KOREAN REGISTER

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Guidance for Prevention Systems of Pollution from Ships

GC-36-E

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APPLICATION OF

"Guidance for Prevention Systems of Pollution from Ships"

1. Unless expressly specified otherwise, the requirements in the Guidance apply to ships for which contracts for construction are signed on or after **July 1st 2025**.
2. The amendments to the Guidance for 2024 edition and their effective date are as follows;

Effective Date 1 January 2025

CHAPTER 5 Wind Assisted Propulsion Systems

Section 3 Basic Requirements for Wind Assisted Propulsion Systems

- 304. 3 (1) (B) & (3) have been amended.
- 306. 1 has been amended.
- 306. 2 has been newly added.
- 308. 1 has been amended.

Section 4 Additional Requirements for Wind Assisted Propulsion Systems

- 402. 2 has been amended.

CONTENTS

CHAPTER 1 Environmental Protection Ships

Section 1 General

101. General

1. This Chapter applies to the ships classed with the Society or intended to be registered under the Society with the notation, which intended to comply with the environmental protection requirements for design, construction and operation for obtaining the relevant notation.
2. This Chapter determines the level of the environmental protection system of ships based on the application in viewpoints of marine pollution prevention, air pollution prevention, preventing destruction of the ecosystem, ship recycling, and safety management systems.
3. The notation prescribed in **(1)** are classified into the followings.
   (1) **CLEAN1** notation: Ships complying with requirements in **Sec. 2**.
   (2) **CLEAN2** notation: Ships complying with additional requirements of the Society in **Sec. 3**.
   (3) **CLEAN3** notation: Ships complying with additional requirements of the Society in **Sec. 4**.

102. Survey

1. Classification survey
   (1) The documents specified in applicable requirements for each notation are to be submitted to the Society. Certificates are to be issued for ships for conformation to the Convention. In case of ships which is not applied the Convention, statement of compliance from the Society can be provided based on submitted data and documents to confirm compliance with requirements.
   (2) The appropriate installation of all relevant equipment specified in applicable requirements for each notation and the proper provision on board of all relevant documents, procedures and record books are to be confirmed.
2. Periodical survey
   (1) The periodical surveys to maintain the classification are to be carried out at Annual Survey, Intermediate Survey and Special Survey. However, the survey for **MARPOL Annex IV** and **V** is to be carried out at Special Survey and the periodical survey for AFS convention is not required.
   (2) The satisfactory condition of all relevant equipment specified in applicable requirements for each notation and proper maintaining of all relevant documents, procedures and record books are to be confirmed.

Section 2 Environmental Protection Ships (Phase 1)

201. General

1. For obtaining **CLEAN1** notation, the ship is to be in compliance with applicable requirements of **MARPOL Annex I, II, IV, V** and **VI** and AFS, BWM convention or more equivalent to those conventions.
2. The "**CLEAN1**" notation can be applied to the ships when it is complied with this section.
3. The requirements in this section apply to ships for arranging phase 1 of environmental protection system. Ships are to be available the documents of **Table 1.2.1** onboard.

202. Marine pollution prevention

1. All oil tankers of 5,000 tons deadweight or more are to be classed with Emergency Response Service System of the Society or any society which is subject to verification of compliance with QSCS(Quality System Certification Scheme) of IACS.

203. Air pollution prevention

1. The emission of nitrogen oxides from engine is to be complied with **MARPOL Annex VI Reg.13**.
2. The sulphur content of fuel oil used or carried for use on board a ship is to be complied with **MARPOL Annex VI Reg.14**. Alternatively, ratio of emission sulphur dioxide per carbon dioxide (SO_2 (ppm)/CO_2(% v/v)) is to be complied with **IMO Res.MEPC.340(77)**.

204. Preventing destruction of the ecosystem

1. The ships are to have **BWT** and/or **BWE** notation for ballast water management.

Table 1.2.1 Documentation requirements for CLEAN1 notation

Items		Certificate/Statement of Compliance
Marine pollution prevention	Oil (related to MARPOL Annex I)	IOPP Certificate
	Noxious Liquid Substances (related to MARPOL Annex II)	NLS Certificate or IBC/BCH Statement of Compliance
	Sewage (related to MARPOL Annex IV)	ISPP Certificate or Statement of Compliance
	Garbage (related to MARPOL Annex V)	
Air pollution prevention	Emission to air (related to MARPOL Annex VI)	IAPP Certificate
	Energy Efficiency (related to MARPOL Annex VI)	IEE Certificate/ Statement of Compliance
Preventing destruction of ecosystem	Anti-Fouling Systems (related to AFS Convention)	IAFS Certificate/ Statement of Compliance
	Ballast water management (related to BWM Convention)	IBWM Certificate/ Statement of Compliance

Section 3 Environmental Protection Ships (Phase 2)

301. General

1. For applying phase 2 of environmental protection system, in addition to those in **Sec.2**, it shall be complied with requirements in this section. In addition, it shall be complied with the requirements of the relevant agreement with respect to ship recycling, and the ship shall be managed in accordance with the international safety management code.
2. The "**CLEAN2**" notation can be applied to the ships when it is complied with this section.
3. Ships applied **CLEAN2** notation are to be available the documents of **Table 1.3.1** onboard.

302. Marine pollution prevention

1. For machinery spaces, the following requirements are to be complied with:
   (1) Fuel oil tanks, lubricating oil tanks and other oil tanks, which are mechanically filled by pumps, etc., are to be equipped with high level alarm to prevent overfilling.
   (2) Oil filtering equipment for machinery spaces is to be provided with arrangements to ensure that any discharge of oily mixtures is automatically stopped in cases where the oil content of effluents exceeds 15 ppm.
   (3) Drip trays with capacities of at least the following are to be fitted under all vents and filling manifolds for fuel oil tanks, lubricating oil tanks, other oil tanks:
   (A) for vessels less than 1600 gross tonnage: 80 ℓ
   (B) for vessels equal to or larger than 1600 gross tonnage: 159 ℓ

(4) Bilge water management plan is to be place onboard. This plan is to include the following.
(A) Vessel name and class number
(B) Type and size of vessel
(C) Bilge water treatment procedure and system arrangement

2. For cargo area of oil tankers, the following requirements are to be complied with:
(1) Each cargo tank is to be fitted with a high level alarm and an overfill alarm, and the overfill alarm is to be independent of the tank gauging system.
(2) All cargo manifolds are to be fitted with drip trays with means for drainage to a appropriate tank onboard. The drip trays is to have the following capacities:
- length: beyond forward and aft ends of the manifold
- width: at least 1,800 mm, though such that the spill tray extends at least 1,200 mm outboard of the end of the manifold flange
- depth: minimum depth 300 mm

(3) Coamings are to be fitted on deck in accordance with **Pt 8, Ch 2, 401. 6** of the **Rules for the Classification of Steel Ships**.
(4) Requirements in **Pt 7, Ch 1, 1002. 7 (4)** of the **Rules for the Classification of Steel Ships** are to be complied with.

3. All oil tankers of 5,000 tons deadweight or more are to have **ERS** notation.

4. NLS tankers defined in **MARPOL Annex II/16.9** are to be comply with the following requirements.
(1) All cargo manifolds are to be fitted with drip trays with means for drainage to a appropriate tank onboard. The drip trays is to have the following capacities:
- length: beyond forward and aft ends of the manifold
- width: at least 1800 mm, though such that the spill tray extends at least 1200 mm outboard of the end of the manifold flange
- depth: minimum depth 300 mm

(2) Coamings are to be fitted on deck in accordance with **Pt 7, Ch 6, 307. 7** of the **Rules for the Classification of Steel Ships**.
(3) Piping systems serving permanent ballast tanks are to be independent of piping systems serving cargo tanks and of cargo tanks themselves in accordance with **Pt 7, Ch 6, 305. 1.** of the **Rules for the Classification of Steel Ships**.

5. Sewage system ventilation pipes are to be independent from other ventilation piping systems.

6. A sewage management plan is to be placed onboard. This plan is to include the following.
(1) Vessel name and class number
(2) Diagrams and component description of the sewage system
(3) Instructions for the operation and management of the sewage system

7. The recorded data shall include, as a minimum, date of discharge; quantity of sewage discharge; location and type of reception facility; and for sea discharges, the distance to the nearest land and the vessel's speed.

8. A garbage management plan in accordance with **IMO Res.MEPC.220(63)** is to be placed onboard.

303. Air pollution prevention

1. The emission of nitrogen oxide from engine is to be complied with **203. 1**. And one or more notations specified in Chapter 2 is to be applied.

2. It is to be complied with **202. 2.** of this chapter with respect to sulphur oxide. And notations specified in Chapter 3 is to be applied.

3. Fuel oil management plan is to be placed onboard. This plan is to include the following.
(1) Vessel name and class number
(2) fuel oil quality complying with **MARPOL Annex VI/18.3**
(3) Those vessels using separate fuels when entering or leaving an ECA are to include in the fuel oil management plan the following:
(A) Procedures on how to perform the fuel oil changeover
(B) Diagrams of the fuel oil system including details of change over
(C) Methods and means of recording volume of low-sulfur fuel oils in tanks, and date, time, and

position of the vessel when any operation of fuel oil changeover

4. Refrigerating facilities and air-conditioning equipment using ozone depleting substances are to comply with the following.
   (1) Annual refrigerant leakage is to be not more than 10 % in mass(kg) of the total refrigerant charge of each system.
   (2) At least one gas detector is to be provided to spaces into which the refrigerant in facilities could leak. The detection is to give an visible and audible alarm in a manned location when the refrigerant concentration exceeds a predetermined limit(for example, 25 ppm for ammonia or 300 ppm for halogenated fluorocarbons).
   (3) For refrigerant recovery, refrigerant compressors are to be capable of evacuating a system charge into an storage container and capacity of this storage container is to be at least 125 % of the largest volume of discharged refrigerant.
   (4) A Ozone depleting substances management procedures is to be placed onboard if necessary. This procedure is to include:
      (A) Vessel name and class number
      (B) Diagrams and component description of all refrigerant systems
      (C) Procedures detailing the means to control the loss, leakage, venting, and disposal of refrigerants
      (D) Methods and means of recording refrigerant inventory
         (a) Supply of refrigerant onboard
         (b) Discharge of refrigerant to the atmosphere due to leaks or system maintenance
         (c) Recovered refrigerant including its storage location
         (d) Refrigerant disposal to land-based reception facilities
      (E) Refrigerants data sheet
      (F) Specification of fire fighting systems, including data sheet for extinguishing media
5. Portable and fixed fire extinguishing systems are not to include halon 1211, 1301, 2402 and perfluorohydrocarbons.
6. Where installed onboard, incinerators are to be type-approved in accordance with **IMO Res.MEPC.76(40)** or **Res.MEPC.244(66)** whichever is applicable to the ship.

Table 1.3.1 Documentation requirements for CLEAN2 notation

Items		Plans and documents to be submitted		Certificate/ Statement of Compliance
		For approval	For information *(2018)*	
Marine pollution prevention	Oil (related to MARPOL Annex I)	Arrangement for cargo and oil loading and discharge manifold, including drip trays and drainage systems	(1) Bunkering procedures (2) Bilge water management plan	
	Noxious Liquid Substances (related to MARPOL Annex II)	Arrangement for cargo and oil loading and discharge manifold, including drip trays and drainage systems		
	Sewage (related to MARPOL Annex IV)		Sewage management plan	
	Garbage (related to MARPOL Annex V)		Garbage management plan	
Air pollution prevention	Emission to air (related to MARPOL Annex VI)	Piping diagram for refrigeration and air conditioning systems	(1) Fuel oil management plan (2) Ozone depleting substances management procedure, if necessary	
Preventing destruction of the ecosystem	Anti-Fouling Systems (related to AFS Convention)		Biofouling management plan	
Ship recycling	Ship recycling (related to Ship Recycling Convention)			IIHM Certificate/ Statement of Compliance
Safety management system	Safety management system (related to ISM Code)			SMC

Section 4 Environmental Protection Ships (Phase 3)

401. General

1. For applying phase 3 of environmental protection system, in addition to those in Sec.3, it shall be complied with requirements in this section.
2. The "**CLEAN3**" notation can be applied to the ships when it is complied with this section.
3. Ships applied **CLEAN3** notation are to be available the documents of **Table 1.4.1** onboard.

402. Marine pollution prevention

1. Oil filtering equipment is to be provided with automatic stopping arrangements are to be provided for any discharge of oily mixtures when the oil content in the effluent exceeds 5 ppm.
2. Lubricating oil tanks and hydraulic oil tanks are to comply with the requirements of **MARPOL Annex I/12A**.
3. NLS tankers defined in **MARPOL Annex II/16.9** are to be comply with the following requirements.
   (1) The arrangements of cargo tanks are to comply with the double hull and double bottom requirements of a Type 2 ship specified in **Pt 7, Ch 6, 206. 1. (2)** of the **Rules for the Classification of Steel Ships** unless a Type 1 ship is to comply with requirements of a Type 1 ship.
   (2) Gauging systems for cargo tanks are to be of closed device specified in **Pt 7, Ch 6, 1301. 1. (3)** of the **Rules for the Classification of Steel Ships**.
4. Ships are not to dispose of food wastes into the sea except when they have been passed through a comminuter or grinder.

403. Air pollution prevention

1. Refrigerants and Fire-extinguishing Medium used onboard are to be of the following.
   (1) Ozone depleting potential(ODP) = 0
   (2) Global warming potential(GWP) 〈 2000
2. Tankers carrying crude oil or petroleum product with flash point less than 60℃ are to have **VEC2** notation.
3. At least one incinerator is to be installed onboard and is to be type approved in accordance with **IMO Res.MEPC.76(40)** or **Res.MEPC.244(66)**.

Table 1.4.1 Additional documentation requirements for CLEAN3 notation

Items		Plans and documents to be submitted		Certificate/ Statement of Compliance
		For approval	For review	
Marine pollution prevention	Oil	Arrangements of tanks which are to be protected in accordance with **402. 2** of Oil item		Type approval certificate of oil filtering equipment in accordance with **402. 1** of Oil item(1)
Air pollution prevention	Emission to air			Type approval certificate of incinerator in accordance with **403. 3** of Emission to air item

Note
(1) When oil filtering equipment is not applied Type approval in accordance with 402.1, it should get the Statement of Compliance published by this Society after confirmation compliance with requirements. *(2022)*

CHAPTER 2 Nitrogen oxide Emission Abatement Systems

Section 1 General

101. General

1. This Chapter applies to nitrogen oxide emission abatement system to control of emitted amount of nitrogen oxide (hereinafter NOx) to the atmosphere through engines installed on ships.
2. Amount of emitted NOx via nitrogen oxide emission abatement system is to be complied with **Reg.13 of MARPOL Annex VI**, taking into account operating environment of installed ship.
3. NOx emission abatement system can comply with the designed amount of emission in accordance with above 2 by passing selective catalytic reduction device, exhaust gas recirculation system, or adjusting combustion condition.
4. Where considered necessary by the Society, the requirements in this Chapter can be applied correspondingly to systems other than those intended for reducing NOx emissions.

102. Notation

1. Ships equipped with the NOx emission abatement system specified in **101. 3** shall be applied the "**CEmN**" notation.
2. Additional notation is to be applied in accordance with mechanism of NOx emission abatement system as follow:
   - CEmN-SCR : Ships equipped with selective catalytic reduction system conformed to **Sec. 2**
   - CEmN-EGR : Ships equipped with exhaust gas recirculation system conformed to **Sec. 3**
   - CEmN-E&F : Ships reducing emission of NOx by adjusting combustion environment and/or fuel used in engines without a separate NOx emission abatement system
3. When multiple NOx emission abatement systems are applied, the additional notations in **102. 2** can be specified side-by-side.
   For example, notation "CEmN-E&F, EGR" is applied, if ship is complied with the **Reg.13.4(Tier II) of MARPOL Annex VI** by adjusting combustion environment and/or fuel used in engines and the **Reg.13.5(Tier III) of MARPOL Annex VI** is complied by using exhaust gas recirculation system.

Section 2 Selective Catalytic Reduction(SCR) system

201. General

1. Application

(1) This Section applies to the Selective Catalytic Reduction(hereinafter SCR) system, reductant agent tanks and piping systems of reductant agents, etc. using urea (e.g. AUS 40 - aqueous urea solution specified in **ISO 18611-1:2014**) or ammonia solutions as the reductant agents to reduce NOx emission from engines. In cases where agents other than those mentioned above are used, they are to be as deemed appropriate by the Society in a viewpoint of corrosion, fire, and human safety.
(2) This Section covers the safety requirements for the installation of SCR system.
(3) As separate from requirements in this Section, the performance and tests, etc. related to SCR systems to reduce NOx emission are to comply with requirements in Conventions and guidelines such as the **MARPOL Annex VI**, NOx technical code and **IMO Res.MEPC.291(71)** and requirements from administration such as Marine Environment Management Act in Republic of Korea.
(4) Where a ship designed for the reduction of NOx emissions by the use of SCR system is designed, is to be constructed and tested in accordance with this Section, the CEmN-SCR notation is to be assigned.
(5) The requirements of this Section may need to be supported by additional considerations, on a

case by case basis. Designs that are not in compliance with this Section may be approved after evaluation by the Society, provided that it can be demonstrated that the design represents an equal or better level of safety.

2. Definitions

The definitions of terms are to be followed to the **Rules for the Classification of Steel Ships**, unless otherwise specified below.

(1) **SCR system** means a system consisting of a an SCR chamber and a reductant injection system.
(2) **SCR chamber** means an integrated unit, which contains the catalyst blocks, and into which flows exhaust gas and reductant, and which receives the reductant agent supply from the reductant agent injection system.
(3) **Catalyst block** means a block of certain dimension through which exhaust gas passes and which contains catalyst composition on its inside surface to reduce NOx from exhaust gas.
(4) **Reductant injection system** means a system, which consists of the pumps to supply reductant to the nozzles, the nozzles to spray reductant into the exhaust gas stream and control devices of the spray.
(5) **Control system** means a system, which adjust quantity of the reductant agent required depending on the changes of engine load and speed, and which supply to the reductant injection system by compressed air and control the operation of the soot blowing system, includes the system to control the changeable device of exhaust gas.
(6) **Soot blowing system** means a system, which blows soot accumulated inside the catalyst block using the air or steam.
(7) **Ammonia slip** means that ammonia is released into the atmosphere without being completely consumed at the catalytic reaction.

202. Plans and Data

1. Plans and specifications covering the Selective Catalytic Reduction(SCR) system are to be submitted and are, as applicable, to include: *(2023)*

(1) General arrangement of the SCR installation, layout, and systems
(2) Documentation detailing the SCR specification
(3) Documentation demonstrating the **204. 2. (1). (A)** (including recommendation from Engine maker)
(4) Hull plans showing the foundation and attachments
(5) Piping diagram
(6) Diagrams for the control, alarm and safety systems
(7) Details of damper/bypass valves
(8) Documentation detailing the effect on Stability(where necessary)
(9) Investigation table of electrical load analysis

203. (Void) *(2023)*

204. System configuration

1. General

(1) The piping system which may contain ammonia solution and urea solution is to comply with the requirements of the **Rules for the Classification of Steel Ships** in addition to the requirements of this Section.
(2) The control system of the reductant injection system is to be in accordance with the requirements in **Pt 6, Ch 2 of the Rules for the Classification of Steel Ships**, automatic and remote control system is to be in accordance with the requirements in **Pt 9, Ch 3 of the Rules for the Classification of Steel Ships**.
(3) Structural materials used for SCR systems and reductant agent tank construction, together with associated piping, pumps, valves, vents and their component materials, are to be suitable at the temperature and pressure for the reductant agent to be carried.

