6.5 Servo oil pressure

Design pressure for servo oil system is to be taken as the maximum working pressure, taking into account the load caused by Q_{smax} or Q_{sex} when not protected by relief valves, reduced by relevant friction losses in bearings caused by the respective ice loads. Design pressure is, in any case, not to be less than the relief valve set pressure.

Ch 8, Sec 3

Replace Table 12 by:

Table 12 : Values for the G parameter for different m/k ratios

m/k	G	m/k	G	m/k	G	m/k	G
3,0	6,0	5,5	287,9	8,0	40320	10,5	$11,899 \cdot 10^6$
3,5	11,6	6,0	720,0	8,5	119292	11	$39,917 \cdot 10^6$
4,0	24,0	6,5	1871	9,0	362880	11,5	$136,843 \cdot 10^6$
4,5	52,3	7,0	5040	9,5	$1,133 \cdot 10^6$	12	$479,002 \cdot 10^6$
5,0	120	7,5	14034	10	$3,629 \cdot 10^6$		

Ch 8, Sec 3, [1.7.1]

Replace "stem" by "stern" in the second paragraph.

Ch 8, Sec 3, [1.7.3] and [1.7.4]

Replace the formula of "K_{ice-s}" by:

$K_{ice-s} = Q_{peak} / Q_n \geq 1$

Ch 8, Sec 3, [2.2]

Delete requirement [2.2.7].

Ch 8, Sec 3, [2.3.1]

Replace item b) in the alphanumeric list by:

b) Where the diameter of the propeller shaft, as calculated by the formula given in Pt C, Ch 1, Sec 7, [2.2.3], is greater than that calculated according to the formula given in a) above, the former value is to be adopted.

CHAPTER 9

Ch 9, Sec 1, [1.1]

Add the following requirement [1.1.3]:

1.1.3 For ships having a measurement, monitoring, recording and transmission equipment for ships emissions and effluents as per the requirements of Ch 9, Sec 2, [2.1.2], the additional class notations CLEANSHIP and CLEANSHIP SUPER may be completed by CEMS.

Ch 9, Sec 1, [2.1.1]

Replace Note 1 by:

Note 1: Empty packagings previously used for the carriage of hazardous substances are considered as hazardous substances.

Ch 9, Sec 1, [2.1]

Replace requirement [2.1.2] by:

2.1.2 Wastewater

Wastewater includes both sewage and grey water as defined in [2.1.3] and [2.1.5].

Replace requirement [2.1.8] by:

2.1.8 Oil residue (sludge) tank

Oil residue (sludge) tank means a tank which holds oil residue (sludge), and from which sludge may be disposed directly through the standard discharge connection or any other approved means of disposal.

Replace requirements [2.1.12], [2.1.13] and [2.1.14] by:

2.1.12 Advanced wastewater treatment (AWT)

AWT means any treatment of wastewater that goes beyond the secondary or biological water treatment stage and may include the removal of nutrients such as phosphorus and nitrogen and a high percentage of suspended solids.

AWT plants are to be of a type approved in accordance with IMO resolution MEPC(227)64 as amended by MEPC.284(70).

2.1.13 Accidental discharge

Accidental discharge means any discharge to sea caused by unforeseen or accidental events, such as damage to the ship or its equipment, and including discharge necessary for the purpose of protection of the ship or saving life at sea.

2.1.14 No discharge condition

No discharge condition means a condition without discharge of hazardous wastes, treated and untreated wastewater, oily wastes or garbage into the sea.

Note 1: Where the **AWT-A/B** notation is assigned to the ship, the discharge of treated sewage and treated grey water is allowed under the no discharge condition.

Note 2: In the "No discharge condition", no effluents from exhaust gas cleaning systems may be discharged into the sea

Ch 9, Sec 1, [2.2]

Replace requirements [2.2.2] and [2.2.3] by the following requirements [2.2.2], [2.2.3], [2.2.4] and [2.2.5]:

2.2.2 Global warming potential (GWP)

GWP means the climatic warming potential of a greenhouse gas relative to that of carbon dioxide (CO_2), calculated in terms of the 100-year warming potential of one kilogram of a greenhouse gas relative to one kilogram of CO_2.

2.2.3 Ozone depleting substances

Ozone-depleting substances means controlled substances defined in paragraph (4) of article 1 of the Montreal Protocol on Substances that Deplete the Ozone Layer, 1987, listed in Annexes A, B, C or E to the said protocol in force at the time of application of Annex VI of MARPOL 73/78.

Ozone-depleting substances that may be found on board the ship include, but are not limited to:

- Halon 1211Bromochlorodifluoromethane
- Halon 1301Bromotrifluoromethane
- Halon 2402 1,2-Dibromo-1,1,2,2-tetrafluoroethane (also known as Halon 114B2)
- CFC-11 Trichlorofluoromethane
- CFC-12 Dichlorodifluoromethane
- CFC-113 Trichloro-1,2,2-trifluoroethane
- CFC-114 1,2-Dichloro-1,1,2,2-tetrafluoroethane
- CFC-115 Chloropentafluoroethane.

2.2.4 NOx technical code

NOx Technical Code means the Revised Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines adopted at MEPC 58 on 10 October 2008 with Resolution MEPC.177(58), as amended by Resolution MEPC.317(74).

2.2.5 Permanently sealed equipment

Permanently sealed equipment are equipment where there is no refrigerant charging connections or potentially removable components containing ozone-depleting substances.

Ch 9, Sec 1, [2.3]

Delete requirement [2.3.1].

Ch 9, Sec 1, Table 1

Delete the row "CEMS"

Replace the Table Head and rows "CLEANSHIP", "CLEANSHIP SUPER", "BWT", "GREEN PASSPORT", "GWT", "HVSC" and "MEM" by:

Table 1 : Additional class notations for environmental protection

Additional class notations	Scope	Reference to the Rules	Eligible for the assignment of **CLEANSHIP SUPER** notation	Assignment conditions
CLEANSHIP	Prevention of sea and air pollution	Ch 9, Sec 2, [2]	N/A	**CLEANSHIP** may be completed by the notation **CEMS**
CLEANSHIP SUPER	Prevention of sea and air pollution	Ch 9, Sec 2, [2] Ch 9, Sec 2, [3]	N/A	At least 3 eligible notations are to be assigned **CLEANSHIP SUPER** may be completed by the notation **CEMS**
BWT	Fitting of a ballast water treatment plant	Ch 9, Sec 4, [3]	Yes	
GREEN PASSPORT or **GREEN PASSPORT EU**	Hazardous material inventory	NR528	No	
GWT or **GWT-B**	Fitting of a treatment installation for grey waters	Ch 9, Sec 5, [2]	Yes	
HVSC	Fitting of a high voltage shore connection	NR557	Yes	
MEM	The level of methane emissions of the gas-fuelled or dualfuel engines in gas operating mode has been measured	Ch 9, Sec 9	No	
Note 1: N/A = not applicable.				

Ch 9, Sec 2

Delete Table 12.

Replace Table 1 and Table 2 as follows:

Table 1 : Required certificates

Certificate	Applicable Rules and Regulations
IOPP certificate **(1)**	Annex I of MARPOL 73/78, Appendix II
Type approval certificate of: • 15 ppm bilge separator • 15 ppm bilge alarm	IMO Resolution MEPC.107(49) as amended by MEPC.285(70): • Part 1 of the Annex • Part 2 of the Annex
ISPP certificate **(1)**	Annex IV of MARPOL 73/78, Appendix
Type approval certificate of the sewage system	IMO Resolution MEPC.227(64) as amended by IMO Resolution MEPC.284(70)
Type approval certificate of the incinerator **(2)**	• IMO Resolution MEPC.244(66) • Annex VI of MARPOL 73/78, Appendix IV
(1) Only where required by MARPOL 73/78 Convention, according to the ship's gross tonnage. **(2)** Shipboard incinerator is not required. However, when fitted on board, it is to be type-approved. **(3)** Only where required by Annex VI of MARPOL 73/78 Convention, according to the engine power and intended use. **(4)** The EIAPP certificate may include a NOx-reducing device as a component of the engine. See NOx Technical Code 2008, regulation 2.2.5. **(5)** Where such an equivalent arrangement is provided in pursuance of Annex VI of MARPOL 73/78 Convention, regulation 4. **(6)** For ships assigned the notations **CLEANSHIP-CEMS** or **CLEANSHIP SUPER( )-CEMS** (see [2.1.2]).	

Certificate	Applicable Rules and Regulations
IAPP certificate **(1)**	• Annex VI of MARPOL 73/78, Appendix I • IMO Resolution MEPC.194(61)
EIAPP certificates of diesel engines **(3)(4)**	NOx Technical Code 2008, Appendix I
SOx emission compliance certificate Certificate of unit approval for exhaust gas cleaning system **(5)**	IMO Resolution MEPC.340(77)
IAFS certificate or Declaration on Anti-fouling system	International Convention on the control of Harmful and Anti-fouling systems, 2001, Annex 4, Appendices 1 and 2
Type approval certificate of the measurement, monitoring and recording equipment **(6)**	IMO Resolution MEPC.103(49) for NOx emissions IMO Resolution MEPC.340(77) for SO_2 and CO_2 emissions
(1) Only where required by MARPOL 73/78 Convention, according to the ship's gross tonnage. **(2)** Shipboard incinerator is not required. However, when fitted on board, it is to be type-approved. **(3)** Only where required by Annex VI of MARPOL 73/78 Convention, according to the engine power and intended use. **(4)** The EIAPP certificate may include a NOx-reducing device as a component of the engine. See NOx Technical Code 2008, regulation 2.2.5. **(5)** Where such an equivalent arrangement is provided in pursuance of Annex VI of MARPOL 73/78 Convention, regulation 4. **(6)** For ships assigned the notations **CLEANSHIP-CEMS** or **CLEANSHIP SUPER( )-CEMS** (see [2.1.2]).	

Table 2 : Required operational procedures

Operational procedure	Applicable Rules and Regulations
Shipboard oil pollution emergency plan **(1)**	IMO Resolution MEPC.54(32) as amended by Resolution MEPC.86(44)
Procedure to prepare and maintain an oil record book **(1)**	Annex I of MARPOL 73/78, Appendix III
Procedure to maintain, operate and troubleshoot bilge water treatment systems	IMO Circular MEPC.1/Circ.677
Bunkering procedure	–
Measures to prevent oil pollution and management and disposal of oil leakage and spillage	–
Sewage and grey water management plan and discharge control plan **(1)**	IMO Resolution MEPC.157(55)
Garbage management plan including procedures to prepare and maintain a garbage record book and hazardous waste procedures**(1)**	• IMO Resolution MEPC.220(63) • IMO Circular MEPC/Circ.317 • Annex V of MARPOL 73/78, Appendix • IMO Resolution MEPC.92(45)
Refrigerant management plan: operating procedure to be followed to minimise the risk and the consequences of ozone-depleting refrigerant leakage, under normal and emergency conditions, including: • checking of the piping tightness • recharge • detection of leakage • maintenance and repair **(2)**	–
Procedure to prepare and maintain the ozone-depleting substances record book	–
NOx emission control plan	–
Fuel oil quality management plan	• Annex VI of MARPOL 73/78, Regulation 18 and Appendix VI • IMO Resolution MEPC.182(59)
Where an exhaust gas cleaning (EGC) system is used: • SOx emission compliance plan • Onboard monitoring manual • Procedure to prepare and maintain the EGC record book	IMO Resolution MEPC.340(77)
(1) Only where required by MARPOL 73/78 Convention, according to the ship's gross tonnage. **(2)** Only where ozone-depleting substances are used on board.	

Ch 9, Sec 2, Table 3

Replace item 2 as follows:

Table 3 : Required plans and documents

No.	A / I	Documents
2		Prevention of pollution by oil:
	I	• diagram of the oil residue (sludge) system,
	I	• diagram of the independent clean drain system, where provided
	I	• diagram of the oily bilge system (pumping, treatment, discharge including automatic stopping device and recirculation facilities)
	A	• details of the bilge water holding tank
	A	• calculation of the bilge water holding tank capacity

Ch 9, Sec 2

Replace Table 4 by the following Table 4 and Table 5:

Table 4 : Wastewaters generation quantities

No.	Type of wastewater	Unit	Quantities for			
			Cruise ships	Ro-ro passenger ships designed for night voyages	Ro-ro passenger ships designed for day voyages	Cargo ships
1	Black water	litres/person/day	12 for a vacuum system 100 for a conventional flushing system			
2	Grey water (excluding laundry and galley)	litres/person/day	160	150	50	100
3	Laundry	litres/person/day	80	20	20	40
4	Galley	litres/person/day	90	30	30	60
5	Total grey water (2 + 3 + 4)	litres/person/day	330	200	100	200

Table 5 : Garbage generation quantities

No.	Type of garbage	Unit	Quantities for			
			Cruise ships	Ro-ro passenger ships designed for night voyages	Ro-ro passenger ships designed for day voyages	Cargo ships
1	Plastics	kg/person/day	0,1	0,1	0,1	0,1
2	Paper and cardboard	kg/person/day	1,0	1,0	1,0	1,0
3	Glass and tins	kg/person/day	1,0	1,0	1,0	1,0
4	Food wastes	kg/person/day	0,7	0,7	0,7	0,7
5	Total garbage (1 + 2 + 3 + 4)	kg/person/day	2,8	2,8	2,8	2,8

Replace (existing) Table 6 and Table 7 as follows:

Table 6 : Refrigerant leakage - Leak checks minimum frequency

Charge of fluorinated greenhouse gas, in tonnes of equivalent CO_2	Leak checks maximum interval	
	No leakage detection installed	Leakage detection installed
from 5 up to 50	6 months	12 months
above 50 up to 500	3 months	6 months
up to 500	1 month	3 month

Table 7 : Minimum capacity of the bilge water holding tank according to main engine rating

Main engine rating P, in kW **(1)**	Capacity (m^3)
up to 1000	4
above 1000 up to 20000	P / 250
above 20000	40 + P / 500
(1) For diesel-electric propulsions, the main engine rating is to be substituted with the aggregate power of the electric power motors.	