2. SCR system

(1) SCR chamber

(A) SCR chamber is to be arranged so that the back pressure of the exhaust pipes connecting exhaust pipe end of the stack to the engine does not exceed the allowable back pressure recommended by the engine manufacturer.

(B) Changeable device of exhaust gas piping (By-pass arrangement for Selective Catalytic Reduction system)

(a) In cases where exhaust gas piping system of the engines can be changed over from ordinary exhaust gas piping to piping connected to the SCR system, by-pass arrangements are to be provided for Selective Catalytic Reduction system. *(2022)*

(b) The changeable damper is to be fitted with interlock devices, etc. to prevent the closing of both the exhaust gas piping of ordinary use and the piping supplying exhaust gas to the SCR chamber in the same time.

(c) The changeable damper is to be fitted with the indicators showing the exhaust gas piping being used.

(C) Catalyst blocks are to be constructed which can be easily replaced. Sufficient space for replacing catalyst blocks is to be provided on board ship.

(D) Consideration is to be given to SCR chambers so that the degradation of catalytic reaction by the adherence of soot, etc. is prevented.

(2) Reductant injection system

(A) Injection control system

(a) Reductant injection system is to be provided with interlock devices so that the reductant solution can not be injected in cases where the temperature of exhaust gas at the inlet of the SCR chamber is below the design temperature specified by the manufacturer.

(b) The amount of injected reductant is to be appropriately controlled depending upon the load of the engines or quantity of NOx emissions in consideration of the temperature of the exhaust gas at the inlet of the SCR chamber.

(c) The amount of injected reductant is to be appropriately controlled in order to prevent from occuring the ammonia slip.

(B) Devices for monitoring amount of injected reductant

Device for monitoring the amount of reductant injected when using the SCR system are to be provided at least one of the monitoring stations for engine (e.g. a bridge if a bridge control system is installed, engine control room, or machine control side).

(C) Injecting position of reductant agents

The reductant is to be injected at the proper positions inside the exhaust gas piping or SCR chamber so that the ammonia gas is able to inflow uniformly.

(D) Safety and alarm devices

The reductant injection system is to be provided with safety and alarm devices to prevent the injection of reductant when the temperature at the outlet of engines or the inlet of the SCR chamber exceeds the preset level in order to avoid any self-ignition of ammonia gas caused by an abnormal rise in exhaust gas temperature.

(3) Storage and Supply system of reductant agents

(A) Construction and Arrangement

(a) Compartment excluding machinery spaces provided with reductant agent storage tanks (excluding solid urea storage tanks) and reductant injection systems, etc. are not to be adjacent to accommodation spaces, service spaces or control stations.

(b) Piping systems for the supply, transfer, injection or discharge of the reductant agent are not to pass through accommodation spaces, service spaces or control spaces.

(c) Piping systems for the supply, transfer, fill, or discharge of the reductant agent are not to pass through liquid storage tanks.

(d) The supply and transfer pipes of reductant agents, other than the reductant agent injection nozzles, are not to be located immediately above or near units of high temperature including boilers, steam pipelines and exhaust manifolds, silencers or other equipment required to be insulated as specified in **Pt 8, Ch 2, 102. 6 of the Rules for the Classification of Steel Ships**. As far as practicable, supply and transfer pipes are to be arranged far apart from hot surfaces, electrical installations or other sources of ignition and are to be screened or otherwise suitably protected to avoid reductant agent spray or leakage onto the sources of ignition.

(e) Drain trays of adequate size are to be provided at a position which is lower than the re-

ductant agent storage tanks, reductant injection systems and etc. in the SCR system compartment so that reductant agent does not leak outside the compartment.

(B) Closing and Shut-off devices

(a) Shut-off devices are to be provided with the reductant agent supply pumps. Such devices are to be installed outside of the space concerned, where they will not be cut off in the event of fire in the space they serve, in addition to being installed inside such space.

(b) In cases where exhaust gas heating devices which are fitted with burners and blowers are installed, burners and air supply systems are to be provided with shut-off devices capable of being operated from outside the spaces in case of a fire, in addition to those installed inside the space.

(4) Exhaust gas heating device

(A) General

In cases where exhaust gas heating devices are installed in order to raise the temperature of the exhaust gas from engines, the requirements in this Section are to be complied with. Exhaust gas heating devices which are not equipped with burners are to conform to requirements deemed appropriate by the Society.

(B) Construction and Arrangement

(a) Exhaust gas heating devices are to be arranged so that the pressure in exhaust gas pipes does not exceed the allowable back pressure recommended by the engine manufacturer.

(b) Suitable means are to be taken to prevent the frame of the burner from coming in direct contact with the exhaust gas from the engines.

(c) Suitable means to prevent the accumulation of unburnt fuel from engines in exhaust gas heating devices when the SCR system is not in use or to prevent the unburnt fuel from engines from exploding when the burner is injected are to be taken. In cases where the damper is installed in the flue gas line of the exhaust gas heating device, indicators are to be provided local to the damper showing whether they are open or shut.

(d) Temperature measuring devices of the combustion gas at the outlet of the exhaust gas heating device or of the exhaust gas at the inlet of SCR systems are to be provided.

(e) Air supply system of adequate capacity is to be provided so that the temperature of the exhaust gas rises to the required level.

(f) Means to clean and inspect the combustion chambers and gas flue lines of exhaust are to be provided.

(g) The construction and control of burners are to comply with the requirements in the following :

(ⅰ) The fuel supply is to be appropriately controlled so that the temperature of the exhaust gas from engines is heated to a temperature on which the catalytic agent is able to activate effectively.

(ⅱ) Combustion chamber is to be pre-purged by air before ignition.

(ⅲ) In cases where an automatic ignition system is installed, the burners are to be arranged so that the fuel supply does not precede the ignition spark.

(ⅳ) In cases where an automatic fuel supply system is installed, the burners are to be capable of controlling the amount of fuel supplied.

(ⅴ) In cases where an automatic combustion control device is installed, the main burner and pilot burner, etc. are to operate in accordance with designed procedures.

(C) Installation

Exhaust gas heating devices are to be fitted so as to minimize the effects of the following loads or external forces :

(a) Ship motions or any vibrations caused by machinery installations

(b) External forces caused by the piping and supporting members fitted on the exhaust gas heating device

(c) Thermal expansions due to temperature fluctuation

(D) Safety and Alarm devices

(a) Fuel oil shut-off device

Each exhaust gas heating device is to be provided with a safety device which is capable of shutting off automatically the fuel supply to all burners in the case of the following :

(ⅰ) When the temperature of combustion gas at the outlet of the exhaust gas heating device or exhaust gas temperature at the inlet of SCR chamber exceeds the preset

temperature of the normal operation of the SCR system
(ii) When automatic ignition fails
(iii) When the flame vanishes (in this case, the fuel oil supply is to be shut-off with in 4 seconds after the extinguishing of flame)
(iv) When the combustion air supply stop
(v) When the fuel oil supply pressure to the oil burners falls in the case of pressure atomizing, or when the steam pressure to the burners falls in steam atomizing
(vi) When considered necessary by the Society

(b) Alarm device

Each exhaust gas heating device is to be provided with an alarm device which operates in the following cases :

(i) When the temperature of combustion gas at the outlet of the exhaust gas heating device or exhaust gas temperature at the inlet of SCR chamber exceeds the preset temperature of the normal operation of the SCR system
(ii) When combustion air supply reduces, or when the draught fan stops
(iii) When the fuel oil supply pressure to the oil burners falls in the case of pressure atomizing, or when the steam pressure to the burners falls in steam atomizing
(iv) When the flame vanishes
(v) When the power supply to the alarm device stops
(vi) When considered necessary by the Society

205. Handling urea solution as reductant agent

1. Urea solution storage tank

(1) The storage tank is to be arranged so that any leakage will be contained and prevented from making contact with heated surfaces. All pipes or other tank penetrations are to be provided with manual closing valves attached to the tank.
(2) The storage tank may be located within the engine room.
(3) The storage tank is to be protected from excessively high or low temperatures applicable to the particular concentration of the solution. Depending on the operational area of the ship, this may necessitate the fitting of heating and/or cooling systems. The physical conditions recommended by applicable recognized standards (such as **ISO 18611-3:2014**) are to be taken into account to ensure that the contents of the aqueous urea tank are maintained to avoid any impairment of the urea solution during storage.
(4) Where urea based ammonia solution is stored in integral tanks, the following are to be considered during the design and construction:
(A) These tanks may be designed and constructed as integral part of the hull, (e.g. double bottom, wing tanks).
(B) These tanks are to be coated with appropriate anti-corrosion coating and cannot be located adjacent to any fuel oil and fresh water tank.
(C) These tanks are to be designed and constructed as per the structural requirements applicable to hull and primary support members for a deep tank construction.
(D) These tanks are to be included in the ship's stability calculation.
(5) Each urea storage tank is to be provided with temperature and level monitoring arrangements. High and low level alarms together with high and low temperature alarms are also to be provided.
(6) Urea storage tanks are to be arranged so that they can be emptied of urea, and ventilated by means of portable or permanent systems. *(2020)*
(7) The Society may consider the acceptance of relaxations of requirements on **205.** for additionally installed SCR reductants tanks for the operation of SCR with volume below of 500 L. *(2024)*

2. Ventilation *(2020)*

(1) If a urea storage tank is installed in a closed compartment, the area is to be served by an effective mechanical ventilation system of extraction type providing not less than 6 air changes per hour which is independent from the ventilation system of accommodation, service spaces, or control stations. The ventilation system is to be capable of being controlled from outside the compartment. A warning notice requiring the use of such ventilation before entering the compartment shall be provided outside the compartment adjacent to each point of entry. Alternatively, where a urea storage tank is located within an engine room a separate ventilation

system is not required when the general ventilation system for the space is arranged so as to provide an effective movement of air in the vicinity of the storage tank and is to be maintained in operation continuously except when the storage tank is empty and has been thoroughly ventilated. *(2020)*

(2) The requirements specified in (1) also apply to closed compartments normally entered by persons:

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

(B) When the urea piping systems pass through these compartments, unless the piping system is made of steel or other equivalent material with melting point above 925 ℃ and with fully welded joints.

3. Piping system and venting system of urea solution storage tank

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

(2) Reductant tanks are to be of steel or other equivalent material with a melting point above 925℃. Pipes/piping systems are to be of steel or other equivalent material with melting point above 925℃, except downstream of the tank valve, provided this valve is metal seated and arranged as fail-to-closed or with quick closing from a safe position outside the space in the event of fire; in such case, type approved plastic piping may be accepted even if it has not passed a fire endurance test. Reductant tanks and pipes/piping systems are to be made with a material compatible with reductant or coated with appropriate anti-corrosion coating. *(2020)*

(3) Material requirement "to be of steel or other equivalent material" in (2) with a melting point above 925 degrees C is not applicable for integral tanks on FRP vessels, provided that the integral tanks are coated and/or insulated with a self-extinguishing material. *(2022)*

(4) FRP vessels complying with Regulation 17 of SOLAS Chapter II-2 based upon its associated **IMO guidelines (MSC.1/Circ.1574)**. And FRP vessels exempted from the application of SOLAS e.g., yachts, fast patrol, navy vessels, etc., subject to yacht codes or flag regulations. *(2022)*

4. Safety & Protective equipment

(1) For the protection of crew members, the ship is to have on board suitable protective equipment such as large aprons, rubber gloves with long sleeves, rubber boots, coveralls of chemical-resistant material, and tight-fitting chemical safety goggles or face shields or both. And, the quantity to be supplied is to be at least two sets. Eyewash are to be provided, the location and number of these eyewash stations are to be derived from the detailed installation arrangements. *(2022)*

(2) Eyewasher is to be provided near the bunker manifold and the process fluid transfer pump. If several bunker manifolds are installed on the same deck, one could be installed if the bunker manifold can be easily accessed to eyewasher from the bunker manifold. The treatment fluid transfer pump can be applied in the same manner as the bunker manifold. *(2020)*

206. Handling ammonia solution as reductant agent

1. General

(1) Aqueous ammonia (28% or less concentration of ammonia) is not to be used as a reductant in a SCR except where it can be demonstrated that it is not practicable to use a urea based reductant.

(2) Anhydrous ammonia (99.5% or greater concentration of ammonia by weight) is not to be used as a reductant in a SCR except where it can be demonstrated that it is not practicable to use a urea based reductant and where the Flag Administration agrees to its use. Where it is not practicable to use a urea reductant then it is also to be demonstrated that it is not practicable to use aqueous ammonia. *(2022)*

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

2. Construction and Arrangement

(1) The independent compartment where ammonia solution storage tanks or ammonia solution in-

jection systems, etc. are installed(hereinafter referred to as **"ammonia solution installation compartment"**) is to comply with the requirements in **Pt 9, Ch 1, 404. 1** of the **Rules for the Classification of Steel Ships**.

(2) Where ammonia solution is transferred to the tanks which form part of the ship's hull, the following are to be complied with :

(A) Requirements for both installation and design of the tank types are to comply with the requirements in **Pt 7, Ch 6, Sec 4** of the **Rules for the Classification of Steel Ships**. In the guidance, the word "cargo" means ammonia solution.

(B) For location of the tanks, the vertical extent is to comply with the requirements in **Pt 7, Ch 6, 205. 1 (2)** of the **Rules for the Classification of Steel Ships**. And nowhere less than 760mm from the shell plating.

(C) The segregation of other spaces is to comply with the requirements in **Pt 7, Ch 6, 301. 1** of the **Rules for the Classification of Steel Ships**.

3. Materials

(1) Materials capable of highly corrosion(copper, zinc, cadmium, or their alloys) and materials containing mercury are to be not used at locations where ammonia comes in contact.

(2) Nickel steel is not to be used in pressure vessels and piping systems.

(3) Cast-iron valves are not to be used in the reductant agent piping system.

4. Ventilation

(1) Ventilation systems in the ammonia solution installation compartment are to comply with the requirements in **Pt 9, Ch 1, 405. 2** of the **Rules for the Classification of Steel Ships**.

(2) In cases where the required air flow is not established and maintained by the exhaust ventilation system, ammonia solution supply pumps are to stop automatically and main valves of ammonia solution tanks are to close automatically.

5. Ammonia solution piping system

Ammonia solution pipes are to be classified into Class I piping specified in **Pt 5, Ch 6** of the **Rules for the Classification of Steel Ships**.

6. Drain tanks

(1) Drain tanks which comply with the following are to be installed at a lower position than ammonia solution installation compartments.

(A) In cases where the drainage accumulated in the tank is to be discharged overboard, it is to be diluted or neutralized before discharge.

(B) An drain trap is to be arranged to prevent the reverse flow of the gas from the tanks.

(2) All the vent pipes of the tank are to be connected to the exhaust pipe of the ventilation system.

7. Venting systems of ammonia solution storage tanks

Each ammonia solution storage tank is to be fitted with a controlled tank venting system complying with the requirements in **Pt 7, Ch 6, 803.** of the **Rules for the Classification of Steel Ships**. Where, the word "cargo" means ammonia solution.

8. Ammonia solution supply system

(1) Ammonia solution supply piping is not to pass through accommodation spaces, service spaces or control stations. Ammonia solution supply piping may pass through spaces other than ones in spaces above provided they comply with the following: *(2022)*

(A) Ammonia solution supply piping is to be installed within a ventilated pipe or duct. The air space between the ammonia solution supply piping and the inner wall of this pipe or duct is to be equipped with mechanical exhaust ventilation having a capacity of at least 30 air changes per hour. The ventilation system is to be arranged to maintain a pressure less than the atmosphere pressure. The fan motors are to be placed outside the ventilated pipe or duct.

(B) The ventilation outlet is to be installed at the location specified in **Pt 9, Ch 1, 405. 2.** (1) (C) of the **Rules for the Classification of Steel Ships**.

(C) The ventilation system may double as the one required for ammonia solution installation compartments. In this case, the capacity of the system is to be of 30 air changes per hour for both the ammonia solution installation compartment and the space specified in above (A).

(D) Continuous gas detection is to be provided to indicate leaks and to shut down the ammonia

solution supply to the machinery space.

(E) Ammonia solution supply pumps are to stop automatically and main valves of ammonia solution tanks are to close automatically, if the required air flow in not established and maintained by the exhaust ventilation system.

(F) If ammonia solution leak occurs, the ammonia solution supply is not to be restored until the leak has been found and repaired. Warning notices to this effect are to be placed in a prominent position in the machinery spaces.

(G) Ammonia solution leaked from ammonia solution supply pipes is to be led to drain tanks in 6. This drain tank can double as tanks which accumulate ammonia solution leaked from ammonia solution installation compartments.

(2) The ammonia solution supply pipes arranged in ammonia solution installation compartments need not comply with the requirements specified in above (A).

9. Ammonia solution discharge system

(1) When it is necessary to remove the ammonia solution inside pipes for repairs to any leaking areas of the pipes, ammonia solution discharge piping is to be equipped with a means to temporarily discharge ammonia solution remained in the pipes to tanks.

(2) In cases where a drain tank is used as a means specified (A) above, the following are to be complied with:

(A) Discharge piping is to be installed from the bottom of ammonia solution supply piping to a drain tank, and a stop valve is to be fitted for the discharge piping.

(B) The capacity of the drain tank is to be sufficient to storing the maximum volume of ammonia solution which can remain in the pipes from the main valve of ammonia solution tank to the injection nozzle. Drain tanks are to be equipped with a sounding device.

10. Filling pipes of ammonia solution tank

(1) Filling pipes of ammonia solution storage tank from outboard are to be of exclusive use and to be led above decks as far as possible, and to be provided with a shut-off valve and a blank flange at their open ends. This piping is to be fitted at least 760mm inboard on the open deck and to be identified definitely.

(2) Fixed drip trays or portable drip trays are to be provided below the open end of the ammonia solution filling piping.

(3) Ammonia solution filling piping is to be installed on top or near the location of the ammonia solution storage tanks.

(4) Ammonia solution filling pipes are to be arranged to prevent the emission of gas remaining in the line after use or when not in use.

11. Gas detection and alarm system

(1) Gas detection and alarm systems are to be provided in ammonia solution installation compartments, spaces adjacent to ammonia solution storage tanks which form part of the ship's hull and the empty spaces in the double wall pipes or ducts specified in 8. (1) (A) above complying with the following requirements :

(A) The gas detector complying with the requirements given below, is to be installed on the upper-side of each ammonia solution installation compartment and at the ventilation outlet of the double wall pipes or ducts.

(a) The detectors are to activate an alarm when the gas concentration exceeds 25 ppm.

(b) When the gas concentration exceeds 300 ppm, the detector is to automatically stop the ammonia solution supply pumps, automatically close the main valves of ammonia solution storage tanks, and activate the alarm.

(B) Regardless of above (A), in cases where mechanical ventilation system for double wall pipes or ducts doubles as the one for the ammonia solution installation compartment, the gas detection and alarm system required for the double wall pipes or ducts may double as the one for the ammonia solution installation compartment.

(C) At least one portable gas detection instrument is to be provided for each ammonia solution installation compartment.

(D) The alarm systems are to generate visible and audible alarms near the doors, within and outside the ammonia solution installation compartment and at monitoring locations.

(E) A manually-operated transmitter for leakage warnings is to be provided, near the doors and outside the ammonia solution installation compartment.

(2) Gas detection and alarm system complying with the following requirements are to be provided in

passages leading to the ammonia solution installation compartment.
(A) The gas detectors are to activate the alarm system when the gas concentration exceeds 25 ppm.
(B) The alarm systems are to generate visible and audible alarms in the passage and near the doors of the ammonia solution installation compartment.
(3) Detectors are to be capable of continuous detection and considered to be appropriate by the Society.

12. Safety and protective equipment

Ammonia solution installation compartments are to be provided with the safety and protective equipments complying with the requirements in **Pt 9, Ch 1, 408.** of the **Rules for the Classification of Steel Ships**, in cases where ammonia solution is used as the reductant agent.

207. Survey and Test

1. General

(1) These requirements apply to shop test and onboard test of EGC systems and associated systems. Following tests may be incorporated with the tests required by **Pt 5, Ch 2, 211.** of the **Rules for the Classification of Steel Ships**.

2. Test

(1) Inspection and verification that the foundations and attachments of the principal components of the SCR equipment and associated systems are in accordance with the approved plans and particulars.
(2) Piping systems are to be examined and tested in accordance with **Pt 5, Ch 6, Sec.14** of the **Rules for the Classification of Steel Ships**.
(3) Electrical equipments are to be examined and tested in accordance with **Pt 6, Ch 1** of the **Rules for the Classification of Steel Ships**.
(4) Instrumentation is to be tested to confirm proper operation as per its predetermined set points.
(5) Pressure relief and safety valves installed on the unit are to be tested.
(6) Control system and shutdowns are to be tested for proper operation.

208. Periodical Surveys

1. General

For items not specified in this Section, the relevant requirements specified in **Pt 1** of the **Rules for the Classification of Steel Ships** apply.

2. Annual Survey

Annual surveys are to be included.

(1) External examination of all components, including SCR reaction chamber, injectors, chemical store/supply, heating, tanks, pumps, valves, piping, etc.
(2) Performance test of the instrumentation, control, monitoring, and safety equipment including indicators and alarms.
(3) Performance test of Changeover devices of exhaust gas pipes and the corresponding indicator
(4) Operation test of remote shut-off devices for reductant agent storage tank valves
(5) General examinations of safety and protective equipment
(6) Performance test of Safety Eyewash
(7) Warning notices as per **206.** *(2023)*

3. Intermediate Survey

Requirements as required by the Annual Survey in **2** above are to be surveyed.

4. Special Survey

In addition to all the requirements for Annual Survey, the following items are to be surveyed.

(1) The opening of pumps, exhaust fans and blowers
(2) Internal examination of reductant agent storage tanks and SCR reaction chamber
(3) Operation test of control valves

Section 3 Exhaust Gas Recirculation(EGR) System

301. General

1. This Section is to apply to Exhaust Gas Recirculation(hereinafter EGR) system and their auxiliary systems reducing engine NOx emissions and deals with safety requirements for the arrangement of the system.
2. For items not specified in this Section, the relevant requirements specified in **Pt 5** of the **Rules for the Classification of Steel Ships** apply.
3. As separate from requirements in this Section, the performance and tests, etc. related to EGR system to reduce NOx emission are to comply with requirements in Conventions and guidelines such as the **MARPOL Annex VI** and NOx technical code, and requirements from administration such as Marine Environment Management Act in Republic of Korea.
4. The requirements of this Section may need to be supported by additional considerations, on a case by case basis. Designs that are not in compliance with this Section may be approved after evaluation by the Society, provided that it can be demonstrated that the design represents an equal or better level of safety.

302. Notation

1. Where a ship designed for the reduction of NOx emissions by the use of Exhaust Gas Recirculation system is designed, constructed and tested in accordance with this Section, the **CEmN-EGR** notation of **Table 2.3.1** is to be assigned.
   (1) Where a ship provided EGR system that incorporate engine systems that are designed for the purposes of removing the sulfur by-products from the exhaust gases that originate from the fuel and incorporate, for example, water scrubbing and water cleaning systems, the **CEmN-EGR** is to be assigned.
2. In addition to **CEmN-EGR, CEmN-EGR(R)** and/or **(S)** may be additionally assigned if the relevant requirements are met.

Table 2.3.1. Class Notation of EGR

No.	Notation	relevant requirements
1	**CEmN-EGR**	All requirements of **Section 3 EGR** excluding the relevant requirements of No. **2** and **3** of this table
2	**CEmN-EGR(R)**	In addition to requirements of **CEmN-EGR**, redundancy requirements (Provisions of **305. 3**)
3	**CEmN-EGR(S)**	In addition to requirements of **CEmN-EGR**, test and survey requirements (Items **2~6** of **Table 2.3.3**)

303. Plans and Data

1. Plans and specifications covering the EGR arrangements are to be submitted and are, as applicable, to include: *(2023)*
   (1) General arrangement of the EGR installation, layout, and systems
   (2) Documentation detailing the EGR specification
   (3) Hull plans showing the foundation and attachments
   (4) Piping diagram
   (5) Diagrams for the control, alarm and safety systems
   (6) Data describing the identification of hazards associated with the design and operation of the EGR system and the means of safeguard or control thereof (where necessary)
   (7) Documentation detailing the effect on Stability (where necessary)
   (8) Investigation table of electrical load analysis

304. *(Void) (2023)*

305. EGR System Configuration

1. General

(1) Exhaust Gas Recirculation is the process of recirculating a portion of the engine exhaust gases back to the engine cylinders for the purpose of reducing the amount of excess oxygen within the cylinder and thereby reducing engine NOx emissions.

(2) EGR systems are to be designed to enable continued operation of the engine at the times the EGR system is not in operation, either through operational selection, equipment failure, or system deterioration through partial blocking/clogging.

2. Compatibility with the Engine

(1) Installation and operation of the EGR system is to be compatible with the engine and not to cause any adverse effects on the engine performance such as excessive back pressures or temperatures during operation.

(2) The range of suitable fuels for which the EGR system is capable of continual operation, in particular with respect to sulfur content and other fuel elements known to cause fouling issues, is to be declared by the EGR manufacturer and included in the EGR specification documentation and instruction manuals.

3. Redundancy *(applicable when only the "***CEmN-EGR(R)***" class notation of Table 2.3.1) (2020)*

(1) Redundancy of equipment is to be provided for those rotating and reciprocating components that form part of the EGR essential supplementary systems, such as pumps, fans, blowers, etc.

(2) Consideration will be given to alternative means of compliance or operation to meet above (1) on a case-by-case basis. As applicable, documentation is to be submitted demonstrating that the reliability of the system or component provides continued serviceability of the exhaust emission abatement system or the alternative means of operation provides continued compliance with the statutory environmental requirements, without compromising the vessel propulsion and maneuvering capability.

(3) Unless alternative means of compliance in accordance with above (2) are applicable, redundant washwater pumps, dosing pumps, discharge pumps, etc., essential for the continual operation of the EGR water systems, are to be provided. There are to be at least each two of these essential pumps, the capacity of the pumps, with any one pump out of service, is to be sufficient for continuous operation of the exhaust emission abatement system at full rating.

(4) Where ships fitted with two or more identical exhaust emission abatement systems, the provision of a common standby pump(for each essential system) capable of serving all EGR units will suffice rather than providing individual standby pumps for each EGR unit.

(5) Unless alternative means of compliance in accordance with above (2) are applicable and where exhaust fans or blowers form part of the EGR system and are essential for continual operation of the exhaust emission abatement system at full rating, such fans or blowers are to be installed in a redundant arrangement. The number and power of the fans or blowers should be such that if one unit, or group of units, is out of service the capacity of the remaining units is not to be less than 100% of the total required.

(6) If the Society considers that the redundancy of the pump and blower (including the exhaust fan) required above is acceptable to the Society, the provision of spare parts made up of rotating parts, including motors and bearings may be permitted.

4. Prevention of Flooding

(1) For EGR systems that incorporate a wet washwater scrubbing process, arrangements are to be provided to prevent the ingress of scrubber washwater into the engine under any circumstance.

(2) Monitoring, alarm, and shutdown arrangements are to be provided to prevent an abnormal rise of washwater level in the EGR scrubber unit.

5. EGR is to be designed for proper operation at the inclination requirements specified in **Pt 5, Ch 1, 103. Table 5.1.2** of the **Rules for the Classification of Steel Ships**.

306. EGR System Equipment

1. Pumps/Blowers

(1) Where the notation "**CEmN-EGR(S)**" is applied, blowers and pumps used in EGR SOx scrubber washwater, dosing, discharge systems which are essential for the continual operation of the

EGR exhaust emission abatement system, are to be tested and certified in accordance with the relevant requirements of **Pt 5, Ch 1, 210 & Ch 6.** *(2020)*

2. Heat Exchangers/EGR Exhaust Gas Coolers

(1) Where provided, heat exchangers are to comply with the requirements specified in **Ch 5, Sec. 3** of the **Rules for the Classification of Steel Ships**.

3. Electrical System

For items not specified in this Section, the relevant requirements specified in **Pt 6** of the **Rules for the Classification of Steel Ships** apply.

(1) Electrical Motors and controlgears for motors
Motors and controlgears for motors, where class notation **CEmN-EGR(S)** is applied, are to be ceritified in accordance with the relevant requirements specified in **Pt 6** of the **Rules for the Classification of Steel Ships**. *(2022)*

(2) Standby Pump/Fan
Where redundancy is provided according to the **305. 3. (1)**, In the event of failure of the essential exhaust emission abatement system pumps or fans/blowers, the standby pump or fan/blower is to be automatically started and put into service. This failure is to be alarmed at the local and remote control stations. *(2020)*

(3) Circuit Protection Devices
Circuit breakers are to be installed for miscellaneous EGR system electrical loads and are to be compatible with the prospective short circuit current level calculated at the switchboards.

307. EGR System Piping

1. Exhaust Gas Piping Systems

(1) Exhaust Gas Piping/Scrubber Materials and Installation
(A) Exhaust gas piping materials located before the EGR scrubber, where fitted, may be of the same material specification as the standard engine exhaust gas piping.
(B) The sections of the scrubber that are subjected to washwater (e.g., the interior reaction chamber or washwater piping/nozzles, etc.) are to be constructed of suitable corrosion resistant materials.
(C) Exhaust gas piping materials used after the scrubber unit are to be of a corrosion resistant material such as stainless steel.

(2) Exhaust Gas Piping Valves
(A) Valves used in the EGR exhaust system are to comply with the relevant requirements specified in **Pt 5, Ch 6** of the **Rules for the Classification of Steel Ships**. The valves are to be constructed of corrosion resistant materials.
(B) The EGR exhaust system valves are to be arranged for automatic position control and position monitoring in association with the EGR control and monitoring system.
(C) Valves are to be installed in accessible locations, clear of or protected from obstructions, moving equipment, and hot surfaces, in order to permit regular inspection and periodic servicing.

(3) Insulation
Hot surfaces of EGR systems or their associated equipment or systems likely to come into contact with the crew during operation are to be suitably guarded or insulated. Where the surface temperatures are likely to exceed 220°C and where any leakage, under pressure or otherwise, of fuel oil, lubricating oil or other flammable liquid is likely to come into contact with the EGR unit or exhaust pipes, these surfaces are to be suitably insulated with non-combustible materials that are impervious to such liquids.

2. Washwater Piping

Washwater piping shall comply with **207. 2** of **Chapter 3** of the Guidance. When EGR system is for engines that are to use fuel oil complied with **Regulation 14** of **MARPOL Annex VI**, **207. 2 (3)** of **Ch 3** of the Guidance can be waived. *(2023)*

3. Chemical Storage Tank *(2022)*

Chemical storage tank for washwater system shall comply with **207. 3** of **Chapter 3** of the Guidance. *(2022)*

4. Chemical Treatment Piping Systems

Chemical Treatment Piping Systems using NaOH or $Ca(OH)_2$ in water treatment system shall comply with **207. 4** of **Chapter 3** of the Guidance. *(2022)*

5. Residue System

Residue system shall comply with **207. 5** of **Chapter 3** of the Guidance. *(2022)*

308. System Design

1. General

(1) The EGR control system is to be integrated with, or in direct communication with, the engine control system. Control systems for associated systems, such as water treatment plants, may be connected to an integrated control system or may be a standalone system.

(2) The system is to be designed such that a single fault of a component will not lead to a potentially dangerous situation for human safety and the vessel. Data describing the identification of hazards associated with the design and operation of the exhaust gas recirculation system and the means of safeguard or control is to be submitted. *(2020)*

2. Control and Monitoring System

(1) Automatic control, monitoring, alarm, and safety functions are to be provided for the EGR system so that operations remain within preset parameters for all engine operating conditions. Where vessels are provided with the automation equipment specified in **Pt 9, Ch 3** of the **Rules for the Classification of Steel Ships**, the alarm and monitoring systems are to be integrated in the vessel's centralized monitoring systems.

(2) The temperatures, pressures and flows in the EGR system and associated systems are to be controlled and monitored as follows:

(A) A local control and monitoring system for the EGR system is to be provided to enable safe operation, maintenance, and effective control in the event of an emergency or failure of any remote controls.

(B) The design of the control system is to provide identification of faults in the equipment, as well as the process system. The control and monitoring systems are to comply with the requirements of **Pt 9, Ch 3, 302. 4** of the **Rules for the Classification of Steel Ships**.

(C) Indications of parameters necessary for the safe and effective operation of exhaust gas recirculation system are to be provided at the local and, as applicable, remote control stations, as per Table 2.3.2 of this Section and are to include the following parameters:

(a) EGR system pump/fan/blower/motor operational status

(b) EGR system parameters for operational safety

(c) Level indication of EGR system tanks

(d) Status of any EGR system alarms, shutdowns and Emergency Stop

(D) The computer-based control systems are to comply with the applicable requirements of **Pt 6, Ch 2, Sec. 4** of the **Rules for the Classification of Steel Ships** as a Category II system.

(3) Each control, monitoring and safety system is to be supplied by a separate circuit. Each of these circuits is to be protected from short circuits and monitored for voltage failure.

3. Safety Shutdown System

(1) An independent shutdown system is to be provided. The automatic safety shutdown system is to be based on the following:

(A) Means are to be provided to indicate the parameters causing shutdown.

(B) Upon activation of the safety shutdown system, alarms are to be given at the normal control position and at the local control position.

(C) In the event where shutdown by the safety shutdown system is activated, the restart should not occur automatically, unless after the system is reset manually.

(2) Monitoring and safety shutdowns are to be in accordance with **Table 2.3.2** of this Section.

Table 2.3.2 Monitoring and Safety System Functions for EGR Systems *(2020)*

Parameters	Display	Alarm activated	Automatic EGR Shutdown
EGR exhaust fan/blower motors	Run	Stop	
EGR exhaust bypass, isolation, mixing valves, where provided	Position		
Exhaust gas temperature after EGR unit(except if dry running can be used)	●	H	
Differential pressure across EGR scrubber unit or EGR circuit or pressure before EGR unit(except if dry running can be used)	●	H	HH
EGR washwater pumps, alkali system pumps or dry system supply device	Run	Stop	
EGR washwater and alkali system supply pressure	●	L	
EGR washwater system supply temperature(Closed/Hybrid type)	●	H	
EGR alkali system supply temperature	●	L/H	
Water level in EGR scrubber	●	H	HH
Alkali storage tank temperature		L/H	
Alkali storage tank level	●	L/H	
Alkali system drip tray level		H	
EGR residue tank level	●	H	
Power supply fail of control, alarm, monitoring or safety device		Fail	

309. Survey and Test

1. General

(1) These requirements apply to shop test and onboard test of EGR systems and associated systems. Following tests may be incorporated with the tests required by **Pt 5, Ch 2, 211.** of the **Rules for the Classification of Steel Ships**.

(2) The components of the EGR are to be tested and inspected in accordance with **Table 2.3.3** below.

2. Onboard tests

(1) Inspection and verification that the foundations and attachments of the principal components of the EGR equipment and associated systems are in accordance with the approved plans and particulars.

(2) Piping systems are to be examined and tested in accordance with **Pt 5, Ch 6, Sec.13** of the **Rules for the Classification of Steel Ships.**

(3) Electrical equipments are to be examined and tested in accordance with **Pt 6, Ch 1** of the **Rules for the Classification of Steel Ships**.

(4) Instrumentation is to be tested to confirm proper operation as per its predetermined set points.

(5) Pressure relief and safety valves installed on the unit are to be tested.

(6) Control system and shutdowns are to be tested for proper operation.

Table 2.3.3 Test and Survey for components of EGR *(2022)*

No.	Components	Type approval	Drawing approval	Test and Survey
1	Control panel for EGR	●(6)	●	●
2	Pumps(incl. motors and controlgears for motors)(1),(2)		●(7)	●
3	Blowers(incl. motors and controlgears for motors)(1),(2)		●(7)	●
4	Scrubber body(1),(3)			●
5	Heat exchanger(4)		●(8)	●
6	Storage tank for washwater treatment chemical(1),(5)			●

Note.
(1) For the applicable class notation '**CEmN-EGR(S)**' in **Table 2.3.1**
(2) Components for the continual operation of the EGR are to be tested in accordance with the requirements specified in **Pt 5, Ch 6 & Pt 6** of the **Rules for the Classification of Steel Ships**.
(3) The entire length of both longitudinal and circumferential welded joints and exhaust gas pipe or wash water pipe joints on scrubber body are to be subjected to liquid penetrant testing(PT). Where considered necessary by the Surveyor, additional non-destructive examinations may be required. *(2022)*
(4) It shall be inspected based on the **Rules for the Classification of Steel Ships** of **Pt 5 Ch 5 Sec 3**. *(2022)*
(5) Storage tank that do not form part of the hull are to be subjected to a hydraulic test at a head pressure of 2.5 m on the tank top plate, together with the attachment after manufacture.
(6) Where equipment specified in **Guidance relating to the Rules for the Classification of Steel Ships 6, Ch 1** and **Ch 2, 301.1** is installed, regardless of class notation, the type approval product is to be installed in the control panel.
(7) Only applicable for rated output 100kW and above
(8) Only applicable for PV-1 and PV-2

310. Periodical Surveys

1. General

For items not specified in this Section, the relevant requirements specified in **Pt 1** of the **Rules for the Classification of Steel Ships** apply.

2. Annual Survey

Annual surveys are to be included.

(1) External examination of all components, including scrubber unit, chemical treatment piping/supply unit, washwater, tanks, pumps, valves and piping, etc..
(2) Performance test of the instrumentation, control, monitoring, and safety equipment including indicators and alarms.
(3) Performance test of Changeover devices of exhaust gas pipes and the corresponding indicator
(4) Operation test of Remote shut-off devices for reductant agent storage tank valves if installed
(5) General examinations of safety and protective equipment(refer to **307. 3. (8)**)
(6) Performance test of Safety showers Eyewash if installed
(7) Warning notices as per **307. 4** (refer to **207.4** of **Chapter 3**) *(2023)*

3. Intermediate Survey

Requirements, as required by the Annual Survey in **2.** above, are to be surveyed.

4. Special Survey

In addition to all the requirements for Annual Survey, the following items are to be surveyed.

(1) The opening of pumps, exhaust fans and blowers
(2) Internal examination of chemical storage tank & residue tank if stalled
(3) Internal examination of scrubber
(4) Operation test of control valves ⚓

CHAPTER 3 Sulphur oxide Emission Abatement Systems

Section 1 General

101. General

1. This Chapter applies to sulphur oxide(hereinafter SOx) emission abatement system to use fuel oil containing small sulphur content or to control ratio of emission sulphur dioxide per carbon dioxide (SO2(ppm)CO2(% v/v)) to the atmosphere through engines installed on ships.
2. The containing sulphur content of fuel oil in **1.** is to be complied with the **Reg.14 of MARPOL Annex VI**.
3. Amount of emission ratio via SOx emission abatement systems in 1. is to be complied with **IMO Res.MEPC.340(77)**, taking into account operating environment of installed ship.
4. Where considered necessary by the Society, the requirements in this Chapter can be applied correspondingly to systems other than those intended for reducing SOx emissions.