Ch 9, Sec 2, Table 8

Delete the two rows "Metals analyses" and the table footnote (1).

Ch 9, Sec 2, Table 9

Delete the two rows "Metals analyses" and the table footnote (1).

Ch 9, Sec 2, [1.1.1]

Delete the last sentence of requirement [1.1.1].

Ch 9, Sec 2, [1.1]

Add the following requirements [1.1.4] and [1.1.5].

1.1.4 Initial survey tests

After installation on board, the equipment and systems relevant to the requirements of the present Chapter are to be tested in the presence of the Surveyor under operating conditions. The control, monitoring and alarm systems are also to be tested in the presence of the Surveyor or their functioning is to be simulated according to a procedure agreed with the Society.

1.1.5 Periodical tests

Periodical tests and measurements to be done by the shipowner are given in Article [4].

Ch 9, Sec 2, [2]

Replace sub-article [2.1] by:

2.1 Waste management and monitoring

2.1.1 Separation of waste streams

Design arrangements and procedures for collecting, sorting, treating, storing and discharging solid and liquid waste and harmful substances are to be such that the discharge or discharge prohibition criteria laid down in annexes I, IV and V of MARPOL 73/78 Convention can be fulfilled.

2.1.2 Continuous emission monitoring system (CEMS)

Ships having the notation **CEMS** are to be fitted with a measurement, monitoring, recording and transmission equipment as following:

a) On-board emission measurement and monitoring equipment

Ships having the notation **CEMS** are to be provided with a type-approved measurement, monitoring and recording equipment, for:

- NOx emissions, in compliance with IMO Resolution MEPC.103(49)
- SO_2 and CO_2 emissions, in compliance with IMO Resolution MEPC.340(77)

Note 1: The correspondence between the SO_2/CO_2 ratio and the sulphur content of the fuel oil is detailed in IMO Resolution MEPC.340(77), Table 1 and Appendix II.

b) Remote transmission of the parameters related to waste discharge and air emissions

The following waste discharge and air emission parameters required to be monitored and recorded are to be transmitted on a regular basis (e.g. every day) via a satellite communication system to a shipowner facility ashore:

- NOx, SO_2 and CO_2 emission records in accordance with [2.1.2], item a)
- Oily waste discharge records, in accordance with [2.2.7]
- Wastewater discharge records, in accordance with [2.3.5], or [3.3.4] as applicable for **CLEANSHIP SUPER** notation
- Garbage waste records, in accordance with [2.4.8]
- For units fitted with a exhaust gas cleaning system, the washwater discharge records, in accordance with IMO Resolution MEPC.340(77) Article 10.

Such information is to be made available to the Surveyor of the Society upon request.

Ch 9, Sec 2, [2.2]

Replace requirements [2.2.3], [2.2.4] and [2.2.5] by:

2.2.3 Oil water separating equipment

The following equipment, approved in accordance with IMO Resolution MEPC.107(49) as amended by IMO Resolution 285(70), is to be provided:

- 15 ppm bilge separator
- 15 ppm bilge alarm
- automatic stopping device.

The capacity of the bilge separator is to take into account the route of the vessel, the volume of the bilge water holding tanks and the separating technology.

The 15 ppm bilge separator and the 15 ppm bilge alarm are to be installed in accordance with the provisions of IMO Resolution MEPC.107(49), paragraph 6, as amended by IMO Resolution 285(70).

2.2.4 Oil residue (sludge) tanks

The minimum capacity of the oil sludge tank is to be calculated according to the criteria specified in MARPOL Annex I, Unified Interpretation 16.

The arrangement of the oil residue tank (sludge) is to comply with MARPOL Annex I, reg. 12 and is to:

- be provided with a designated pump that is capable of taking suction from the oil residue (sludge) tank(s) for disposal of oil residue (sludge). Oil residue (sludge) may be disposed of directly from the oil residue (sludge) tanks through the standard discharge connection referred to in MARPOL 73/78, Annex I, Reg. 13, or any other approved means of disposal
- have no discharge connections to the bilge system, oily bilge water holding tank(s), tank top or oily water separators unless for arrangement authorized in MARPOL Annex I, reg. 12.3 (see also IACS recommendations 121)
- be designed and constructed so as to facilitate their cleaning and the discharge of residues to reception facilities.

2.2.5 Overboard discharges from the bilge pumping system

The overboard discharge valve of any bilge overboard discharge line, unless passing through the 15 ppm bilge separator, is to be kept shut and provided with lead-sealing arrangements.

Note 1: Lead-sealing arrangements is not to be understand as a requirement for the valves to be blanked or physically locked. Emergency bilge discharge, and other overboard discharge valves of similar nature, must be available for use at all times in case of an emergency (SOLAS regulation II-1/21). Valve sealing may be accomplished through use of a breakable seal, electronic tracking, or similar method.

Add the following requirement [2.2.8]:

2.2.8 Operational procedures

Operational procedures covering oil pollution prevention are to cover the following topics:

- Procedure to maintain, operate and trouble shoot bilge water treatment systems
- Procedure to prepare and maintain an oil record book.

Ch 9, Sec 2, [2.3]

Replace requirements [2.3.1], [2.3.2], [2.3.3] and [2.3.4] by:

2.3.1 Compliance with MARPOL 73/78

Ships granted with the additional class notation **CLEANSHIP** are to comply with the following requirements of MARPOL 73/78 Convention, Annex IV, as amended:

- Reg. 9 for sewage systems
- Reg. 10 for standard discharge connection
- Reg. 11 for discharge criteria.

Note 1: Discharge of grey water is not regulated by MARPOL 73/78 Convention.

Note 2: Attention is drawn to the fact that some national regulations prohibit the discharge of sewage (treated or untreated) and grey water while in port or within other designated areas.

2.3.2 Design and arrangement of the sewage system

a) Ships, other than passenger ships sailing in special area, are to be equipped with one of the following sewage systems:
   - a sewage treatment plant, or
   - a sewage comminuting and disinfecting system fitted with facilities for temporary storage of sewage when the ship is less than 3 nautical miles from the nearest land, or
   - a holding tank of the capacity to the satisfaction of the Society (see [2.3.3]).

b) Passenger ships sailing in special area, are to be equipped with one of the following sewage system:
   - a sewage treatment plant, or
   - a holding tank of the capacity to the satisfaction of the Society, see [2.3.3].

Note 1: Special area means area covered by MEPC.264(68) International Code for Ships operating in Polar Waters (Polar Code).

In case a sewage treatment plant is installed on board without sewage holding tank, justifications are to be provided for operation in areas, such as port, where outboard discharge of sewage and treated sewage is not permitted.

2.3.3 Holding tanks

The holding tanks are to be efficiently protected against corrosion and fitted with a level indicator and a high level alarm. The provisions of Pt C, Ch 1, Sec 10 [8.11.10] are to be complied with.

The capacity holding tank capacity is to be justified in regards on the ship's intended usage, the maximum number of people on board and the sewage treatment systems installed on board. The wastewater quantities to be considered are to be derived from the experience gained on similar types of ships operated in similar conditions. Where no data are available, the figures listed in *(New)* Tab 4 are to be used.

The sewage discharge pipes connection to reception facilities are to be fitted with standard discharge connection in accordance with MARPOL, Annex IV, Reg. 10.

Sewage, including drainage from medical premises (see also Pt C, Ch 1, Sec 10, [8.11.10], item d), is to be collected separately from grey water, except if a common treatment installation is installed on board.

Note 1: This does not preclude the mixing of effluents after treatment (e.g. treated sewage mixed with grey water).

Note 2: When sea water is mixed with wastewater (e.g. for the purpose of washing the holding tanks), the discharge requirements for the wastewater apply to the resulting mixture.

Note 3: When categories of wastewater having different discharge requirements are mixed together, the most stringent requirements apply to the resulting mixture.

2.3.4 Sewage treatment plants and piping

Sewage treatment plants are to be of a type approved in accordance with the provisions of IMO Resolution MEPC.227(64), as amended by MEPC.284(70).

Provisions are to be made in the design for easy access points for the purpose of obtaining representative influent and effluent samples.

The capacity of the sewage treatment plant is to be enough to accommodate the maximum number of people on board. The wastewater quantities to be considered are to be derived from the experience gained on similar types of ships operated in similar conditions. Where no data are available, the figures listed in *(New)* Tab 4 are to be used.

Add the following requirement [2.3.6]:

2.3.6 Operational procedures

The sewage and grey water management plan and discharge control plan are to cover the following topics:

- Sewage and grey water installation and maintenance;
- Procedures and arrangement to obtain representative influent and effluent samples;
- Discharge control plan and procedure following requirements and prescription of MARPOL Annex IV, reg.11, MEPC.157(55) “Recommendation on Standards for the Rate of Discharge of Untreated Sewage from Ships”, and, as relevant, other regulations such as MEPC.264(68), part II-A, Chapter 4.

Ch 9, Sec 2, [2.4]

Replace requirement [2.4.2] by:

2.4.2 Storage and disposal

Except otherwise stated in this Article, storage arrangements are to be provided for all kinds of liquid and solid wastes, with a capacity corresponding to one day operation of the ship.

Note 1: Although disposal into the sea and onboard incineration are possible in the conditions specified in MARPOL 73/78 Convention, storage and subsequent discharge to port reception facilities is to be given first priority. Attention is drawn to the specific requirements imposed by certain flag Authorities and/or State or Port Administration, which may restrict or prohibit waste discharge and/or incineration in the waters under their jurisdiction.

Ch 9, Sec 2, [2.4.5]

Replace reference to [2.2.1] by a reference to (new) Tab 5 in the first paragraph of requirement [2.4.5].

Ch 9, Sec 2, [2.4.6]

Replace reference to [2.2.1] by a reference to (new) Tab 5 in the second paragraph of requirement [2.4.6].

Ch 9, Sec 2, [2.4]

Replace requirement [2.4.7] by:

2.4.7 Incinerators

Where fitted, incinerators are to be type-approved by the Society, designed and constructed according to the requirements of:

- MEPC.244(66), as amended
- MARPOL Annex VI, Appendix IV.

Proper hazardous waste management procedures including segregating hazardous wastes are to be instituted on board each ship to assure hazardous wastes are not introduced into the incinerator. In particular, batteries are to be removed from any waste that will be incinerated on board.

Add the following requirement [2.4.9].

2.4.9 Garbage management plan

Procedures for collection, sorting, processing and disposal of garbage are to be available in the garbage management plan required by MARPOL 73/78, Annex V, Reg. 9.

The garbage management plan is to follow MEPC.220(63) "2012 Guidelines for the development of garbage management Plan". Restrictions to the discharge of garbage into the sea are to be clearly indicated and in accordance to MARPOL Annex V (see also MEPC.295(71) "2017 Guidelines for the implementation of MARPOL Annex V, Table 1").

The garbage management plan is to include procedures in order to make sure that the following hazardous wastes are not discharged at sea nor mixed with other waste streams:

- photo processing waste (including X-ray development fluid waste)
- dry cleaning waste, containing in particular tetrachloroethylene or perchloroethylene (PERC)
- printing materials, like inks, except soy based, non chlorinated hydrocarbon based ink products
- laser printer toner cartridges
- unused and outdated pharmaceuticals
- fluorescent / mercury vapour bulbs
- batteries
- used cleaners, solvents, paints and thinners
- products containing metals such as lead, chromium, copper, cadmium and mercury.

Ch 9, Sec 2, [2.6]

Add the following requirement [2.6.6]:

2.6.6 Operational procedures

The onboard operational procedure is to cover:

- measures to prevent oil pollution
- oil leakage and spillage management and disposal, and cleaning of the deck container.

Ch 9, Sec 2, [2.7]

Replace requirements [2.7.1] and [2.7.2] by:

2.7.1 Compliance with MARPOL 73/78

Ships granted with the additional class notation **CLEANSHIP** are to comply with MARPOL 73/78 Convention, Annex VI, regulation 12 (Ozone Depleting Substances).

2.7.2 Application

The following requirements apply to the ship refrigeration and air conditioning (AC) permanent installations with an initial charge of more than 3 kg or more than 5 tonnes of CO2 equivalent of refrigerant.

They do not apply to permanently sealed equipment as defined in Ch 9, Sec 1, [2.2.5].

Replace requirements [2.7.5], [2.7.6] and [2.7.7] by:

2.7.5 Prevention of leakage

The following measures are to be taken in order to avoid deliberate emissions of ozone depleting substances:

- Refrigeration systems are to be designed in such a way as to minimise the risk of medium release in the case of maintenance, repair or servicing.
- Arrangements are to be made to isolate those sections which are to be serviced by a system of valves and by-passes, in such a way as not to stop the operation of the plant, while in service, preventing the risk of release of the medium outside of the plant.
- Means are to be provided to avoid the possibility of leak to the atmosphere of the refrigerants or its vapours in any case of failure of the plant.
- A warning instruction plate stating that deliberate emissions of halogenated substances are prohibited, is to be displayed in the vicinity of the vessels and of the releasing devices.

These requirement does not apply to spaces containing only pipes.

2.7.6 Leak detection

Leak detectors are to be of a type approved by the Society. They are to be installed in spaces where the medium might leak in order to provide continuous leak monitoring.