102. Notation

1. Ships equipped with the SOx emission abatement systems specified in **101. 1** shall be applied the "**CEmS**" notation.
2. Additional notation is to be applied in accordance with mechanism of SOx emission abatement systems as follow:
   - CEmS-EGC : Ships equipped with exhaust gas cleaning system conformed to **Sec. 2**
   - CEmS-LSF : Ships using low sulphur fuel oil complied with **Sec. 4**
3. When multiple SOx emission abatement systems are applied, the additional notations in **102. 2.** can be specified side-by-side.
   For example, notation "**CEmS-EGC, LSF**" is applied when a ship complies with the **Reg.14.1 of MARPOL Annex VI** through exhaust gas cleaning system following Section 2, and satisfies the **Reg.14.4 of MARPOL Annex VI** using low shlphur fuel oil while the ship is operating within an emission control area.
4. For ships with ready for exhaust gas cleaning system, notation is applied in accordance with **Sec. 3**.

Section 2 Exhaust Gas Cleaning(EGC) system

201. General

1. This Section is to apply to arrangements and system design of Exhaust Gas Cleaning(hereinafter EGC) system reducing SOx emissions of fuel oil combustion machinery except incinerator.
2. For items not specified in this Section, the relevant requirements specified in **Pt 5** of the **Rules for the Classification of Steel Ships** apply.
3. As separate from requirements in this Section, the performance and tests, etc. related to EGC system to reduce SOx emission are to comply with requirements in Conventions and guidelines such as the **MARPOL Annex VI** and **IMO Res.MEPC.340(77)** and requirements from administration such as Marine Environment Management Act in Republic of Korea.
4. The requirements of this Section may need to be supported by additional considerations, on a case by case basis. Designs that are not in compliance with this Section may be approved after evaluation by the Society, provided that it can be demonstrated that the design represents an equal or better level of safety.

202. Notation

1. **Table 3.2.1** shows the Class Notation of EGC, and the EGC installed for the purpose as above provisions of **301. 1** is basically given **CEmS-EGC** notation of **Table 3.2.1.** In addition to **CEmS-EGC**, **CEmS-EGC(R)** and/or **(S)** may be additionally assigned if the relevant requirements are met.

Table 3.2.1 Class Notation of EGC

No.	Notation	relevant requirements
1	**CEmS-EGC**	All requirements of **Section 2 EGC** excluding the relevant requirements of item 2 and 3 of Table 3.2.1
2	**CEmS-EGC(R)**	In addition to requirements of **CEmS-EGC**, redundancy requirements (Provisions of **205. 3)**
3	**CEmS-EGC(S)**	In addition to requirements of **CEmS-EGC**, test and survey requirements (Item **4.~ 8.** of **Table 3.2.4)**

2. In addition to **Table 3.2.1**, **D, O, C** or **H** as an additional special feature notation may be assigned to ships according to a type of system. For example, "**CEmS-EGC(R)-O**" is given to ships applying the **CEmS-EGC(R)** class notation with wet open type.

Table 3.2.2 Class Notation according to EGC Type

Class Notation	Type
- D	Dry type
- O	Wet open type
- C	Wet closed type
- H	Wet hybrid type

203. Plans and Data

1. Plans and specifications covering the EGC arrangements are to be submitted and are, as applicable, to include: *(2023)*
   (1) General arrangement of the EGC installation, layout, and systems
   (2) Documentation detailing the EGC specification
   (3) Hull plans showing the foundation and attachments
   (4) Piping diagram
   (5) Diagrams for the control, alarm and safety systems
   (6) Data describing the identification of hazards associated with the design and operation of the exhaust gas cleaning system and the means of safeguard or control thereof (where necessary)
   (7) Documentation detailing the effect on Stability (where necessary)
   (8) Investigation table of electrical load analysis

204. (Void) *(2023)*

205. EGC System Configuration

1. General

(1) EGC systems are to be designed to enable continued operation of the engine at the times the EGC system is not in operation, either through operational selection, equipment failure, or system deterioration through partial blocking/clogging.

(2) The exhaust piping from a number of fuel oil combustion machinery may be led to a common SOx scrubber unit.

2. Compatibility with the Engine

(1) Installation and operation of the EGC system is to be compatible with the engine and not to cause any adverse effects on the engine performance such as excessive back pressures or temperatures during operation.

(2) Details are to be submitted demonstrating the exhaust flow compatibility of the EGC unit with the connected fuel oil combustion machinery over the whole operational range of the fuel oil combustion machinery. This data is to be demonstrate that the operating parameters of the oil burning machinery are not to be exceed the approved design limits with the EGC system in operation. In the case of integrated scrubbers, this compatibility evaluation is to show that the EGC unit is capable of accommodating the maximum combined exhaust flows of all the connected oil burning equipment for the worst case scenario for that particular ship arrangement and operational profile.

(3) Where necessary, consideration will be given to those EGC units that incorporate extractive exhaust fans to maintain the fuel oil combustion machinery operating parameters within the approved design limits. *(2023)*

3. Redundancy *(Applicable when only the* **"CEmS-EGC(R)"** *class notation)*

(1) Redundancy of equipment is to be provided for those rotating and reciprocating components that form part of the EGC essential supplementary systems, such as pumps, fans, blowers, etc.

(2) Consideration will be given to alternative means of compliance or operation to meet above (1) on a case-by-case basis. As applicable, documentation is to be submitted demonstrating that the reliability of the system or component provides continued serviceability of the exhaust gas cleaning system or the alternative means of operation provides continued compliance with the statutory environmental requirements, without compromising the vessel propulsion and maneuvering capability.

(3) Unless alternative means of compliance in accordance with above (2) are applicable, redundant washwater, dosing, discharge, etc., pumps, blowers, essential for the continual operation of the EGC water systems, are to be provided. There are to be at least two of these essential pumps, the capacity of the pumps, with any one pump out of service, is to be sufficient for continuous operation of the exhaust emission abatement system at full rating.

(4) Where ships fitted with two or more identical exhaust emission abatement systems, the provision of a common standby pump (for each essential system) capable of serving all EGC units will suffice rather than providing individual standby pumps for each EGC unit.

(5) Unless alternative means of compliance in accordance with above (2) are applicable and where exhaust fans or blowers form part of the EGC system and are essential for continual operation of the exhaust emission abatement system at full rating, such fans or blowers are to be installed in a redundant arrangement. The number and power of the fans or blowers should be such that if one unit, or group of units, is out of service the capacity of the remaining units is not to be less than 100% of the total required.

(6) If the Society considers that the redundancy of the pump and blower (including the exhaust fan) required above is acceptable to the Society, the provision of spare parts made up of rotating parts, including motors and bearings may be permitted.

4. Exhaust gas by-pass/dry operation

EGC units that incorporate a wet washwater scrubbing process are to be capable of being operated without the washwater system in operation or are to be installed with an exhaust bypass arrangement or changeover system to enable continued operation of the fuel oil combustion machinery in the event the exhaust emission abatement system is not in operation, either through operational selection or equipment failure. As applicable, evidence of material suitability is to be submitted for dry running of SOx scrubbers. Such a device may not be required if the flow of unrestricted exhaust gas is ensured and there is no risk of a failure that results in the stop of the oil burning machinery.

5. Prevention of Flooding

(1) Arrangements are to be provided to prevent the ingress of scrubber washwater into the fuel oil combustion machinery under any circumstance.

(2) Alarm and shutdown arrangements are to be provided to prevent an abnormal rise of washwater level in the EGC scrubber unit.

6. Exhaust gas cleaning systems are to be designed for proper operation at the inclination requirements specified in **Pt 5, Ch 1, 103. Table 5.1.2** of the **Rules for the Classification of Steel Ships**.

206. EGC System Equipment

1. Pumps/Blowers

(1) When the "**CEmS-EGC(S)**" class notation is applied, Equipment required for continuous operation of the EGC, such as rinse water pumps, circulation pumps, exhaust pumps and blowers are certified in accordance with the relevant requirements of **Pt 5, Ch 1, 210** and **Ch 6** of the **Rules for the Classification of Steel Ships**.

2. Heat Exchangers/EGC Exhaust Gas Coolers

(1) Where provided, heat exchangers are to comply with the requirements specified in **Pt 5 Ch 5, Sec. 3** of the **Rules for the Classification of Steel Ships**.

3. Dry scrubber consumable equipment

(1) For dry type exhaust gas cleaning systems, details of the granulate supply and discharge systems are to be submitted.

(2) Unless alternative means of compliance in accordance with 205. 3. (2) of this Section are applicable, drive arrangements for the exhaust cleaning reductant consumable are to be arranged in a redundant arrangement.

4. Electrical Systems

For items not specified in this Section, the relevant requirements specified in **Pt 6** of the **Rules for the Classification of Steel Ships** apply.

(1) Electrical Motors and controlgears for motors
When the "**CEmS-EGC(S)**" class notation is applied, motors and controlgears for motors are to be certified in accordance with the relevant requirements specified in **Pt 6** of the **Rules for the Classification of Steel Ships**.

(2) Standby Pump/Fan
The standby pumps and blowers, where redundancy is provided according to the 205. 3., are to be automatically started and put into service. This failure is to be alarmed at the local and remote control stations.

(3) Circuit Protection Devices
Circuit breakers are to be installed for miscellaneous EGC system electrical loads and are to be compatible with the prospective short circuit current level calculated at the switchboards.

207. EGC System Piping

1. Exhaust Gas Piping Systems

(1) Exhaust Gas Piping/Scrubber Materials

(A) Exhaust gas piping materials located before the EGC SOx scrubber, where fitted, may be of the same material specification as the standard fuel oil combustion machinery exhaust gas piping.

(B) The sections of the scrubber that are subjected to washwater (e.g. the interior reaction chamber or washwater piping/nozzles, etc.) are to be constructed of suitable corrosion resistant materials.

(C) Exhaust gas piping systems after the SOx scrubber unit are to be of a corrosion resistant material such as stainless steel or to be coated with a suitable corrosion resistant materials.

(D) Exhaust gas pipings are to comply with in **Pt 5 Ch 6 Sec 1** and **Sec 6** of the **Rules for the Classification of Steel Ships**.

(2) Exhaust Gas Piping Valves

(A) Valves used in the EGC system are to comply with the relevant requirements specified in **Pt 5, Ch 6** of the **Rules for the Classification of Steel Ships**. The valves are to be constructed of corrosion resistant materials and the valves located at the front of the SOx scrubber may be the same material as the valve of the the oil burning machinery.

(B) Isolation and bypass valves used in EGC system exhaust piping systems are to prevent the passage of exhaust gases to other fuel oil combustion machinery or machinery spaces.

Where bypass arrangements for the SOx scrubber unit are provided, the isolation and bypass valves are to be arranged in an interlocked, fail safe manner, such that free flow of exhaust gases to the atmosphere at all times is possible, either through the scrubber unit or through the bypass. Bypass valves are to be provided with a local position indicator.

(C) Valves are to be installed in accessible locations, clear of or protected from obstructions, moving equipment, and hot surfaces, in order to permit regular inspection and periodic servicing.

(3) Interconnection of exhaust gas piping

(A) Normally, exhaust pipes from engines and flue gas pipes from oil-fired boilers are to be routed separately and not interconnected. However, interconnected exhaust piping systems to a common EGC unit may be accepted subject to the arrangements preventing the passage or leakage of exhaust gases to other equipment or spaces that may then pose a safety risk to that equipment or health risk to the vessel's crew or passengers.

(B) The integrated EGC system is to be designed not to exceed the backpressure limits specified by the connected engines or boilers.

(4) Insulation

Hot surfaces of EGC units or their associated equipment or systems likely to come into contact with the crew during operation are to be suitably guarded or insulated. Where the surface temperatures are likely to exceed 220°C and where any leakage, under pressure or otherwise, of fuel oil, lubricating oil, or other flammable liquid is likely to come into contact with the EGC unit or exhaust pipes, these surfaces are to be suitably insulated with non-combustible materials that are impervious to such liquids.

2. Washwater piping

(1) Piping and Connections

(A) The EGC SOx washwater system pipe fittings and joints are to comply with the requirements specified in **Pt 5, Ch 6** of the **Rules for the Classification of Steel Ships**.

(B) The piping material for the corrosive scrubber washwater system is to be selected based on the corrosive nature of the liquid media.

(C) The means are to be provided to prevent clogging of washwater nozzles.

(2) Remote Control Valves

(A) Upon loss of control power, the remote control valves are to remain in the last ordered position, provided there is a readily accessible manual means to close the valves or are to fail safe

(B) Remote control valves are to be clearly identified and are to be provided with position indicators at the local and EGC system remote control station, as applicable.

(C) Valves are to be installed in accessible locations, clear of or protected from obstructions, moving equipment, and hot surfaces, in order to permit regular inspection and/or periodic servicing.

(3) Overboard Discharges

(A) The overboard discharges of any EGC system are not to be interconnected to other systems. However, if backflow prevention means are provided, seawater from other systems used for dilution is acceptable.

(B) Due consideration is to be given to the location of overboard discharges with respect to vessel propulsion features, such as thrusters or propellers to prevent any discharge water onto survival craft during abandonment.

(C) Special attention is to be paid to the corrosion resistivity of EGC washwater overboard discharge piping. Where applicable, adequate arrangements are to be provided to prevent galvanic corrosion due to the use of dissimilar metals and the welding oxides of piping are to be removed. *(2020)*

(D) In case distance piece is fitted between the outboard discharge valve and the shell plating, it shall be made of corrosion resistant material steel or be coated with an anti-corrosive material suitable for the operating environment. The thickness of the distance piece shall be at least the minimum values specified in (a) and (b) as below; otherwise Sch.160 thickness specified in piping standards shall, as far as practicable, be used. *(2024)*

(a) 12 mm in cases where complete pipe is made of corrosion resistant material steel(ex. super duplex stainless steel); or

(b) 15 mm of mild steel in cases where the inside the pipe is treated with an anticorrosive coating or fitted with a sleeve of corrosion resistant material.

3. Chemical Storage Tank *(2022)*

(1) The storage tank for chemical treatment fluids is to be arranged so that any leakage will be contained and prevented from making contact with heated surfaces. All pipes or other tank penetrations are to be provided with manual closing valves attached to the tank. 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 accessible even in the event of chemical treatment fluid leakages. Tank and piping arrangements are to be approved.

(2) The storage tank may be located within the engine room.

(3) The storage tank 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.

(4) Each storage tank for chemical treatment fluids is to be provided with level monitoring arrangements and high/low level alarms. In cases where heating and/or cooling systems are provided, high and/or low temperature alarms or temperature monitoring are also to be provided accordingly.

(5) The storage tanks are to have sufficient strength to withstand a pressure corresponding to the maximum height of a fluid column in the overflow pipe, with a minimum of 2.4 m above the top plate taking into consideration the specific density of the treatment fluid.

(6) Where chemical treatment fluid is stored in integral tanks, the following are to be considered during the design and construction:

(A) These tanks may be designed and constructed as integral part of the hull, (e.g. double bottom, wing tanks).

(B) These tanks are to be coated with appropriate anti-corrosion coating and are to be segregated by cofferdams, void spaces, pump rooms, empty tanks or other similar spaces so as to not be located adjacent to accommodation, cargo spaces containing cargoes which react with chemical treatment fluids in a hazardous manner as well as any food stores, oil tanks and fresh water tanks.

(C) These tanks are to be designed and constructed as per the structural requirements applicable to hull and primary support members for a deep tank construction.

(D) These tanks are to be included in the ship's stability calculation.

(7) Storage tanks for chemical treatment fluids are to be arranged so that they can be safely emptied of the fluids and ventilated by means of portable or permanent systems.

(8) Arrangement of Tank

(A) The NaOH storage and EGC residue/NaOH overflow tank are not to be situated where spillage or leakage therefrom can constitute a hazard by falling onto combustibles or heated surfaces. In particular, these tanks are not to be located over boilers or in close proximity to steam piping.

4. Chemical Treatment Piping Systems

The requirements are for the washwater chemical treatment system detailed in this paragraph are based on the use of using NaOH or $Ca(OH)_2$ in the EGC scrubber water treatment system. If other chemicals are to be used, measures are to be derived from a risk based analysis for equivalent safety level with requirements in **4** to diminish hazardous to human life.

(1) General

(A) Regardless of design pressure and temperature, piping systems containing chemical treatment fluids only are to comply with the requirements applicable to Class I piping systems as per the Rule of Part 5 Chapter 6. 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. *(2022)*

(B) The material of the NaOH related piping systems, NaOH storage tank, EGC residue/NaOH overflow tanks, drip trays, and any other components which may come into contact with the NaOH solution or sludge is to be of steel or other equivalent material with a melting point above 925 degrees C. Storage tanks and pipes/piping systems for chemical treatment fluids are to be made with a material compatible with chemical treatment fluids, or coated with appropriate anti-corrosion coating. Aluminum, zinc, brass, or galvanized steel components are not to be used. *(2022)*

(2) Bunkering of NaOH

(A) The bunker station for NaOH is to be located on the open deck away from sources of igni-

tion and arranged such that a spill at a bunker station would not result in NaOH contacting or mixing with other incompatible materials. Alternatively, closed or semi-enclosed bunker stations may be approved subject to the provision of effective ventilation.

(B) Spill trays, which may be of the dry type or having means of drainage to the EGC residue/ NaOH overflow tank, are to be provided.

(3) Air Pipes, Overflow Pipes and Sounding Devices

(A) The NaOH storage tank is to be provided with a fill line from the bunker station and a shut off valve is to be provided at the bunkering station. Overflow and drains leading to the EGC residue/NaOH overflow tank are to enter at or near the top of the tank. However, if this is determined to be impracticable, these lines are to be fitted with a non-return valve at the EGC residue/NaOH overflow tank.

(B) The NaOH storage and EGC residue/NaOH overflow tanks are to be provided with air pipes complying with **Pt 5, Ch 6, Sec. 2** of the **Rules for the Classification of Steel Ships**, and the outlets are to terminate in a safe location on weather deck and the tank venting system is to be arranged to prevent entrance of water into the tank for chemical treatment fluids. *(2022)*

(4) Spill Trays

(A) Those areas of the NaOH storage and EGC residue/NaOH overflow tanks that could result in leakage, locations where leakage from pumps and other associated equipment such as strainers, heaters, flanges, valves, etc., which may require occasional dismantling for examination or maintenance may occur, and where leakage may otherwise normally be expected are to be located within spill trays.

(B) Either drainage arrangements for the spill tray that lead to the dedicated EGC residue/ NaOH overflow tank which are fitted with high level alarm are to be provided or arrangements to activate an alarm in the event of spillage are to be provided. Where drainage arrangements are provided, the drain line to the EGC residue/NaOH overflow tank is to be fitted with a non-return valve.

(5) Miscellaneous Piping

(A) The NaOH piping systems are to be independent of other ship service piping and systems.

(B) Piping systems for NaOH systems are not to be located in accommodation, service, or control spaces.

(C) The pipe joints are to be kept to a minimum. The direct connections of pipe lengths are to be all welded except for necessary flanged connections to valves and other equipment.

(D) Supply, bunkering, and transfer lines for NaOH systems are not to be located over boilers or in close proximity to steam piping, exhaust systems, hot surfaces required to be insulated, or other sources of ignition.