Provisions for the following verifications are to be made in the onboard operational procedure:

- Checking by the shipowner of the leakage detection system at least once every 12 months to ensure its proper functioning.
- Additional checking of the refrigerants by trained people for leakage at a frequency shown in Tab 6, depending on the initial charge of the system in tonnes of CO_2 equivalent, and corrective actions and repairs in case of leakage detection.

2.7.7 Alarm

Any detection of medium leak is to activate an audible and visible alarm in a normally manned location. The alarm is to be activated when the concentration of refrigerant reaches a value agreed with the Society on a case-by-case basis, considering LEL and limit of toxicity of the refrigerant used in the system..

Add the following requirements [2.7.8] and [2.7.9]

2.7.8 Records

Provisions are to be made to record:

- recharge, full or partial, of equipment containing ozone depleting substances
- repair or maintenance of equipment containing ozone depleting substances, including:
  - Checks for leakage
  - Checks of leakage detection system
- discharge of ozone depleting substances to the atmosphere and leakage
- discharge of ozone depleting substances to land-based reception facilities
- supply of ozone depleting substances to the ship, storage location and quantities.

2.7.9 Operational procedures

The refrigerant management plan is to include:

- Maintenance procedure
- Leakage checking frequency and procedure
- Leakage detection system checking frequency and procedure
- List and quantity of all refrigerant on board
- Qualification and training of personnel.

Ch 9, Sec 2, [2.9.1]

Replace requirement [2.9.1] by:

2.9.1 Compliance with MARPOL 73/78

Diesel engines fitted to ships granted with the additional class notation **CLEANSHIP** are to comply with the requirements of:

- MARPOL 73/78, Annex VI, Reg. 13
- NOx Technical Code (2008), as amended.

Ch 9, Sec 2, [2.10.3]

Replace requirement [2.10.3] by:

2.10.3 Use of exhaust gas cleaning systems

a) Exhaust gas cleaning (EGC) systems, which may be accepted as an arrangement equivalent to the use of low sulphur fuel oils in pursuance of MARPOL 73/78 Convention, Annex VI, Regulation 4.1, are to be approved in accordance with IMO Resolution MEPC.340(77) "2021 Guidelines for exhaust gas cleaning systems".

b) EGC systems are to be fitted with data measuring, recording and processing devices in accordance with IMO Resolution MEPC.340(77).

c) The discharge washwater is to satisfy the criteria given in IMO Resolution MEPC.340(77).

d) A holding tank having a capacity sufficient to store washwater treatment residues generated by the EGC unit during 30 days operation of the ship is to be provided onboard.

Note 1: Washwater treatment residues generated by the EGC are then delivered ashore to adequate reception facilities in order not to be discharged to the sea or incinerated on board.

Note 2: These requirements are also applicable to the residues holding tanks of EGC unit integrated in an EGR, which are to comply with Pt C, Ch 1, Sec 11, [4.8].

e) The EGC system's storage tank containing the chemical treatment fluids is to be protected from excessively high or low temperatures applicable to the particular concentration chemical treatment fluids. Depending on the operational area of the ship, this may necessitate the fitting of heating and/or cooling systems.

Ch 9, Sec 2, [3.1.1]

Replace the reference to "IMO Circular MEPC.1/Circ.642" by a reference to "IMO Circular MEPC.1/Circ.642, as amended"

Ch 9, Sec 2, [3.1]

Replace requirement [3.1.2] by:

3.1.2 In addition to the procedures required in [2.4.2], the garbage management plan is to include the procedures for garbage source reduction, minimization and recycling.

Ch 9, Sec 2, [3.2]

Replace requirement [3.2.1] by:

3.2 Oily wastes

3.2.1 The bilge water holding tank is to have a capacity that provides to the ship the flexibility of operation in ports, coastal waters and special areas, without the need to discharge de-oiled water overboard.

The minimum capacity of the bilge water holding tank, in m^3, is not to be less than the value calculated from Tab 7. Lower capacities are to be justified.

Ch 9, Sec 2, [3.3]

Replace requirement [3.3.3] by:

3.3.3 Sewage sludge

Arrangements are to be made for sludge from sewage treatment to be collected and stored then discharged ashore or, where permitted, incinerated on board.

Where provided, incineration devices are to completely burn the sludge to a dry and inert ash and not to discharge fly ash, malodors or toxic substances.

The capacity of the sewage sludge tanks is to be calculated taking into consideration:

- the maximum period of voyage between ports where sludge can be discharged ashore, or
- the incinerator capacity and whether incineration is permitted in the areas where the ship is intended to operate.

In the absence of precise data, a figure of 30 days is to be used.

Arrangements are to be made to dispose of ashes from sludge incineration ashore.

Ch 9, Sec 2, [3.4]

Replace requirement [3.4.1] by:

3.4.1 Arrangements are to be made to store food wastes and wastes contaminated with food in high integrity sealed packaging and refrigerated to 5°C.

Ch 9, Sec 2, [4]

Replace the title of Article [4] by:

4 Onboard tests and measurements

Ch 9, Sec 2, [4.1.1]

Delete the first paragraph of the requirement.

Ch 9, Sec 2, [4]

Delete sub-article [4.2]

Ch 9, Sec 2, [4.3.3]

Replace the second paragraph by:

Tab 10 lists the number of occurrences where the pollutant maximum concentration may exceed the limit concentration specified in Tab 11 for the effluent standard for biological analyses of waters, without exceeding the reject value.

Ch 9, Sec 3, [1.1]

Add the following requirement [1.1.2]:

1.1.2 Periodical tests and measurements to be done by the shipowner are given on Pt A, Ch 5, Sec 8, [2.2.3].

Ch 9, Sec 3

Delete Article [3].

Ch 9, Sec 4, [3.2.1]

Replace the reference to "Guidance note NI538" by a reference to (existing) "Pt C, Ch 1, Sec 12".

Ch 9, Sec 4, [3.2]

Delete [3.2.2].

Ch 9, Sec 5, Table 1, Table 2 and Table 3

Replace the row "GWT" in Table 1, Table 2 and Table 3 as follows:

Table 1 : Required certificates

Notations	Certificate	Applicable Rules and Regulations
GWT or **GWT-B**	Type approval certificate of the grey water treatment plant	See Article [2]

Table 2 : Required operational procedures

Notations	Operational procedure	Applicable Rules and Regulations
GWT or **GWT-B**	Grey water management plan and discharge control plan	–

Table 3 : Required plans and documents

Notation	A / I	Documents
GWT or **GWT-B**	I	• diagram of the grey water system (collection, treatment, discharge)
	A	• details of the grey water holding tank
	A	• calculation of the grey water holding tank capacity
	I	• description of the grey water treatment plant and relevant operating principles

Ch 9, Sec 5

Replace Article [2] by:

2 Additional class notation GWT and GWT-B

2.1 Scope

2.1.1 The additional class notations **GWT** and **GWT-B** apply to ships fitted with a grey water treatment system, the effluents of which have a quality complying with the relevant provision of [2.2].

Note 1: Effluents from the grey water treatment plant may be reused or recycled only if they comply with a recognised quality standard for potable water.

2.2 Design of the grey water treatment plant

2.2.1 Required capacity

The capacity of the grey water treatment plant is to be sufficient for the maximum number of persons onboard, taking into account the daily production of grey water given in Ch 9, Sec 2, [2.3.4].

2.2.2 Effluent quality

a) For ships granted with the additional class notation **GWT**, the grey water treatment plant is to be so designed that the minimum level of effluent quality complies with the limits given in IMO Resolution MEPC.227(64) section 4.1.

b) For ships granted with the additional class notation **GWT-B**, in addition to the requirements of item a), the grey water treatment plant is to comply with IMO Resolution MEPC.227(64) section 4.2.

2.2.3 Type tests

Grey water treatment plants are to be type-approved in accordance with the relevant requirements of IMO Resolution MEPC.227(64).

Chapter 9

Replace the title of Section 6 by:

Section 6 Notations NOX-x% and SOX-x%

Ch 9, Sec 6, [1.1]

Replace requirement [1.1.1] by:

1.1.1 The requirements of this Section apply to ships having one of the additional class notations **NOX-x%** or **SOX-x%**.

Ch 9, Sec 6, Table 1

Delete the row "CEMS".

Ch 9, Sec 6

Delete Article [4].

Ch 9, Sec 8, [4.3.1]

Replace reference to "ISO 8217" by a reference to "ISO 8217:2017."

Ch 9, Sec 13, [2.1.3]

Replace the last sentence of requirement [2.1.3] by:

For ships which are required to maintain minimum propulsion power as per MARPOL Annex VI regulation 21.5, the minimum propulsion power may be assessed according to MEPC.1/Circ.850 rev.3.

CHAPTER 12

Ch 12, Sec 3, Table 1

Replace item 1 as follows:

Table 1 : Documentation to be submitted

No.	I/A **(1)**	Documents to be submitted
1	I	Description and operation manuals of the ship's SAS systems and equipment, including limiting conditions for SAS operations

Chapter 12

Add the following new Section 9 "Electric Vehicles Onboard Charging (EVOC)":

Section 9 Electric Vehicle Onboard Charging (EVOC)

1 General

1.1 Application

1.1.1 The additional class notation **EVOC** may be assigned, in accordance with Pt A, Ch 1, Sec 2, [6.16], to ships having the service notation **ro-ro passenger ship** and complying with the requirements of the present section for the purpose of charging electric vehicles carried on board.

1.1.2 The electric vehicles considered in this Section include any electrically propelled vehicles including cars (plug-in hybrid electric vehicles or battery electric vehicles), drones, forklifts, bikes, scooters, motorcycles, buses and trucks.

1.1.3 For the purpose of this Section, the recharging area is expected to be part of a closed ro-ro space or ro-ro weather deck. Other arrangements will be considered on a case-by-case basis.

1.1.4 The scope of **EVOC** additional class notation excludes the following operational conditions:

- Recharging of electric vehicles during loading or unloading operations
- Use of non-ship owned cables, unless:
  - they are provided by an original equipment manufacturer, and
  - they are compliant with IEC 62196, and they are free of visible damage.

1.2 Definitions and abbreviations

1.2.1 Electric Vehicle (EV)

Electric vehicle means any vehicle propelled by an electric motor, drawing current from a rechargeable energy storage system such as batteries.

1.2.2 Plug-in Hybrid Electric Vehicle (PHEV)

Plug-in hybrid electric vehicle means an electric vehicle that can charge its rechargeable electrical energy storage device from an external electrical source and also derives part of its energy from another onboard source.

1.2.3 EV charging station

EV charging station means a stationary apparatus connected to the supply network, aiming to supply electric energy to an EV for charging.

1.2.4 Recharging area

Recharging area means the part of a ro-ro or vehicle space where electric vehicles may be connected to charging stations for recharging purposes.

1.2.5 Cable assembly

Cable assembly means an assembly consisting of flexible cable or cord fitted with a plug and/or a vehicle connector used to establish the connection between an EV and its charging station.

1.3 Documents to be submitted

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

Table 1 : Documents to be submitted

No.	A/I **(1)**	Document
1	A	General arrangement of electrical installation of car deck including charging stations and the zone where vehicles are intended to be charged
2	A	Diagram of the supply and monitoring of the charging system
3	I	Electrical power balance
4	A	Charging stations technical specifications, datasheet and certificates
5	I	Onboard procedures (fire-fighting, safety patrols, vehicle charging, …)
6	I	Electric cables storage plan
7	A	Arrangement, diagrams and specifications of the fixed fire detection and fire alarm system
(1) A = For approval; I = For information		

No.	A/I (1)	Document
8	A	Hazardous area layout including positions of charging stations
9	A	Diagram and arrangement for the video television surveillance system
10	I	Risk analysis report as detailed in [2.2]
11	I	Charging equipment cables and sockets maintenance plan
12	A	Fire control plan
13	A A A I	In the case of a recharging area located on weather deck: • Details of the water monitors, including their capacity, range and trajectory of delivery • Plan of the water monitor seating arrangements • Water monitor control system diagram • Water monitor operating manual.
14	A A A I	In the case of a recharging area located in a closed ro-ro or vehicle space: • Arrangement of the water-based fixed fire-extinguishing system, including pipe routing, nozzle location, section arrangement and surface areas of protected zones • Details of the pumps, piping and nozzles (capacity, service pressures, material etc.) • System control diagram • System operating manual.
15	A	In the case of a recharging area located in a closed ro-ro or vehicle space: Particulars of the ventilation system, including arrangement of the fan rooms, characteristics of the fans and volume of the ventilated spaces.
(1) A = For approval; I = For information		

2 Arrangement and safety assessment

2.1 Recharging area arrangement

2.1.1 Charging stations are to be located either in closed vehicle spaces or on weather decks, in areas dedicated to the transportation of vehicles.

2.1.2 Charging stations, are to be located, as far as practicable, away from the means of escape.

2.1.3 A locker or specific storage area is to be provided in the vicinity of the charging station in order to allow storing the electric cables intended for vehicle charging while not in use, in such a way that they are protected from damage due to loading and unloading operations.

2.1.4 Clearly visible signs and markings are to be provided in the recharging area and next to each charging station.

2.2 Risk assessment

2.2.1 A risk assessment is to be conducted in order to ensure that any risks arising from EV charging affecting persons on board, the environment or the integrity of the ship are addressed. Consideration is to be given to the hazards associated with installation, operation and maintenance following any foreseeable failure.

2.2.2 Hazards are to be identified using acceptable and recognised hazard identification techniques. The risk assessment is to address at least the following:

- Loss of containment due to potential thermal runaways and gas and liquid leaks from the vehicles' batteries
- Electrical hazards caused by power management and charging issues, thermal runaways, electrical failures, etc.
- Operational hazards including those linked to commissioning, installation and maintenance of the charging stations in the vehicle space
- Emergency situations and impact on/from adjacent areas involving toxic gases emissions, fire hazards or explosions.