(E) The residues generated from the exhaust gas cleaning process are to be stored in a designated residue tank, separate from the engine room sludge tank, and arranged for discharge to appropriate shore reception facilities in accordance with **MARPOL Annex I, Ch III, Reg.13**. *(2022)*

(6) Ventilation

(A) If a storage tank for chemical treatment fluid is installed in a closed compartment, the area is to be served by an effective mechanical supply and exhaust ventilation system providing not less than 6 air changes per hour which is independent from the ventilation system of other spaces. Warning notices requiring the ventilation of spaces prior to entrance shall be provided outside the compartment adjacent to each point of entry and inside the compartment. *(2023)*

(B) Where the storage tank is located within an engine room a separate ventilation system is not required when the general ventilation system for the space is arranged so as to provide an effective movement of air in the vicinity of the storage tank and is to be maintained in operation continuously except when the storage tank is empty and has been thoroughly air purged. *(2024)*

(C) The requirements specified in (A) also apply to closed compartments normally entered by persons: *(2022)*

(a) when they are adjacent to the integral storage tank for chemical treatment fluids and there are possible leak points (e.g. manhole, fittings) from these tanks; or

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

(7) Personnel Protection

(A) For the protection of crew members, the vessel shall have on board suitable protective equipment consisting of aprons, gloves with long sleeves, boots, coveralls of chemical-resistant material, and chemical safety goggles or face shields or both. And, the quantity to be supplied is to be at least two sets.

(B) Safety instructions relating to precautions and corrective response actions are to be posted in the compartment containing NaOH and beside the entrance to the compartment.

(C) Eyewasher and safety showers are to be provided near the bunker manifold and the process fluid transfer pump. If several bunker manifolds are installed on the same deck, one could be installed if the bunker manifold can be easily accessed to eyewasher and safety shower from the bunker manifold.

(D) An eyewash station and safety shower is to be provided in the vicinity of a chemical bunkering station on-deck. If the bunkering connections are located on both port and starboard sides, then consideration is to be given to providing two eyewash stations and safety showers, one for each side. *(2022)*

(E) The treatment fluid transfer pump can be applied in the same manner as the bunker manifold. And, if the treatment fluid transfer pump is shielded by a structure capable of visual surveillance, one eyewasher and safety showers could be installed in the installation area.

(F) An eyewash station and safety shower is to be provided in the vicinity of any part of the system where a spillage/drainage may occur and in the vicinity of system connections/components that require periodic maintenance. *(2022)*

5. Residue Tank

(1) The material of the EGC residue tank is to be selected based on the corrosive nature of the EGC residue.

(2) The tanks are to be independent from other tanks, except in cases where these tanks are also used as the over flow tanks for chemical treatment fluids storage tank. *(2022)*

(3) The capacity of the EGC residue tank is to be based on the expected residue volumes applicable to the exhaust gas cleaning process and the maximum period of voyage between ports where EGC residue can be discharged. In the absence of precise data, a figure of 30 days is to be used. *(2022)*

(4) The EGC residue tank is to be provided with air pipes complying with **Pt 5, Ch 6, 201.** of the **Rules for the Classification of Steel Ships**. The residue tank is to be arranged with a high level alarm.

(5) Sounding arrangements are to be provided for the EGC residue tank in accordance with **Pt 5, Ch 6, 203.** and **Pt 8, Ch 2, Sec 1** of the **Rules for the Classification of Steel Ships**.

(6) The EGC residue tank is to be so designed as to facilitate cleaning.

(7) Where EGC residue tanks used in closed loop chemical treatment systems are also used as the overflow tank for the NaOH storage tank, the additional requirements of **206. 3**. of this Section are to be applied.

208. System Design

1. General

(1) The EGC control system is to be integrated with, or in direct communication with, the engine control system.

(2) The system is to be designed such that a single fault of a component will not lead to a potentially dangerous situation for human safety and the vessel. Data describing the identification of hazards associated with the design and operation of the exhaust gas cleaning system and the means of safeguard or control is to be submitted.

2. Control and Monitoring System

(1) Automatic control, monitoring, alarm, and safety functions are to be provided for the EGC system so that operations remain within preset parameters for all engine operating conditions. Where vessels are provided with the automation equipment specified in **Pt 9, Ch 3** of the **Rules for the Classification of Steel Ships**, the alarm and monitoring systems are to be integrated in the vessel's centralized monitoring systems.

(2) The temperatures, pressures and flows in the EGC system and associated systems are to be controlled and monitored as follows:

(A) A local control and monitoring system for the EGC system is to be provided to enable safe operation, maintenance, and effective control in the event of an emergency or failure of any remote controls.
(B) The design of the control system is to provide identification of faults in the equipment, as well as the process system. The control and monitoring systems are to comply with the requirements of **Pt 9, Ch 3, 302. 4** of the **Rules for the Classification of Steel Ships**.
(C) Indications of parameters necessary for the safe and effective operation of the exhaust gas cleaning process are to be provided at the local and, as applicable, remote control stations, as per Table 3.2.3 of this Section and are to include the following parameters:
(a) EGC system pump/fan/blower/motor operational status
(b) EGC system parameters for operational safety
(c) Level indication of EGC system tanks
(d) Status of any EGC system alarms, shutdowns and Emergency Stop
(D) The computer-based control systems are to comply with the applicable requirements of **Pt 6, Ch 2, 201. 7** of the **Rules for the Classification of Steel Ships** as a Category II system.

(3) Each control, monitoring and safety system is to be supplied by a separate circuit. Each of these circuits is to be protected from short circuits and monitored for voltage failure.

3. Safety Shutdown System

(1) An independent shutdown system is to be provided. The automatic safety shutdown system is to be based on the following:
(A) Means are to be provided to indicate the parameters causing shutdown.
(B) Upon activation of the safety shutdown system, alarms are to be given at the normal control position and at the local control position.
(C) In the event where shutdown by the safety shutdown system is activated, the restart should not occur automatically, unless after the system is reset manually.

(2) Monitoring and safety shutdowns are to be in accordance with **Table 3.2.3** of this Section.

Table 3.2.3 Monitoring and Safety System Functions for EGC Systems *(2020)*

Parameters	Display	Alarm activated	Automatic Shutdown
EGC exhaust fan/blower motors	Run	Stop	
EGC exhaust bypass, isolation, mixing valves, where provided	Position		
Exhaust gas temperature after EGC unit(except if dry running can be used)	●	H	
Differential pressure across EGC scrubber unit or EGC circuit or pressure before EGC unit(except if dry running can be used)	●	H	HH
EGC washwater pumps, alkali system pumps or dry system supply device	Run	Stop	
EGC washwater and alkali system supply pressure	●	L	
EGC washwater system supply temperature(Closed/Hybrid type)	●	H	
EGC alkali system supply temperature	●	L/H	
Water level in EGC scrubber	●	H	HH
Alkali storage tank temperature		L/H	
Alkali storage tank level	●	L/H	
Alkali system drip tray level		H	
EGC residue tank level	●	H	
Power supply fail of control, alarm, monitoring or safety device		Fail	

209. Survey and Test

1. General

(1) These requirements apply to shop test and onboard test of EGC systems and associated systems. Following tests may be incorporated with the tests required by **Pt 5, Ch 2, 211.** of the **Rules for the Classification of Steel Ships**.

(2) The components of the EGC are to be tested and inspected in accordance with **Table 3.2.4**.

2. Onboard tests

(1) Inspection and verification that the foundations and attachments of the principal components of the EGC equipment and associated systems are in accordance with the approved plans and particulars.

(2) Piping systems are to be examined and tested in accordance with **Pt 5, Ch 6, Sec. 14** of the **Rules for the Classification of Steel Ships**.

(3) Electrical equipments are to be examined and tested in accordance with **Pt 6, Ch 1** of the **Rules for the Classification of Steel Ships**.

(4) Instrumentation is to be tested to confirm proper operation as per its predetermined set points.

(5) Pressure relief and safety valves installed on the unit are to be tested.

(6) Control system and shutdowns are to be tested for proper operation.

Table 3.2.4. Test and Survey for components of EGC *(2022)*

No.	Components	Type approval	Drawing approval	Test and Survey
1	Exhaust gas emission monitoring system	●(6)		
2	Washwater emission monitoring system	●(6)		
3	Control panel for EGC	●(6)	●	●
4	Pumps(incl. motors and controlgears for motors(1),(2)		●(8)	●
5	Blowers(incl. motors and controlgears for motors)(1),(2)		●(8)	●
6	Scrubber body(1),(3),(7)			●
7	Heat exchanger(4)		●(9)	●
8	Storage tank for washwater treatment chemical(1),(5)			●

Note.

(1) For the applicable class notation '**CEmS-EGC(S)**' in **Table 3.2.1**

(2) Components for the continual operation of the EGC are to be tested in accordance with the requirements specified in **Pt 5, Ch 6 & Pt 6** of the **Rules for the Classification of Steel Ships**.

(3) The entire length of both longitudinal and circumferential welded joints and exhaust gas pipe or wash water pipe joints on scrubber body are to be subjected to liquid penetrant testing(PT). Where considered necessary by the Surveyor, additional non-destructive test may be required. *(2022)*

(4) It shall be inspected based on the **Rules for the Classification of Steel Ships** of **Pt 5 Ch 5 Sec 3**. *(2022)*

(5) Storage tank that do not form part of the hull are to be subjected to a hydraulic test at a head pressure of 2.5 m on the tank top plate, together with the attachment after manufacture.

(6) Where equipment specified in **Guidance relating to the Rules for the Classification of Steel Ships Pt 6, Ch 1** and **Ch 2, 301.1** is installed, Regardless of class notation, the type approval product is to be installed.

(7) When ships install scrubber without exhaust gas by-pass arrangement required in **205. 4**, scrubber body is to be performed non-destructive examinations irrespective of notation in **202.** *(2022)*

(8) Only applicable for rated output 100kW and above

(9) Only applicable for PV-1 and PV-2

210. Periodical Surveys

1. General

For items not specified in this Section, the relevant requirements specified in **Pt 1** of the **Rules for the Classification of Steel Ships** apply.

2. Annual Survey

Annual surveys are to be included.

(1) External examination of all components, including scrubber unit, chemical treatment piping/supply unit, washwater, tanks, pumps, valves and piping, etc..
(2) Performance test of the instrumentation, control, monitoring, and safety equipment including indicators and alarms.
(3) Performance test of Changeover devices of exhaust gas pipes and the corresponding indicator
(4) Operation test of Remote shut-off devices for reductant agent storage tank valves if installed
(5) General examinations of safety and protective equipment(refer to **207.3.(8)**)
(6) Performance test of Safety showers Eyewash if installed
(7) Warning notices as per **204.** *(2023)*

3. Intermediate Survey

Requirements as required by the Annual Survey in **2** above are to be surveyed.

4. Special Survey

In addition to all the requirements for Annual Survey, the following items are to be surveyed.

(1) The opening of pumps, exhaust fans and blowers
(2) Internal examination of chemical storage tank & residue tank if stalled
(3) Internal examination of scrubber
(4) Operation test of control valves

Section 3 Exhaust Gas Cleaning system(EGC) Ready ships

301. General

1. This Section applies to ships which are prepared for conversion with the design or the partial installation related with exhaust gas cleaning system mentioned in **Sec 2** during the new building phase or in-service.

2. EGC ready levels are defined in 2 steps, and additionally defined in 4 steps according to type of system.

302. Class Notation

1. General

(1) The class notations specified in **2.~4.** may be assigned according to the EGC ready levels.
(2) The requirements for the class notations in this Section are to comply with **303.**

2. EGC Ready D

EGC Ready D as an additional special feature notation may be assigned to ships for which the concept design is prepared.

3. EGC Ready I

EGC Ready I as an additional special feature notation may be assigned to ships for which parts of the systems(scrubber main unit) are installed or the detailed design in addition to the concept design.

4. D, O, C, H (Type of system)

EGC Ready D, O, C or H as an additional special feature notation may be assigned to ships according to type of system in addition to **2.~3.**

Table 3.3.1. Class Notation according to EGC Type

Class Notation	Type
-D	Dry type
-O	Wet open type
-C	Wet closed type
-H	Wet hybrid type

For example, **EGC Ready I(EX)-O** is given to the detailed design of the exhaust gas scrubber with wet open type and the ship equipped with the exhaust gas system, and the basis for the exhaust gas scrubber with wet closed type **EGC Ready D-C** is granted for vessels prepared for design only.

303. Requirements for levels of EGC Ready

1. General

(1) This Section prescribes plans to be submitted and consideration for preparing(refer to below **4.**) the exhaust gas cleaning system. The design and installation of structures and systems are to be in accordance with applicable requirements in **Sec 3**.

(2) Drawing approval and survey for EGC ready are not accepted as Drawing approval and survey for conversion of exhaust gas cleaning system. When the ship is converted, drawing approval and survey are to be carried out in accordance with **Sec 3** in force at the time of the ship conversion. Approved Drawings and certifications from new building stage may be used as reference for conversion.

2. Level of preparing concept design(D)

(1) Plans and documents
- (A) General arrangement of ship
- (B) Arrangement of the EGC installation, layout, and systems
- (C) Arrangement of machinery space including EGC component
- (D) Arrangement and capacity of tanks for storage, chemicals, process washwater, exhaust gas cleaning residues, etc
- (E) Arrangement of exhaust gas system
- (F) Arrangement of washwater system(if applicable)
- (G) Arrangement of chemical treatment system(if applicable)
- (H) Schematic diagram for electrical, control, alarm, and monitoring system
- (I) Documentation detailing the effect on Load Line and Stability of the exhaust gas cleaning system
- (J) Documentation detailing the effect on electric load

3. Level of detailed design and installation(I)

(1) EGC Ready I includes the approval of the detailed drawings and the installation of the specific equipment mounted on the ship and is classified as a separate system as shown below
- (A) Hull structural arrangement and reinforecement-SR
- (B) Exhaust gas system-EX
- (C) Washwater system-WR
- (D) Chemical treatment system, if applicable-CH
- (E) Residue system-SD
- (F) SOx Scrubber system-EG

(2) Plans and documents

In order to receive EGC Ready I, the following drawings must be submitted and approved according to the specific equipment. However, if approved by the Society, some modifications may be made depending on the type of equipment.
- (A) Hull structural arrangement and reinforecement-SR
  - Hull plans showing the foundation and attachments of accessories to the vessel's structure, including scantlings, welding details, and foundation details of principal components

(B) Exhaust gas system-EX
- Detailed drawings of the exhaust system

(C) Washwater system-WR
- Detailed drawings of washing water system and related equipment (washing water supply and drainage equipment)

(D) Chemical treatment system, if applicable-CH
- Detailed drawings of chemical treatment piping system and related equipment

(E) Residue system-SD
- Detailed drawings of the residue piping system and related equipment

(F) SOx Scrubber system-EG
- Arrangement of the EGC installation, layout, and systems
- Material specifications for the EGC equipment and associated systems, including coolers, blowers, pumps, valves, storage/process tanks, residue tanks, piping, distribution systems, separators, and associated components
- Documentation detailing the effect on Load Line and Stability of the exhaust gas cleaning system(retrofit only)
- Documentation detailing the effect on electric load

4. Consideration for preparing

(1) It is to be considered for EGC ready D as below:

(A) The engine casings are to be designed and arranged considering size of the scrubber unit.

(B) The machinery space are to be designed and arranged considering related scrubber unit and tanks if applicable.

(C) The sea suction and overboard dischage outlets are to be designed considering installation of washwater system, washwater treatment system, and related component if applicable.

(D) In calculating the capacity of the generator and switch board, the electric load/switch board that is increased/added due to the installation of the EGC are to be considered and reflected in the submitted drawings in **303**.

(E) The effects of stability and load line due to the installation of the EGC are to be considered and reflected in the drawings submitted in **303**.

(F) In the calculation of fire extinguishing agents for fixed fire extinguishing systems for machinery space, the increase or decrease in the volume of the machinery is to be considered due to the installation of the EGC.

(G) Consideration is to be given to fire extinguishing equipment which is required to be installed or maintained in the machinery space due to installation of the EGC.

304. Survey

1. Classification survey during construction

The shop test and onboard test are to be in accordance with **Sec 2**.

2. Periodical surveys

Periodical surveys in application of this Section, the general condition of the relevant systems installed on board is to be examined visually at periodical surveys for the vessels having **EGC Ready I** notation. The systems are to be surveyed and evaluated for the condition at time of conversion, and the scope of test will be defined depending on time elapsed from new building and maintenance level of the systems.

Section 4 Ships using Low Sulphur Fuel Oil

401. General

1. This Section applies to ships using two kinds of fuel oil complied with **Reg.14.1** and **Reg.14.4 of MARPOL Annex VI**.
2. It is applied the "**CEmS-LSF**" notation for ships arranged fuel oil system in **402.**, without exhaust gas cleaning system.

402. Fuel oil system

1. Manual for bunkering or fuel oil change-over of fuel oil is to be provided on measures and procedures to minimize mixing of newly bunkered fuel with fuel already on-board or between incompatible fuels in-use.
2. Fuel oil settling tanks and service tanks are to be provided with drain valves or cocks on their bottoms. Where drain valves or cocks are fitted to fuel oil tanks, the valves or cocks are to be of self-closing type.
3. If settling tanks for fuel oil are not provided onboard, the fuel oil bunker (storage) and daily service tanks are to be designed and constructed in such a way as to direct water and sludge towards a drainage outlet.
4. A heating or cooling units should be provided, where heating or cooling of fuel oil is required for the efficient functioning of the fuel oil treatment system.
5. For items not specified in this Section, the relevant requirements specified in **Pt 5** and **Pt 8** of the **Rules for the Classification of Steel Ships** apply. ⚓

CHAPTER 4 Ships satisfying Energy Efficiency Design Index(EEDI) Phase 3 *(2022)*

Section 1 General

101. General

1. This Chapter applies to the ships whose verified attained EEDI are less than or equal to the required EEDI for phase 3 in **MARPOL Annex VI, Regulation 24** as amended by **IMO Res.MEPC.328(76)**.
2. Ships applying the EEDI notation in accordance with this Chapter are to comply with the applicable requirements of **MARPOL Annex VI, Regulations 19, 22** and **24**, and are to hold a valid IEE Certificate.

102. Definitions

1. **Required EEDI** means a value determined in accordance with **MARPOL Annex VI, Regulation 24** as amended by **IMO Res.MEPC.328(76)**, using a phase 3 reduction factor as applicable to the ship type and ship size.
2. **Attained EEDI** means a value calculated in accordance with **MARPOL Annex VI, Regulation 22**, in consideration of the guidelines developed by IMO.
3. **Verification** means an activity of confirming that the attained EEDI in 2 is not greater than the required EEDI specified in 1, and confirming the extra reduction rate in comparison with phase 3 reduction factor in 1.

103. Document submission

1. Classification survey
   (1) Ships applying to be assigned an EEDI notation should submit the following documents to the Society for approval and/or reference.
   (A) Calculation for required EEDI specified in **102. 1**
   (B) EEDI technical file
   (C) IEE certificate
2. Alteration survey
   (1) Documents specified in **1** is to be submitted to the Society, when attained EEDI is to be recalculated after major alteration specified in **MARPOL Annex VI, Regulation 2.**

104. Class notation

1. **"EEDI-P3"** notation is to be assigned to ships whose attained EEDI specified in **102. 2** is less than or equal to the required EEDI specified in **102. 1**.
2. **"EEDI-ER[x]"** notation can be assigned to ships satisfying the requirement of **1** and requesting to record the extra reduction rate of the attained EEDI in comparison with phase 3 reduction factor. Where ER means Extra Reduction, and [x] means the extra reduction rate expressed in percent (%). For example, EEDI-ER[12] is assigned to a ship when the extra reduction rate of attained EEDI is 12%. ⚓

CHAPTER 5 Wind Assisted Propulsion Systems *(2022)*

Section 1 General

101. General

1. This chapter applies to systems for assisting the propulsion performance of ships by using wind power.
2. This chapter focuses on two wind technologies assisted propulsion: Flettner rotors or wing sails(including rigid sails and soft sails). The ships installed those systems are to comply with **Sec 3**.
3. The wind assisted propulsion system is considered to be a auxiliary propulsion system that supplements the main propulsion system. Therefore, the ship must be fully operable by main propulsion mean(s) and other than wind assisted propulsion systems are to comply with the requirements of the Society.
4. As separate from requirements in this Chapter, when the improved energy efficiency of ships through the wind assisted propulsion system is counted to energy efficiency indexes such as EEDI and EEXI, verification or test procedure should be complied with in the international conventions and guidance such as the **MEPC.1/Circ.896** and/or requirements from the Administration. *(2023)*

102. Definitions

The definitions of terms are to follow **Rules for the Classification of Steel Ships**, unless otherwise specified in this chapter.