2.2.3 The risks are to be analysed using acceptable and recognised risk analysis techniques. The analysis is to ensure that risks are eliminated wherever possible. Risks which cannot be eliminated are to be mitigated as necessary. If mitigation solutions are operational, details of risks, and the means by which they are mitigated, are to be included in the operating manual.

3 Electrical installation

3.1 General

3.1.1 The electrical power available for EV charging supply is to be sufficient to simultaneously recharge the batteries of all potential vehicles to be connected to the charging stations fitted for this purpose.

3.1.2 The installation of charging stations is to be such that their number and capacity is calculated according to the surplus of power available on board in respect of the vessel's essential services and services for habitability. The safety of the ship and its essential services are to have priority over EV charging.

3.1.3 At least one charging cable complying with [3.3] is to be provided for each charging station.

3.1.4 Electromagnetic compatibility

The charging station installation and associated components are not to cause electromagnetic disturbance and are to comply with Pt C, Ch 2, Sec 2, [3].

3.1.5 All electrical components are to be so designed and manufactured that they are capable of operating satisfactorily under the normally occurring variations in voltage and frequency specified in Pt C, Ch 2, Sec 2, [2].

3.1.6 The electronic components of the charging stations are to be constructed to withstand the tests required in Pt C, Ch 3, Sec 6.

3.1.7 The charging station is to be capable of functioning according to the network parameters taking into consideration the adaptation of the transmission voltage and frequency of the vehicle to that of the ship and station.

3.1.8 The minimum required degree of protection for charging equipment is IP55 in closed vehicle spaces and IP56 on weather decks.

3.1.9 The equipment for charging is to be designated for charging and with a protection against mechanical damage. It is to be capable of being disconnected when any potential fault is anticipated (e.g. by means of an isolation switch between the charging station and the vessel's main distribution system).

3.1.10 An isolating transformer, adapted to the performance parameters of the charging station is to be provided in order to create an earthed distribution network. For an enhanced circuit protection scheme, a residual current device (RCD) is to be provided for each charging station to ensure the disconnection of the faulty circuit before the earth fault develops into full grounding of a distribution phase.

3.1.11 Means for detection and protection for earth faults, overloads and short-circuit faults are to be provided on electric circuits with an audible and visual alarm to the safety centre and central control station.

3.1.12 Means are to be provided to avoid failures due to overload or short-circuits both within the main power distribution system and downstream at the level of the connection of the charging vehicles.

3.2 Sockets and outlets

3.2.1 Socket-outlets and plugs are to comply with the relevant provisions of Pt D, Ch 12, Sec 4, [3.4].

3.2.2 A lockable cover is to be provided on the connector/plug of charging stations with a detachable cable in order to prevent unauthorized use and inappropriate connections.

3.2.3 Socket-outlets, regardless of their rating, are to be provided with a switch and be interlocked such that the plug cannot be inserted or withdrawn whenever the switch is on. Vehicles can only be plugged into the charging station before the switch is on.

3.2.4 All sockets intended for recharging purposes are to be capable of being disconnected from the shipboard power system from a central location outside the vehicle space or weather deck.

3.3 Electrical cables and connections

3.3.1 The cables are to be long enough to reach the EV's charge port without being physically strained or blocking the access to car deck passages. Where cables need to be laid in access ways, means (e.g. cable ducts…) are to be provided to prevent impairing passage on those access ways.

3.3.2 A maintenance plan is to be prepared for electrical cables and their sockets and associated equipment in the vehicle spaces intended for vehicles charging.

3.3.3 Electrical cables used for vehicles' charging are to be of a type approved by the Society, according to IEC 62196.

3.3.4 Electrical cables intended for vehicles charging are to be armoured or metal-sheathed unless otherwise mechanically protected.

3.3.5 Electrical cables intended for vehicles charging that may be damaged during loading and unloading operations are to be mechanically protected, even when armoured, unless the ship's structure already provides protection. Any metal casings used for mechanical protection of cables are to be protected against corrosion and earthed.

3.3.6 For AC charging, cables may be either detachable or tethered; while only tethered cables are allowed for DC charging.

3.4 Charging station

3.4.1 The charging station is to be of a type approved by the Society.

3.4.2 Among the different types of charging plugs available for electric vehicles, the charging station is to offer at least the plug type 2, as described in EN 62196-2:2017, with the adapters suitable for other types of plugs also specified in the same standard.

3.4.3 The charging station is to have at least the same resistance to vibration as required for all other electrical installations on board.

3.4.4 The charging station is to be integrated into the ship's power management system (PMS), and the functionality of communication between the charging station and the PMS is to be established. In case of high power demands, it is to be automatically disconnected from the electric grid until sufficient power is available again.

3.4.5 It is also to be integrated into the ship's alarm and monitoring system such that, in the event of failure, an audible and visual alarm is triggered at the navigating bridge or in a continuously manned central control station. The alarm involving malfunctions in the charging station, the connection or the EV battery is to be different from other alarms in the vehicle space.

3.4.6 A test current determining the circuit integrity is to be carried out automatically at each electric vehicle before launching its charging process. This test is to be integrated into the control system of the charging stations.

3.4.7 It is to be possible to manually disconnect the charging station from the grid by the crew. This manual disconnection is to be located in a non-hazardous area.

3.4.8 A remote shutdown of the charging station is to be available in case of an accident (e.g. a nearby fire hazard).

3.4.9 The charging station is to be provided with the following electrical protection features:

- Short-circuit protection
- Overcharging protection ensuring a shutdown if the battery overcharges
- Temperature monitoring triggering disconnection in case of overheating or damage
- Emergency shutdown in the event of a hazard
- Internal cooling of the charging station or cable, if needed.

3.4.10 Individual visual signals are to be associated with the charging stations in order to identify the vehicles in a current charging status. Such indicators are to be fitted in an easily visible position.

4 Fire safety

4.1 Fire detection

4.1.1 A fixed fire detection and fire alarm system, providing combined heat and smoke detection in the recharging area, and complying with the requirements of Pt C, Ch 4, Sec 15, [8], is to be installed.

In case the recharging area is located on a weather deck, a fixed fire detection and fire alarm system approved based on IMO Circular MSC.1/Circ.1242, according to Pt C, Ch 4, Sec 15, [8.2.3], item a) 7), may be considered. The type of detectors is to be adequate to detect battery fires on open decks.

4.1.2 The ship's electrical supply to the charging vehicles is to be automatically cut off upon activation of two fire detectors.

4.1.3 The recharging area is to be easily identifiable on the fixed fire detection and fire alarm control panel.

4.1.4 A video television surveillance system is to be provided, covering the recharging area and allowing continuous video monitoring for fire location identification. The number and arrangement of the cameras is to be such that all parts of the recharging area(s) are visible and easily identifiable. Thermal imaging cameras are acceptable for this purpose.

4.1.5 The video television surveillance system is to provide immediate playback capability at the navigating bridge and in the safety centre.