1. **"Wind assisted propulsion system"** means an assembly leveraging wind energy for generating thrust force to assist the propulsion of a ship. It includes support structure members, thrust generating members, and drive system.
2. **"Drive System"** means the system that drives the operation motions of the wind assisted propulsion systems. Typical drive systems include electrical or hydraulic motors with control systems.
3. **"Support Structure Member"** means the primary support member of the wind assisted propulsion systems that transfer the load from the thrust generating members to the foundation structures. Support structure members could be considered as part of the wind assisted propulsion systems or part of the hull structural foundation.
4. **"Foundation Structure"** means the stationary part of the installation that is designed to transfer forces and moments experienced by the wind assisted propulsion systems to the deck structures on the vessel.
5. **"Thrust Generating Member"** means the structural member for the thrust generation of a wind assisted propulsion systems. For example, the thrust generating member of a flettner rotor is the rotating cylinder. The thrust generating member of a wing sail is the sail itself.
6. **"Shipboard Installation"** means the process of installing and integrating a wind assisted propulsion system on board the vessel.
7. **"Apparent Wind"** means the wind measured from a moving object, which is the combination of the true wind and the wind induced by the vessel movement.
8. **"True Wind"** means the wind measured from a motionless object fixed to the ground.
9. **"Flettner Rotor"** means a rotating cylinder/rotor to generate thrust from wind force by the Magnus effect at wind assisted propulsion systems.
10. **"Wing Sail"** means sails utilizing a pressure difference formed by the air flowing into and across the sail surface to propel the ship forward at wind assisted propulsion systems. By the type of material used, wing sails can be categorized into:
    (1) Soft Sails: Usually made of plastic fibers or similar
    (2) Rigid Sails: Usually made of metal or composite materials

103. Class notations

Ships equipped with wind assisted propulsion systems may be assigned one of the additional installations notation of **ES-Wind** or **ES-Wind1** according to the requirements applicable to the system.

104. Equivalency

The equivalence of alternative and novel features which deviate from or are not directly applicable to the guideline is to be in accordance with **Pt 1**, **Ch 1**, **105**. of **Rules for the Classification of Steel Ships**.

Section 2 Survey

201. General

For ships in which the wind assisted propulsion systems are installed, the drawings and documents in **202.** and **203.** are to be submitted to the Society before commencing construction. In addition, if deemed necessary by the Society, additional drawings and data other than those specified below may be requested.

202. Drawings and documents to be submitted

1. For **ES-Wind** notation:
   (1) The following drawings and documents associated with the wind assisted propulsion systems and shipboard installation are to be submitted to the Society for approval.
      (A) Arrangement of wind assisted propulsion systems
      (B) Structural drawings of foundation structure
      (C) Material specification of foundation structure
      (D) Equipment number calculation (if applicable)
      (E) Stability data
      (F) Navigation bridge visibility
      (G) Operation and control diagram for mobile equipment and storage facilities (if applicable)
      (H) Details on the impact of the wind assisted propulsion system onboard power load
   (2) Drawings and data for reference
      (A) Wind assisted propulsion systems specifications
      (B) Applied loads for normal operating conditions and extreme conditions used in the design of the foundation structure in accordance with **Ch 3, Sec 2 203.** to **205.**
      (C) Strength evaluation report of foundation structure
   (3) As a minimum, the following drawings and documents are to be submitted for review and kept on board for easy reference by the crew and the attending Surveyor:
      (A) Maintenance manual for wind assisted propulsion system
      (B) Operation manual for wind assisted propulsion system. As a minimum, the operation manual is to include:
         (a) Description of chain of command with general responsibilities during normal operation
         (b) All relevant operational conditions and operational window of the wind assisted propulsion system, including operation under different environmental conditions, and measures for emergency shut-off
         (c) Measures for vessel maneuvering both with and without the wind assisted propulsion system actively running under operating conditions representative of the vessel's operation, including the operation limits of the system and measures under extreme conditions
         (d) Description of any inherent operational limitations for each mode of operation and for each change in mode of operation
         (e) Procedure for emergency shutdown of the wind assisted propulsion system
         (f) Procedures and a list of tools to change the wind assisted propulsion system from normal operation mode to extreme mode(survival mode) in case of control system failure under severe environmental conditions
         (g) Procedures and a list of tools to restore the wind assisted propulsion system after power failure or emergency shutdown

(h) Onboard personnel protection plan
(C) Testing procedures of wind assisted propulsion system, including sea trial/commissioning procedures
(D) Radar blind sector plan

2. For **ES-Wind1** notation
(1) In addition to the drawings and documents in **1**, the following are to be submitted for the **ES-Wind1** notation:
(A) Structural drawings and details of the wind assisted propulsion systems assembly (including support structure members and thrust generating members)
(B) Non-destructive inspection plans and records for the steel welding of the supporting structure member and the connection of the supporting structure member and the thrust generating member
(C) Drawings of slewing ring with strength calculation and details (if applicable)
(D) Drawings and data for driving machinery including associated gears.
(E) Dimensions, materials, welding details, as applicable, of all torque-transmitting components (shafts, gears, clutches, couplings, coupling bolts, etc.) and all load bearing components (shaft bearings, cable lifter, sheaves, drums, bed-frames, etc.) of the wind assisted propulsion system
(F) Electrical system diagrams with components specification
(G) Control, alarm, monitoring, and safety systems
(H) Hydraulic piping system diagram including system design pressure, relief valve arrangement and settings, materials and typical pipe joint details, if applicable
(2) Drawings and materials for reference
(A) Material specifications for all structure members
(B) Strength evaluation report and load of support structure members
(C) Strength calculations for mobile equipment and storage facilities

203. Production Survey

1. When the ES-Wind notation is applied:
(1) The inspection of the wind assisted propulsion system is to be carried out at each stage under the responsibility of the manufacturer, according to the manufacturer's own inspection plan, and the report is to be submitted to the Surveyor in charge. And, in accordance with the manufacturer's inspection plan, testing and inspection may be carried out on behalf of the manufacturer by an institution recognized by the manufacturer.
(2) The qualifications of welding and non-destructive inspection personnel engaged in all construction and assembly steps are to be defined.
(3) The materials used for the foundation structure of the wind assisted propulsion system are to comply with **Pt 2, Ch 1** of **Rules for the Classification of Steel Ships**.

2. When the ES-Wind1 notation is applied:
(1) All structure members of wind assisted propulsion systems including load bearing support are to be surveyed during construction to determine that the details for structures, material, mechanical components, welding, and workmanship are acceptable to the Society.
(2) The Surveyor is to have access to all material test certificates. All in-factory testing for structural components or assembled components of the wind assisted propulsion system is to be witnessed by the attending Surveyor.
(3) The welding procedures are to be submitted to and approved by the Society.
(4) Test and inspection of drive systems
(A) Each electrical motor and related control gear are to be in accordance with **Table 5.2.1**.
(B) Each hydraulic motor is to be inspected based on design review in accordance with **Table 5.2.1** and **Pt 5, Ch 6, Sec 13** of **Rules for the Classification of Steel Ships** in the presence of a Surveyor.
(C) Other components associated with drive systems are to be certified and tested in accordance with **Table 5.2.1**. Where a slewing ring is fitted, surveys at the factory of the slewing ring manufacturer are required.

Table 5.2.1 Equipment and system subject to the approval and test

No.	Equipment and system	Drawing approval	Test and inspection
1	Motors	●(1)	●
2	Control gears for Motors	●(1)	●
3	Gears	●(2)	●
4	HPU & Hydraulic equipment	●	●
5	Control, alarm and safety system	●	●

(Notes)
(1) Only applicable for motors of 100 kW and above.
(2) Only applicable for gears of rated output 100 kW and above.

3. Non-destructive test

(1) When **ES-Wind** notation is applied, non-destructive testing is to be carried out at the welded joints of the foundation structure of wind assisted propulsion systems in accordance with **Pt 2, Ch 2, Annex 2-7** "Guidance for non-destructive testing of ship hull steel welds" of the **Rules for the Classification of Steel Ships** or other approved code. The non-destructive inspection scope and methods are to be submitted with the design drawings.

(2) When **ES-Wind1** notation is applied, non-destructive testing is to be carried out at the welded joints of the support structure member and the connection part of support structure members and thrust generating members of wind assisted propulsion systems in accordance with **Pt 2, Ch 2, Annex 2-7** "Guidance for non-destructive testing of ship hull steel welds" of the **Rules for the Classification of Steel Ships** or other approved code. The non-destructive inspection scope and methods are be submitted with the design drawings.

(3) The method and scope of non-destructive testing for the slewing ring can be referred to by the manufacturer's recommendation. After hardening and finishing, the bearing ring raceway should be inspected along the entire length by non-destructive testing with surface defect identification. Bearing rings are to be inspected by 100% ultrasonic test for internal defects and the manufacturer is to demonstrate that the material is free of harmful defects that could impair the performance of the slewing ring. Records of non-destructive testing are to be provided to the Surveyor, and additional testing may be requested if deemed necessary.

204. Installation Survey

The following items are to be verified by the attending Surveyor:

1. Installation and arrangement

(1) Wind assisted propulsion systems is to be installed according to the approved drawings, and attending Surveyor is to confirm the following items.
  (A) Visual inspection for welded connection of foundation structure and support structure members
  (B) Non-destructive testing in accordance with **203. 3**.

2. Testing

Testing for wind assisted propulsion system is to follow the approved testing procedures and is to include at least the following items:

(1) For **ES-Wind** notation:
  (A) Operation test of Wind Assisted Propulsion Systems (see **314. 2**) *(2024)*
  (B) Tests of all the alarms and safety functions
  (C) Automatic safety shutdown operation
  (D) Emergency shutdown operation
  (E) Correct operation of fire detection system and fire extinguishing systems, where provided

(2) For **ES-Wind1** notation:
  (A) Tests for ES-Wind notation
  (B) General examination of machinery, piping, and electrical equipment (see **Sec 4**)

(C) Operational tests of machinery, electrical units, and control systems

3. Where the ES-Wind1 notation is applied to the wind assisted propulsion system fitted with slewing rings:

(1) Prior to mounting of the mast, the Surveyor is to witness flatness checks and surface finish requirements to verify compliance with the manufacturer's specifications for the following:
(A) Attachment area for slewing ring
(B) Slewing ring
(C) Mounting flange on pedestal

(2) Shimming or surface leveling compounds are not to be used to attain the required level of flatness of the mounting surfaces.

(3) During installation, bolts are to be pretensioned by controllable means. Pretensioning, by bolt torque or hydraulic tensioning device, is to be in accordance with the bearing manufacturer's instructions, which are to be submitted for review. Elongation of the bolts is to be measured to verify pretensioning.

(4) The Surveyor is to confirm that at least 10% of the bolts meet the bearing manufacturer's instructions.

(5) Once wind assisted propulsion system has been mounted, a Rocking Test is to be conducted in accordance with the bearing manufacturer's instructions and the results are to be documented and made available to the attending Surveyor during a periodic survey.

205. Sea trials

The sea trial testing of the wind assisted propulsion system is to be carried out depending on the approved sea trial/commissioning procedures under a wind condition corresponding to the design wind speed in accordance with **Sec 3, 304. 3** (1). Where the wind condition is considered impractical, the wind condition for sea trial testing may be reduced but is subject to approval by the Society.

1. Where the **ES-Wind** notation is applied, the followings are to be verified.

(1) The wind assisted propulsion system is able to respond to change of wind conditions as designed, including emergency situations. During the sea trial, installation of the entire wind assisted propulsion system is to be operated in the presence of the Surveyor to demonstrate its reliability and sufficiency to function satisfactorily under operating conditions and its freedom from dangerous vibrations and other detrimental operating phenomena at speeds within the operating range. Based on the sea trial, the following information of the vessel is to be updated and provided on board:
(A) Stopping time at astern test
(B) Ship headings and distances recorded on sea trials, and
(C) For ships with multiple propulsion systems, ability to navigate and maneuver with one propulsion system inoperative

(2) The normal operation of the ship is not adversely impacted by the operation of the wind assisted propulsion system, including maneuverability and stability. For the details of recording the maneuvering information from the sea trial, **IMO Resolution A.601(15)** may be referred to.

2. Where the **ES-Wind1** notation is applied, the control system interaction trials are to be verified.

(1) The interactions between the wind assisted propulsion system and the main propulsion and steering systems, and the control system response is to be conducted following the submitted trial plan from the manufacturer.

206. Annual survey

1. Where the **ES-Wind** notation is applied, the followings are to be included in the annual survey.

(1) Visual inspection of foundation structure of wind assisted propulsion systems for deformation, excessive wear, corrosion, fracture or damage

(2) Function test of the safety systems for the wind assisted propulsion system, including emergency stops, locks or release systems for extreme conditions, alarms, and fire detection systems, where fitted

2. Where the **ES-Wind1** notation is applied, in addition to **1**, the followings are to be included in the annual survey.

(1) Visual inspection of support structure members and other structural members of wind assisted propulsion systems for deformation, excessive wear, corrosion, fracture or damage
(2) Operation test of the wind assisted propulsion system and the associated control system(s)
(3) Where applicable, slewing rings are to be inspected for loose bolts, damaged bearings and deformed or damaged weldments. Rocking tests are performed every 6 months according to the bearing manufacturer's instructions. The results of this test are to be recorded for review by the Surveyor at each annual survey
(4) Visual examination and operational test for machinery and gears of wind assisted propulsion system including drive, clutches, brakes and slewing machinery.

207. Special Surveys

In addition to the annual survey items in **206**, special survey shall include the following items.

1. For foundation structure of wind assisted propulsion systems with built-up sections with multi-layered plates, sufficient non-destructive testing for surface is to be conducted on any laminated sections to ensure that the sections are firmly attached to prevent buckling and interlayer corrosion. Welding repairs are be conducted only in accordance with the manufacturer's welding procedures.

2. Where **ES-Wind1** notation is applied, the support structure members of wind assisted propulsion systems equipped with a slewing ring, if applicable, are to be undergo following tests and inspections.

(1) Inspection for slewing ring including bolt arrangements and foundation for slack bolts, damaged bearings and deformed or damaged weldments.
  (A) The pretension of the slewing ring bolt is to be checked as required by the manufacturer's onboard documentation.
  (B) All slewing ring bolts are to be tested (such as hammer test or torque verification) to ensure integrity and tightness.
  (C) Dismantling and drawing out the slewing ring bolt need not be carried out for inspection, unless considered suspect by Surveyor.
  (D) All bolts suspected by the Surveyor are to be removed and examined by non-destructive testing.
(2) Rocking test
  (A) The rocking test is to be performed in accordance with the bearing manufacturer's recommendations or procedures. If the results of the rocking test or grease sample indicate potential bearing wear in excess of manufacturer's recommendations, the bearing is to be replaced.
(3) A grease sample is to be taken from the slewing ring bearing for analysis.
  (A) The grease sample is to be obtained and analyzed in accordance with the manufacturer's recommendations for the slewing ring bearing.
  (B) In the absence of other methods, grease analysis for particulate is to be performed in accordance with **ASTM D1404**.

Section 3 Basic Requirements for Wind Assisted Propulsion Systems

301. General

1. This section provides the minimum requirements for ships with wind assisted propulsion systems installed. Ships in compliance with the requirements of this section may be assigned an additional notation **ES-Wind**.

302. Materials

1. Materials are to be in accordance with **Pt 2** of the **Rules for the Classification of Steel Ships**.

303. Environmental conditions

1. The design is to take into account the weather conditions, humidity, dust, aggressive media, oil and salt-containing air, exhaust gases and exhaust gas heat, vibrations and other relevant environmental conditions.

2. Wind assisted propulsion systems including auxiliary machinery and electrical installations, are to be dimensioned with respect to temperature and humidity as listed below:

(1) Enclosed spaces
  (A) Air temperature: 0°C ~ +45°C
  (B) Relative air humidity: 80%
(2) Open deck
  (A) Air temperature
    (a) Wind assisted propulsion systems in operation: −10°C ~ +45°C
    (b) Wind assisted propulsion systems out of operation: −25°C ~ +45°C
  (B) Relative air humidity
    (a) 80% and influence of salt spray and green sea

304. Design loads

1. General

(1) **2** and **3** define the design loads for wind assisted propulsion systems and the ship foundation structure. In addition, the interference effect between the hull of the ship and the global structural behavior of wind assisted propulsion systems is specified.
(2) For the structural design, all loads acting on the wind assisted propulsion systems in operation and out of operation state are to be considered.
(3) Wind assisted propulsion systems is affected by aerostatic and aerodynamic forces. In addition, gyroscopic and other inertial effects (e.g. weight imbalance during rotation and due to ship motion) are to be reflected in the rotor design.
  (A) In operation: Wind assisted propulsion systems is deployed to generate auxiliary propulsion.
  (B) Out of operation: Wind assisted propulsion systems is not generating auxiliary propulsion (e.g., port mode or extreme conditions).
(4) The loads acting on structure of wind assisted propulsion systems and foundation structure are categorized as follows.
  (A) Normal operating loads
  (B) Extreme loads

2. Normal operating loads

(1) Wind loads
  (A) Wind loads is converted into thrust that supports the ship' propulsion, which will be one of the main design characteristics. Wind loads should be considered for wind assisted propulsion systems in operation and out of operation as well as extreme weather conditions.
  (B) Loads on wind assisted propulsion systems categorized as normal operating loads are derived from the wind speed reflecting the gust effect when wind assisted propulsion systems is in operation (eg, auxiliary propulsion generation). The maximum design wind speed for normal operation should be determined by the designer.
  (C) The wind load is to be determined using the aerodynamic relationship associated with the

true wind assisted propulsion systems.

(D) The wind load acting on wind assisted propulsion systems is to be calculated as the apparent wind speed including the gust effect in which the true wind speed increases by 25% or more.

(E) Technical evidence of adequate lift and drag coefficients and the method used to convert airflow into structural loads is to be provided.

(F) Onboard anemometers and vanes that measure the apparent wind speed (and direction) should be in a position that represents the highest sail element with the airflow as unobstructed as possible.

(2) Inertia loads

(A) Load effects arising from self-weight(mass) and dynamic forces on wind assisted propulsion systems, excited by ship motions in nautical conditions are to be considered. For the installed ship, an appropriate acceleration value is to be determined in accordance with the **Rules for the Classification and Steel Ships**.

(3) Other

(A) Other loads are as follows, but are not limited thereto.

(a) Special operating conditions

(b) Global ship vibrations

(c) Global ship deformation

3. Extreme load

(1) Wind load

(A) When wind assisted propulsion systems is out of operation, extreme wind loads exceeding the normal operating load are generated at the maximum true wind speed.

(B) The maximum true wind speed is determined by the correlation between the design wind speed and the height. In no case should the design wind speed be less than 55.0 m/s. *(2025)*

(C) Wind pressure is based on the drag acting on wind assisted propulsion systems, and can be determined according to the shape of elements of wind assisted propulsion systems subjected to extreme wind loads.