4.2 Fixed fire-extinguishing systems

4.2.1 The recharging area is to be covered by one of the following water-based fixed fire-extinguishing system:

- A fixed water based fire-fighting system for ro-ro spaces and special category spaces, complying with Pt C, Ch 4, Sec 15, [6.1.4], for a recharging area located in a closed vehicle space, or
- Fixed water monitors complying with the requirements of [4.2.4] for a recharging area located on the weather deck.

4.2.2 Controls allowing to cut-off electrical power supply to the charging vehicles are to be available close to the controls of the water-based fixed fire extinguishing system required in [4.2.1].

4.2.3 Recharging area located in a closed vehicle space

One or several dedicated sections of the fixed water based fire-fighting system are to cover the recharging area. These sections are to be clearly identified at the system release station.

4.2.4 Recharging area located on a weather deck

a) Fixed water monitors are to be provided on the weather deck where the recharging area is installed, capable of delivering water to:

- the recharging area; and
- the area, including superstructure boundaries, located within 8m measured horizontally from the recharging area.

b) The combined capacity of all water monitors is to be such as to provide an average coverage of 2 L/min per square meter of protected area. In addition, the output of each monitor is to be at least 1250 L/min.

c) Water monitors are to be of a type approved by the Society and are to be capable of throwing a continuous full water jet without significant pulsations and compacted in such a way as to be concentrated on a limited surface.

Monitors are to be of robust construction and capable of withstanding the reaction forces of the water jet.

d) The seatings of the monitors are to be of adequate strength for all modes of operation.

e) The strengthening of the structure of the ship, where necessary to withstand the forces imposed by the water monitor system when operating at its maximum capacity in all possible directions of use, is to be considered, on a case-by-case basis, by the Society.

f) It is to be possible to remotely operate the fire monitors from a safe position in case of a fire on the weather deck.

g) The distance from the monitor to the farthest extremity of the protected area forward of that monitor is not to be more than 75% of the monitor throw in still air conditions.

h) The capacity of the pump and arrangement of the piping system supplying water to the water monitors is to be sufficient to achieve the full throw of any one monitor and to ensure coverage of the whole protected area at the flowrate indicated in item b).

i) Where the ship's required fire pumps are used to feed the water monitors:

- It is to be possible to segregate the ship's fire main from the water monitors by means of a valve in order to operate both systems separately or simultaneously
- The capacity of the pumps is to be sufficient to serve both systems simultaneously.

j) Where the pump dedicated to the fixed water based fire-fighting system required by Pt C, Ch 4, Sec 13, [5] is used to feed the water monitors, it is to be possible to segregate both systems by means of a valve and both systems need not be able to operate simultaneously.

k) Scupper or freeing ports, sized to remove no less than 125% of the combined capacity of both the monitor(s) and the required number of fire hose nozzles, are to be provided to ensure efficient drainage of water accumulating on deck surfaces when the fire monitors are in operation.

4.3 Portable equipment

4.3.1 At least one portable thermal imaging device is to be available on board.

4.3.2 At least one fire blanket is to be available close to each recharging area. The size of the fire blanket is to be sufficient to cover completely any electrical vehicle intended to be charged on board.

4.3.3 At least 3 water fog applicators are to be available close to any recharging area located on the weather deck.

5 Prevention of explosion and limitation of the consequences of toxicity

5.1 Sources of ignition

5.1.1 All electrical equipment related to the charging system, including connectors, sensors and control units, are to be of a certified safe type suitable for use in the hazardous areas defined in Pt D, Ch 12, Sec 4.

5.2 Ventilation

5.2.1 Closed vehicle spaces containing recharging areas are to be fitted with a mechanical ventilation system, capable of providing at least 10 air changes per hour on a continuous basis while electrical vehicles are under recharging.

5.2.2 The fans and fire dampers are to be operable from outside the vehicle space.

6 Testing

6.1 Workshop tests

6.1.1 Before installation, the following workshop tests are to be carried out at the manufacturers' premises:

- Testing of charging stations according to Pt C, Ch 2, Sec 7, Tab 1. Tests on charging stations are to be attended by the Surveyor.
- Testing of charging cables according to the relevant parts of Pt C, Ch 2, Sec 9, [3].
- Testing of the connectors, socket-outlets and plugs according to IEC 62196 standard.

6.2 Shipboard test

6.2.1 Fire monitor system

After assembly on board, the fire monitor system required by [4.2.1] is to be checked for leakage at normal operating pressure, and is to undergo an operational test to check their characteristics and performances.

6.2.2 Video television surveillance

The video television surveillance system required by [4.1.4] is to undergo an operational test in order to check that all parts of the recharging area(s) are visible and easily identifiable. This test is to be carried out with an arrangement representative of a fully loaded cargo deck.

6.2.3 Charging stations

A working test is to be carried out on the charging stations and their associated safeties required in [3.4] (i.e. remote disconnection, automatic trip, etc.).

CHAPTER 14

Ch 14, Sec 1, [1.1.1]

Add the following Note 1 at the end of requirement [1.1.1]:

Note 1: Ships covered by SOLAS Convention are not normally allowed to rely only on batteries for propulsion. See Pt C, Ch 2, Sec 3, [2.2.3].

Ch 14, Sec 1, [3.1.8]

Replace item c) of the alphanumeric list by:

c) A fixed fire detection and fire alarm system complying with the requirements of Pt C, Ch 4, Sec 15, [8] is to be provided in battery rooms. Combined heat and smoke detection is to be installed in battery rooms for Lithium-type batteries.

Ch 14, Sec 1, [5.3]

Replace requirement [5.3.5] by:

5.3.5 Factory acceptance tests

The following items, at least, are to be checked:

- ability to achieve safety functions
- proper working of alarms and defaults and related functions and/or interfacing to the other ship systems
- proper working of monitoring systems
- when direct cooling is provided, temperature rise test in order to check the proper working of the cooling circuit (see [3.2.1])

  Note 1: When this test is impractical at the factory, the following alternative may be considered:

  - a calculation based on a method validated by tests is to be submitted to the Society, and
  - Proper working of the cooling circuit is to be checked after installation onboard, see [5.3.6].

  Note 2: The test condition to be selected is the most unfavourable nominal operating conditions of the batteries (maximum charging or discharging current which will produce the maximum heating losses)
- Insulation tests (High voltage test and insulation resistance test according to Pt C, Ch 2, Sec 8, [3])
- IP characteristics.

CHAPTER 15

Ch 15, Sec 6, [2.1]

Replace requirement [2.1.3] by:

2.1.3 The control station of the MOB detection system is to be installed in a continuously manned control station.

Ch 15, Sec 8, [1.2.1]

Replace "MEPC 324(75)" by "MEPC.328(76)" in the first item of the bulleted list in item c).

Ch 15, Sec 8, [1.3.1]

Replace "MEPC 324(75)" by "MEPC.328(76)" in the second item of the bulleted list in item c).

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