(D) The wind pressure acting on the side area of the exposed elements of wind assisted propulsion system is to be applied in the most unfavorable direction and is to be calculated in accordance with **Pt 9, Ch 2, 402, 5** (1) of the **Rules for the Classification of Steel Ships**.

(2) Snow and ice load

(A) Snow and ice loads are to be considered where applicable.

(B) When ice loads are included in the load considerations, the impact of freezing on structural design is to be determined and submitted by the manufacturer.

(3) Green sea load

The wind assisted propulsion system is to be capable of withstanding the design pressure due to green waves and spray water. *(2025)*

(a) For ships applying **Pt 13** of the **Rules for the Classification of Steel Ships**, the maximum design pressure acting on the wind assisted propulsion system is to be calculated in accordance with **Pt 13**, **Ch 4**, **Sec 5**, **2.2.3** and **2.2.4** of the **Rules for the Classification of Steel Ships**. However, in this case, the exposed deck pressure coefficients (χ) and $P_{D-\min}$ may be ignored.

(b) For ships applying **Pt 3** of the **Rules for the Classification of Steel Ships**, the maximum design pressure acting on the wind assisted propulsion system is to be calculated in accordance with **Pt 3**, **Ch 4**, **201. 1** of the **Rules for the Classification of Steel Ships**.

(4) Other extreme loads

Wind directional instability (magnitude and rate) can be important for some types of wind assisted propulsion systems and is to be addressed where applicable.

305. Load combination

1. The load to be used in the strength analysis of the structural part is to be the combined load in consideration of the load specified in **304. 2** and **3** so as to be the most severe load on the structural part.

306. Strength and structure

1. Structural parts are to be designed to withstand the load combination specified in **305.** and to comply with the requirements of **Pt 9, Ch 2, 403.** of the **Rules for the Classification of Steel Ships**. When applying **Pt 9, Ch 2, 403.** of the **Rules for the Classification of Steel Ships**, the normal operating loads is to be considered as the condition specified in **Pt 9, Ch 2, 402. 9** (2), and the extreme loads is to be considered as the condition specified in **Pt 9, Ch 2, 402. 9** (3) of the **Rules for the Classification of Steel Ships**. *(2025)*
2. Notwithstanding the provisions of **1**, the evaluation of buckling strength for structural parts and the strength assessment of bolts, conducted in accordance with standards recognized by the Society, may be given special consideration. *(2025)*
3. When requested by the Society, fatigue strength evaluation is to be carried out and submitted.

307. Stability

1. In the case of existing ships, data on the projected side area that is changed according to the installation of wind assisted propulsion systems is to be submitted, and if necessary, a revision of data related to stability may be requested.
2. For new ships, it is to be in accordance with **Pt 1, Ch 1, 307.** of the **Rules for the Classification of Steel Ships**.
3. Additional data may be required for similar wind assisted propulsion systems such as wing sails.

308. Navigation bridge visibility

1. Ships equipped with wind assisted propulsion systems are to demonstrate that they meet the bridge visibility requirements in all operating situations in accordance with **SOLAS V/Reg.22**. If the bridge visibility requirements are relaxed, alternative safety measures (e.g., camera systems, aerial lights, or risk assessments) are to be implemented. In cases where a ship subject to **SOLAS V/Reg.22** cannot meet the bridge visibility requirements, alternatives are to be approved by the flag state on a case-by-case basis. *(2025)*

309. Radar blind area

1. When the Society issues a cargo ship SE certificate (or equivalent according to the ship type) on behalf of the flag state, it is to demonstrate compliance with the radar blind area requirements. If this certificate is not issued by the Society, radar blind area information is to be provided to the flag state and evidence of acceptance of the flag state is to be provided to the Society. More information on radar blind areas can be found in **IMO SN.1/Circ.271** and **MSC.192(79)**.

310. Navigation light

1. The installation of wind assisted propulsion systems is not to violate the requirements for blockage of navigation light and is to comply with the latest **COLREG** convention requirements. If compliance is impractical, alternative is to be approved by the flag state administration on a case-by-case basis.

311. Equipment Number and Equipment

1. The additional lateral projected area and weight increased by the installation of wind assisted propulsion systems are to be considered when determining the equipment number for anchoring and mooring equipment.
2. For new ships, the equipment number is to be calculated in accordance with **Pt 4, Ch 8** of the **Rules for the Classification of Steel Ships**.
3. For ships being converted or modified, the required equipment is to comply with the following.
   (1) If the equipment letter is increased by one level due to an increase in equipment number, no change is required.

(2) If the equipment letter is increased by two levels, the existing equipment can be used if an additional chain of the existing diameter is installed. This additional chain must meet the length requirement of the new equipment number, and the mass of the additional chain must compensate for the increase in the mass of the anchor required for the new equipment number. (Alternatively, the size and length of the existing anchor chain may be allowed as a replacement if worn down to the limit permitted for the size by the new equipment number. However, in this case, new bow anchors are be fitted.)
(3) If the equipment letter is increased by three or more levels, new equipment is required. If the anchor catcher can withstand increased loads and chain sizes, or if new anchor catcher equipment is required to meet the revised requirements, it is to be confirmed by the Society.

312. Electrical Equipment and Control Systems

1. It is to be demonstrated that the ship can provide sufficient electrical power for the operation, control, and monitoring of the wind assisted propulsion systems without compromising the safety and operation of the ship. The requirements of electrical systems and electrical equipment for the wind assisted propulsion system installation are to be applied according to **Pt 6, Ch 1** of **Rules for the Classification of Steel Ships**.

313. Arrangement of control, monitoring, alarm and safety system

1. The installation of the automated control systems is to be in accordance to **Pt 6, Ch 2** of **Rules for the Classification of Steel Ships**.
2. The control, monitoring, alarm and safety systems are to be designed to counteract the different operational and environmental conditions to which the ship is subjected. A manually-operated emergency shutdown system is to be provided for the wind assisted propulsion system in case of control system failure.
3. If the wind assisted propulsion system has additional survival arrangements for extreme environmental conditions besides system shutdown, the control, monitoring, alarm and safety systems are to provide enough warning ahead of time to allow the wind assisted propulsion system to transition from the operating arrangement into the survival arrangement. A manually operated system is to be provided to transition the wind assisted propulsion system from the operating arrangement to the survival arrangement in case of control system failure.
4. The safety system is to be designed to limit the consequence of failures and the wind assisted propulsion system is to be constructed based on the fail-safe principle.

314. Installation in Hazardous Areas

1. When the wind assisted propulsion systems are installed in a hazardous area, the requirements in **Pt 6, Ch 1, Sec 9** of **Rules for the Classification of Steel Ships** are to be complied with.
2. When wind assisted propulsion systems are located in hazardous areas, measure(s) prevent from fire or explosion is/are to be provided for the following cases regarded as ignition sources: *(2024)*
   (1) Higher temperature than flash point of cargoes during operation; or,
   (2) Sparking construction during operation

315. Crew safety

1. The crew is to be protected from the potential hazards of moving and rotating parts of the Wind assisted propulsion systems by providing safe passage.

316. Fire safety

1. The space where the drive units for the wind assisted propulsion systems are installed is considered "Other machinery space" and the fire protection arrangements are to be in accordance with **Pt 8** of **Rules for the Classification of Steel Ships**.

Section 4 Additional Requirements for Wind Assisted Propulsion Systems

401. General

1. This section provides additional requirements to be applied to ships that are assigned the **ES-Wind1** notation.
2. A wind assisted propulsion systems are considered a non-essential service in accordance with **Pt 6, Ch 1, 101.** of **Rules for the Classification of Steel Ships**. The criteria for wind assisted propulsion systems in this section are applicable to features that are permanent and can be verified by plan review, calculation, physical survey, or other appropriate means.
3. When ships are assigned the **ES-Wind1** notation, equipment and systems for wind assisted propulsion systems are to be certified by the Society in accordance with **Table 5.2.1**.

402. Structure design

1. The structural drawings of wind assisted propulsion systems are to be reviewed by the Society.
2. The manufacturer is to submit the loads used in the design of all structural members of the wind assisted propulsion systems. The structure of the wind assisted propulsion systems is to be designed to withstand all ship operating conditions and extreme conditions in accordance with **Sec 3. 303.** to **306.**. *(2025)*
3. As a minimum, the load case is to include the cases in **Sec 3, 304. 3** (1) for all structural members. A detailed load analysis report showing the calculation steps for each load component should be submitted for review.
4. The possibility of fatigue damage due to cyclic loading is to be taken into account in the design of the support structure members of the wind assisted propulsion systems in accordance with the **Rules for the Classification of Steel Ships** or other recognized standards.

403. Material

1. The materials used in the construction of the wind assisted propulsion systems are to be suitable for the intended service conditions. The materials used for manufacturing the wind assisted propulsion systems may not be required to be approved by the Society, but the support structure members are to be constructed by materials accepted by the Society.

404. Flettner rotor drive systems

1. Electrical drive systems delivering rotation torque to flettner rotor are to be designed in accordance with **Pt 6, Ch 1, Sec 3** of **Rules for the Classification of Steel Ships**. Gears are to meet the requirements of **Pt 5** of **Rules for the Classification of Steel Ships**.
2. When hydraulic drive systems transmit rotating torque to flettner rotor are to be certified by the Surveyor in accordance with **Pt 5, Ch 6, Sec 13** of **Rules for the Classification of Steel Ships**.
3. The drive capability of the wind assisted propulsion systems is to be maintained even after a single failure to the hydraulic drive units.
4. **Table 5.2.1** provides details for approval of machinery components of a wind assisted propulsion systems. The components are to be reviewed and surveyed based on each specification if not type approved.
5. Materials used for shafts and gears in power transmission system with a rated output of 100 kW or more are to comply with the relevant requirements in **Pt 2, Ch 1** and **Pt 5, Ch 3** of **Rules for the Classification of Steel Ships**.
6. When a calculation method other than the method specified in **5**, strength calculation is to be submitted and reviewed by the Society. In this case, the safety factor of the shaft is to be 1.5 of yield strength and 2.0 of minimum tensile strength of the material. And, the safety factor of the gear is applied values for auxiliary gears in **6** (12) and **7** (13) in **Pt 5** of **Annex 5-4**.

405. Wing sail swing systems

1. Where wing sail swing systems are installed in the wind assisted propulsion system, it is to be capable of rotating the mast at the maximum wind loads specified in **Sec 3, 304.** The operating method of wing sail swing systems is to be included in the operation manual of the wind assisted propulsion system.
2. Materials used for shafts and gears in power transmission system with a rated output of 100 kW or more are to comply with the relevant requirements in **Pt 2, Ch 1** of **Rules for the Classification of Steel Ships**.
3. One static brake is to be provided for wing sail swing systems at least.
4. The capacity of installed static brake system is to be capable of holding the mast at the maximum wind direction load.

406. Mobile Equipment and Storage Facilities

1. Driving parts(hinge, pin, roller, etc.) for mobile equipment and storage facilities are to be had sufficient strength to enable and operate the wind assisted propulsion system when maximum load is applied. The manufacturer is to be submitted a strength calculation for driving parts for reference.
2. Where mobile equipment and storage facilities are arranged by hydraulic system, it is to have complied with **Pt 5, Ch 6, Sec 13** of **Rules for the Classification of Steel Ships**.
3. The measures of mobile equipment and storage facilities are to be provided to keep the position.
4. Suitable arrangements are to be provided for the operation of mobile equipment and storage facilities in the event of an emergency.

407. Control, Monitoring, Alarm and Safety System

1. Control, monitoring, alarm and safety systems are to comply with the requirements of **Pt 6, Ch 2** of **Rules for the Classification of Steel Ships**, as applicable for Category I systems, in accordance with **Pt 6, Ch 2, Table 6.2.2** of **Rules for the Classification of Steel Ships**.
2. Certification of the control, alarm and safety systems is to be in accordance with **Table 5.2.1**. ⚓

CHAPTER 6 Hull Air Lubrication System *(2023)*

Section 1 General

101. General

1. This chapter applies to hull air lubrication systems for improving energy efficiency of ships by reducing hull resistance.
2. This chapter provides requirements on the design, installation and testing of air lubrication systems for hull, stability, machinery, piping systems and electrical systems.
3. As separate from requirements in this Chapter, when the improved energy efficiency of ships through the hull air lubrication system is counted to energy efficiency indexes such as EEDI and EEXI, verification or test procedure should be complied with in the international conventions and guidance such as the **MEPC.1/Circ.896** and/or requirements from the Administration.

102. Definitions

The definitions of terms are to follow **Rules for the Classification of Steel Ships**, unless otherwise specified in this chapter.

1. **"Hull Air Lubrication System"** means to reduce Ship frictional resistance by covering the ship surface with air bubbles, which are injected from the fore part of the ship bottom by using blowers, etc. The systems can consist of a cooling system, pressure vessel, etc. as well as air compressors.
2. **"Air Chamber"** means small spaces where pressurized air from air compressors stays shortly prior to flowing across the hull.
3. **"Air Injection valve"** means a valve located on the most downstream in front of the air injection hole or air chamber. A distance piece can be arranged between the hole or chamber and the air injection valve.

103. Class notations

Ships equipped with hull air lubrication system complying with this chapter excluding **Sec 4** may be assigned one of the additional installations notation of **ES-ALS**. Furthermore, **ES-ALS1** may be assigned if the additional requirements in **Sec 4** are satisfied.

104. Equivalency

The equivalence of alternative and novel features which deviate from or are not directly applicable to the guideline is to be in accordance with **Pt 1, Ch 1, 105.** of **Rules for the Classification of Steel Ships**.

Section 2 Basic Requirements for Hull Air Lubrication System

201. General

1. This section provides the minimum requirements for ships with hull air lubrication system installed.
2. The section provides requirements on technical and design to mitigate risks from flooding and fire and to enhance the crew's safety, caused by the installation of hull air lubrication system.
3. Ships in compliance with the requirements of this section may be assigned a notation **ES-ALS**.
4. Designs that are not in compliance with this Section may be approved after evaluation by the Society, provided that it can be demonstrated that the design represents an equal or better level of safety.

202. Strength and Structure

1. The hull air lubrication systems are to be in accordance with **Pt 3, Ch 14, 201.** and **Pt 5, Ch 6, 107.** of **Rules for the Classification of Steel Ships** in the case of being located forward of the collision bulkhead.
2. The openings, such as air chambers that blow air through the hull, affect the longitudinal strength members used in the hull guider section modulus calculations. The hull structure and openings for air injection are to be designed in accordance with **Pt 3, Ch 3** of **Rules for the Classification of Steel Ships**, and drawings and data are to be submitted to the Society in accordance with **402. 1** of this Guidance. Local stress concentrations due to openings are to be evaluated so that they meet applicable strength and fatigue requirements.
3. All openings are, if necessary, to be properly reinforced and to be provided with sufficient roundness at the corners in accordance with **Pt 3, Ch 4, 701.** of **Rules for the Classification of Steel Ships**.
4. Design and test of air injection valves are in accordance with **204.** of this Guidance.

203. Stability

1. In the case of existing ships, data on light weight that is changed according to the installation of hull air lubrication systems is to be submitted, and if necessary, a revision of data related to stability may be requested.
2. For new ships, it is to be in accordance with **Pt 1, Ch 1, 307.** of **Rules for the Classification of Steel Ships.**

204. Auxiliaries and Piping Arrangement

1. Piping systems of hull air lubrication systems are to comply with **Pt 5, Ch 6** of **Rules for the Classification of Steel Ships.** *(2024)*
2. Efficient means such as non-return valves or equivalent are to be provided in air supply piping system to prevent ingress of water through air chamber. *(2024)*
3. Air injection valves for hull air lubrication system can be arranged in double bottom ballast tanks, voids and so on. And Indicators are to be provided local to the valves or cocks showing whether they are open or shut.
4. Power operated air injection valves are to be arranged for manual operation in the event of failure of the power supply.
5. Distance pieces connected an air chamber to an air injection valve are to comply with **301. 2 of Pt 5, Ch 6** of **Rules for the Classification of Steel Ships**. Where applicable, adequate arrangements are to be provided to prevent galvanic corrosion due to the use of dissimilar metals.
6. Pressure vessels including heat exchangers are to comply with the requirements specified in **Pt 5, Ch 5, Sec 3** of **Rules for the Classification of Steel Ships**. (**403. Table 6.4.1**) *(2024)*

205. Electrical Equipment and Controlgears for Motors

1. The ships' number and capacity of generators are to be sufficient in accordance with **202. of Pt 6, Ch 1** of **Rules for the Classification of Steel Ships** under normal seagoing conditions, taking into account with the operation of hull air lubrication system.
2. The electrical loads related at hull air lubrication system is to be included in the electrical load analysis and submitted for approval.

206. Control, Alarm and Safety Systems

1. Control, alarm and safety systems are to be designed to avoid a single failure event leading to a potentially dangerous situation for human safety and/or the ship.
2. Control, alarm and safety systems are to be designed based on the fail-safe principle.

3. The safety system for hull air lubrication system is to be designed independently as practicable.

207. Ventilation system

A ventilation system having sufficient air exchange capacity is to be provided for a space where hull air lubrication system is arranged including air compressors. International standards such as ISO 8861:1998 may be considered to determine air exchange capacity.

208. Fire safety

1. A space where hull air lubrication system is arranged is to be regarded as an other Machinery Space, Unless the system is installed in Machinery spaces of category A defined in **Pt 8, Ch 1** of **Rules for the Classification of Steel Ships**.
2. Fire integrity of the space is to comply with **Pt 8, Ch 7** of **Rules for the Classification of Steel Ships**.
3. Fire extinguishing arrangements are to be provided for the space in accordance with **Pt 8, Ch 8, Sec 4** of **Rules for the Classification of Steel Ships**.

Section 3 Additional Requirements for Hull Air Lubrication System

301. General

1. This section provides additional requirements for equipment and systems for hull air lubrication system such as air compressor(s), pressure vessel(s), piping system and electrical equipment.
2. The ships complied with this section can be assigned a notation **ES-ALS1**, in addition to the **Sec 2**.
3. When ships are assigned the **ES-ALS1** notation, equipment and systems for hull air lubrication system are to be certified by the Society in accordance with **Table 6.4.1**.
4. The hull air lubrication system is to be monitored and controlled from wheel house or engine control station other than the equipment side, providing to control operation of the air compressor and air injection valves at least for the hull air lubrication system. *(2024)*

302. Auxiliaries and Piping Arrangement

1. Construction, materials, and strength of air compressors for hull air lubrication system are to comply with the requirements specified in **Pt 5, Ch 6, Sec 11** of **Rules for the Classification of Steel Ships**. Where deemed appropriate by the Society, international/national Standards may be applied as equivalent instead of requirements of the aforementioned.

303. Electrical Equipment and Controlgears for Motors

1. Motors and controlgears for motors are to be ceritified in accordance with the relevant requirements specified in **Pt 6, Ch 1** of **Rules for the Classification of Steel Ships**.

304. Control, Alarm and Safety System

1. Control, alarm and safety systems are to comply with the requirements of **Pt 6, Ch 2** of **Rules for the Classification of Steel Ships**, as applicable for Category I systems, in accordance with **Pt 6, Ch 2, Table 6.2.2** of **Rules for the Classification of Steel Ships**.
2. The parameters for the operation of air lubrication system are to be available at the local and remote stations in **301. 4.** and include, but not exhaustive, the following: *(2024)*
   (1) Operation status of air compressors
   (2) Status(open/close) of air injection valves
   (3) Operational status (e.g. run, alarm and shutdown)

3. Hull air lubrication system is to be controllable from the local when the contorl an monitoring system at remote control station in **301. 4.** is a failure. *(2024)*

4. An emergency shutdown system for stopping air compressor and closing air injection valves is to be provided at remote control stations in **301. 4.**. *(2024)*

5. Certification of the control, alarm and safety systems is to be in accordance with **Table 6.4.1**.

Section 4 Survey

401. General

For ships in which the hull air lubrication system are installed, the drawings and documents in **402.** are to be submitted to the Society before commencing construction. In addition, if deemed necessary by the Society, additional drawings and data other than those specified below may be requested.

402. Drawings and documents to be submitted

1. For ES-ALS notation

The following drawings and documents associated with the hull air lubrication system and shipboard installation are to be submitted to the Society.

(1) Drawings and documents for approval
  (A) General arrangement of hull air lubrication system
  (B) Documentation detailing the effect on Stability (where necessary, Refer to **203.**)
  (C) Piping diagram
  (D) Details of air chamber and air injection hole
  (E) Detail of distance piece
  (F) Wiring diagram for hull air lubrication system
  (G) Diagrams for the control, alarm and safety systems
  (H) Investigation table of electrical load analysis (where necessary)

(2) Drawings and documents for reference
  (A) Specification of hull air lubrication system
  (B) Calculation of ventilation for installed place of hull air lubrication system

2. For ES-ALS1 notation

In addition to the drawings and documents in 1, the following are to be submitted for the ES-ALS1 notation:

(1) Drawings and documents for approval
  (A) Detail of air compressor (rated output 100kW and above) (Refer to **210. of Pt 5, Ch 1** of **Rules for the Classification of Steel Ships**)
  (B) Detail of Cooling pump (rated output 100kW and above) (Refer to **210. of Pt 5, Ch 1** of **Rules for the Classification of Steel Ships**)

(2) Drawings and materials for reference
  (A) Operating scenario

403. Production Survey

1. For ES-ALS notation

(1) The inspection of the hull air lubrication system is to be carried out at each stage under the responsibility of the manufacturer, according to the manufacturer's own inspection plan, and the report is to be submitted to the Surveyor in charge. And, in accordance with the manufacturer's inspection plan, testing and inspection may be carried out on behalf of the manufacturer by an institution recognized by the manufacturer.

(2) The materials and welding of hull used for hull air lubrication system are to comply with **Pt 2, Ch 1** of **Rules for the Classification of Steel Ships**.

(3) The qualifications of welding and non-destructive inspection personnel engaged in all construction and assembly steps for air chamber and air supplying piping including air injection valve of hull

air lubrication system are to be defined.

(4) Air chamber and air supplying piping including air injection valve of hull air lubrication system are to complying with **Pt 2, Ch 1** and **Pt 5, Ch 6** of **Rules for the Classification of Steel Ships**.

(5) Distance pieces of hull air lubrication system are to complying with **Pt 5 Ch 6** of **Rules for the Classification of Steel Ships**.

(6) Non-destructive test
Ships installed hull air lubrication system are to be carreid out non-destructive testing at the welded joints of air chamber to hull, structural members and piping system in accordance with **Pt 2, Ch 2, Annex 2-7 "Guidance for non-destructive testing of ship hull steel welds"** of the **Rules for the Classification of Steel Ships** or other approved code. The non-destructive inspection scope and methods are to be submitted with the design drawings.

2. For ES-ALS1 notation

(1) Equipment and components for hull air lubrication system are to be certified and tested in accordance with **Table 6.4.1**.

Table 6.4.1 Test and Survey for components of Hull air lubrication system

No	Equipment and system	Drawing approval	Test and inspection
1	Air compressor for hull air lubrication system	●(1)	●
2	Control panel for hull air lubrication system(2)	●	●
3	Controlgears for air compressor or cooling system	●(1)	●
4	Cooling pump (if installed)	●(1)	●
5	Heat exchanger or pressure vessel(3)	●(4)	●
6	Control, alarm and safety system	●	●

Note.
(1) Only applicable for rated output 100kW and above
(2) Where equipment specified in **Guidance relating to the Rules for the Classification of Steel Ships Pt 6, Ch 1** and **Pt 6, Ch 2, 301. 1** is installed, Regardless of class notation, the type approval product is to be installed.
(3) Regardless of the Class notation, it shall be inspected based on the **Pt 5, Ch 5, Sec 3** of **Rules for the Classification of Steel Ships**.
(4) Only applicable for PV-1 and PV-2

404. Installation Survey

The following items are to be verified by the attending Surveyor:

1. Visual inspection for welded connection of installation for air chamber
2. Non-destructive testing in accordance with **403. 3**
3. Operation of air injection valves
4. Operation of Fire detection system and fire fighting system (if installed)
5. Operational tests of machinery, electrical units, and control systems

405. Sea trials

1. Operation of air injection valves
2. Visual check of air chambers from inside of ships (as possible)
3. Function test of the safety systems
4. Function test of emergency stops
5. Operational tests of machinery, electrical units, and control systems

406. Annual survey

1. Operation of air injection valves
2. Visual check of air chambers from inside of ships (as possible)

407. Special Surveys

1. Outer part of air chambers
2. Distance pieces connecting air injection valve to air chamber (if installed)
3. Function test of the safety systems
4. Function test of emergency stops
5. Operational tests of machinery, electrical units, and control systems ⚓

CHAPTER 7 Onboard Carbon Capture and Storage system

Section 1 General

101. General

1. Carbon capture system could be classified according to three different capture routes.

(1) Post-combustion capture : Separation of carbon-dioxide(hereinafter CO2) from exhaust gas of fuel consumers

(2) Pre-combustion capture : CO2 removal from syngas obtained from gasification prior to its combustion in fuel consumers

(3) Oxy-combustion, Oxyfuel combustion : Combustion of the fuel in nearly pure oxygen and recycled exhaust gas to produce a flue gas with highly concentrated CO2 ready for further processing and purification to a desired CO2 specification

2. There are three general separation processes of CO2 capture that are integrated into the CO2 capture route such as separation with solvent/sorbent, membrane separation and Cryogenic distillation.

(1) Separation with solvent/sorbent : The separation is achieved by passing the CO2-containing gas in intimate contact with a liquid absorbent or solid sorbent that is capable of capturing the CO2

(2) Membrane separation : The membrane separation process is a gas separation technology that takes advantage of the differences in the membrane permeability rates among gas components. It is effective when the feed gas is at high pressure and contains a high-concentration CO2.

(3) Cryogenic distillation : A gas can be made into a liquid by a series of compression, cooling and expansion steps. Once in liquid form, the components of the gas can be separated in a flash or distillation column.

102. Application

1. This chapter is applied to Onboard Carbon capture and storage system(hereinafter OCCS system) by carbon separation with a solvent like **Fig.7.1.1** via capture routes of Post-combustion capture among **101.**

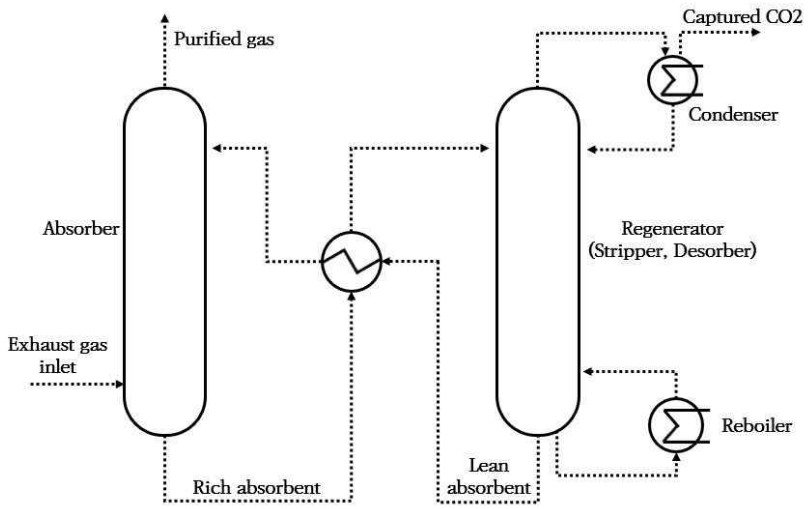

Fig 7.1.17 Schematic diagram of Post-combustion capture by carbon separation with Solvent

2. Ships installed OCCS system to reduce CO2 emission shall be complied with this chapter.

3. Carbon capture and storage system other than separation with solvent, may be approved after evaluation by the Society, provided that it can be demonstrated that the design represents an equal or better level of safety in this chapter.

4. This chapter is purposed to prevent the safety level of ships from deteriorating due to the installation of OCCS system, and approval of the system does not guarantee a minimum captured CO2 rate.

5. Apart from this chapter, waste and washwater generated from OCCS system shall be complied with the regulations in the Administration or port control to be disposed or discharged of.

103. Definitions

The definitions of terms are to follow Rules for the Classification of Steel Ships, unless otherwise specified in this chapter.

1. "**Absorber**" means the equipment to separate of CO2 from the exhaust gas of fuel consumers.

2. "**Absorbent**" means substance able to absorb by chemical absorption and physical absorption carbon from exhaust gas
   (1) The liquid solvent and solid sorbent are used as absorbents, however, the liquid solvent is referred to as an absorbent unless otherwise specified in this chapter.
   (2) Chemicals such as (Alkanol-) amine-based or NaOH are generally used in liquid absorbent. e.g. MEA(Monoethanolamine), DEA(Diethanolamine) and MDEA(Methyldiethanolamine) as an amines absorbent.

3. "**Desorption system**" means the equipment takes off CO2 from the absorbent. The system consists of a regenerator, heat exchangers, etc.

4. "**Fuel**" means a carbon-based fuel such as oil fuel, LNG, LPG, methanol or ethanol in this chapter.

5. "**Fuel consumer**" means machinery emits exhaust gas containing CO2 by combustion of consuming fuel such as internal combustion engine, boiler etc.

6. "**Regenerator**" means the equipment removes the CO2 from rich absorbent by heat. Rich absorbent is regenerated to lean absorbent. The regenerator can also be referred to as 'stripper' or 'desorber'.
   (1) 'Rich absorbent' means absorbent in CO2-loaded conditions extracted from the absorber. Rich absorbent is transferred to regenerator to release the captured carbon.
   (2) 'Lean absorbent' means absorbent in CO2-free conditions saturated CO2 is exhausted at regenerator. Lean absorbent is returned to the absorber to absorb the carbon of exhaust gas again.

104. Plans and Documents

1. The following plans and documents are to be submitted to the Society to install OCCS system on the ships. In addition, if deemed necessary by the Society, additional plans and documents other than those specified may be requested.

2. **Plans and Documents for approval**
   (1) General arrangement of OCCS system
   (2) Specification of OCCS system
   (3) Analysis for compatibility with fuel consumers (incl. **404. 3** (2))
   (4) Piping diagrams for carbon capture and storage system
   (5) Wiring diagram for control, alarm and safety system
   (6) Drawing of gas tanks including information on non-destructive testing of welds and strength and tightness testing of tanks
   (7) Drawings of support and staying of gas tanks
   (8) Specification of materials in gas tanks and gas piping systems
   (9) Specifications of welding procedures for gas tanks
   (10) Specification of stress relieving procedures for independent tanks type C
   (11) Specification of design loads and structural analysis of gas tanks
   (12) A complete stress analysis for gas tanks
   (13) Specification of cooling-down procedure for gas tanks
   (14) Arrangement and specifications of second barriers
   (15) Drawings and specifications of gas tank insulation
   (16) Arrangement of detection ends for gas detection, temperature measurement and pressure measurement

(15) Documentation detailing the effect on Stability (where necessary)
(16) Investigation table of electrical load analysis

3. **Plans and Documents for reference**

(1) Risk assessment
(2) Operation and maintenance manual
(3) MSDS for absorbent
(4) Strength calculation sheet for CO2 storage tank and structural supporter
(5) Calculation sheets of filling limits for CO2 storage tanks

105. Class Notation

1. **Table 7.1.1** shows the Class Notation of OCCS system, and the system installed for the purpose as above provisions of **102. 1** is basically given **CEmC-OCCS** notation of **Table 7.1.1**. In addition, **CEmC-OCCS(R)** and/or **(S)** may be additionally assigned if the relevant requirements are met.

Table 7.1.1 Class Notation of OCCS system

No	Notation	Relevant requirements
1	CEmC-OCCS	All requirements of this chapter excluding the relevant requirements of item **2** and **3** of **Table 7.1.1**
2	CEmC-OCCS(R)	In addition to requirements of **CEmC-OCCS**, redundancy requirements (Provisions of **306.**)
3	CEmC-OCCS(S)	In addition to requirements of **CEmC-OCCS**, test and survey requirements (**308.** and **Table 7.8.1**)

106. Equivalency

The equivalence of alternative and novel features which deviate from or are not directly applicable to this chapter is to be in accordance with **Pt 1, Ch 1, 105.** of **Rules for the Classification of Steel Ships**.

Section 2 Goal and Functional Requirements

201. Goal

The goal of this chapter is to ensure the safety of ships and personnel in particular installations of OCCS system, by describing the design and construction of ships.

202. Functional Requirements

1. Installation and operation of OCCS system is to be compatible with the fuel consumers and is not to cause any adverse effects on performance.
2. The safety, reliability and dependability of the systems are to be equivalent to that achieved with comparable to conventional exhaust gas piping systems of oil-fuelled main and auxiliary machinery and exhaust gas treatment systems referred to **Ch 2 Sec. 2, Sec. 3** and **Ch 3 Sec.2** of this guidance.
3. The probability and consequences of hazards related to absorbent and captured CO2 are to be limited to a minimum through arrangement and system design, such as ventilation, detection and safety actions. In the event of leakage or failure of the risk reducing measures, necessary safety actions are to be initiated.
4. The design philosophy is to ensure that risk reducing measures and safety actions for OCCS system do not lead to an unacceptable loss of power.
5. Unintended accumulation of explosive, flammable or toxic gas concentrations is to be prevented.

6. System components are to be protected against external damages.

7. It is to be arranged for safe and suitable absorbent supply and storage arrangements capable of receiving and containing in the required state without leakage.

8. Piping systems, containment and over-pressure relief arrangements that are of suitable design, construction and installation for their intended application are to be provided.

9. Absorber, regenerator and related components are to be designed, constructed, installed, operated, maintained and protected to ensure safe and reliable operation.

10. OCCS system are to be designed to minimize the risks associated with the storage, handling, consumption, and disposal of hazardous or non-hazardous chemicals, and essential consumables like absorbent for the operation of the system. Appropriate personnel protective equipment, together with emergency treatment facilities, appropriate to the hazards concerned, are to be provided.

11. Suitable control, alarm, monitoring and shutdown systems are to be provided to ensure safe and reliable operation of OCCS system.

12. Leakage detection, and fire protection, detection and extinguishing arrangements are to be provided at the places where OCCS system is installed against possible hazards associated with the operation and/or stop of the systems.

13. The technical documentation is to permit an assessment of the compliance of the system and its components with the applicable rules, guidelines, design standards used and the principles related to safety, availability, maintainability and reliability.

14. A single failure in a technical system or component is to not lead to an unsafe or unreliable situation.

Section 3 Configuration

301. General

1. OCCS system are to be arranged that the pressure in exhaust gas pipes does not exceed the allowable back pressure recommended by fuel consumers manufacturer.

2. When a pre-scrubber is provided to adjust the temperature and humidity fitting to the optimal conditions of the absorption process and to remove SO2 in the exhaust gas, the chemical treatment piping, washwater piping and residue systems, and control and monitoring system shall be complied with **207.** and **208.** of **Ch 3 Sec.2** of this guidance respectively. Unless regulations or conventions specified otherwise, washwater from pre-scrubber shall be complied with **Res.MEPC.307(73)** and **Res.MEPC.340(77)**.

3. OCCS system is to be so designed that it can withstand the loads corresponding to the static and dynamic inclination angles specified in **Ch 5, Sec 1, 103. 1** of **Rules for the Classification of Steel Ships**.

302. Risk Assessment

1. Risk assessment shall be conducted to determine whether the risks arising from the handling of absorbents and the storage of CO2 in OCCS system have dealt with effect on personnel, environment, and structural strength or integrity.

2. The risks shall be evaluated using acceptable and recognized risk assessment techniques. The evaluated risks shall be reduced to a reasonable level through elimination or mitigation measures.

3. The subject of risk assessment shall include at least:
   (1) Supply, storage, handling and unloading system(if installed) of absorbent
   (2) Compression, liquefaction, storage and unloading system of carbon storage system (if installed)
   (3) Supply, storage, and handling of refrigerant for carbon dioxide liquefaction system *(2024)*

4. Expected risks shall include at least:

(1) Leakage of absorbent
(2) Leakage of CO2
(3) Leakage of refrigerant for carbon dioxide liquefaction system *(2024)*
(4) Failure and malfunction of components of carbon capture and storage system

5. When assessing the expected risks, those should be considered at least:

(1) Toxicity, flammability properties of absorbent
(2) The asphyxiation of CO2, especially when personnel on board are exposed
(3) Toxicity, flammability properties of refrigerant *(2024)*

6. The Society may consider the acceptance of relaxations of requirements from **Ch.3** to **Ch.7** based on the risk assessment. *(2024)*

303. Stability

1. In the case of existing ships, data on light weight that is changed according to the installation of OCCS system is to be submitted, and if necessary, a revision of data related to stability may be requested.

2. For new ships, it is to be in accordance with **Pt 1, Ch 1, 307.** of **Rules for the Classification of Steel Ships.**

304. Compatibility with Fuel Consumers

1. The data are to be provided to confirm not to exceed the approved design limits of OCCS system with the whole operational range of fuel consumers.

2. The connected fuel consumers shall not be disturbed due to excessive back pressures or high temperatures due to operating OCCS system. Where necessary, considerations like extract fans will be given to maintain the operating condition of fuel consumers within the approved design limits.

305. By-pass Operation

1. A bypass arrangement of OCCS system or changeover system is to be installed to enable continued operation of the fuel consumers irrespective of the operation of fuel consumers. The following cases are also contained the not in operation of OCCS system:

(1) Operation mode selection of OCCS system
(2) Not in operation of absorbent circulation system; or,
(3) Failure of OCCS system

2. The arrangement or system may not be installed when it is ensured the flow of exhaust gas is not restricted and there is no risk of a failure that results in the stop of fuel consumers.

306. Redundancy (Only when the "CEmC-OCCS(R)" class notation is applied)

1. A redundancy is to be ensured for major equipment of OCCS system including carbon dioxide liquefaction system such as pumps, fans, blowers, etc. and is to be arranged to operate the system continuously in rated capacity whichever one major equipment is failed.

2. To comply with **1.**, an alternative means can be considered per each equipment. The material is to be submitted demonstrating that the alternative means provides the reliability of the system and continuous operation of OCCS system, without compromising the vessel propulsion and maneuvering capability.

3. Where ships fitted with two or more identical OCCS systems, a common standby pump (for each essential system) capable of serving all the systems will be acceptable in lieu of providing individual standby pumps for each system.

4. When the major equipment is failed, standby equipment are to be automatically started and put into service. This failure is to be alarmed at the remote-control station(s) such as the bridge or engine control station.

307. Prevention of Flooding

1. Washwater of pre-scrubber or absorbent of absorber is to be prevented from ingress into fuel consumers.
2. Alarm and shutdown arrangements are to be provided to prevent an abnormal rise of absorbent level in the absorber of carbon capture system.

308. OCCS system Equipment

1. **Pumps/Blowers/Compressor**
   (1) When the "**CEmC-OCCS(S)**" class notation is applied, equipment required for continuous operation of OCCS system, such as absorbent transfer pumps, lean absorbent supply pumps, rich absorbent regenerating pumps, CO2 pump/compressor and blowers are certified in accordance with the relevant requirements of **Pt 5, Ch 1, 210** & **Ch 6. Sec.14** of **Rules for the Classification of Steel Ships**.
2. **Pressure vessel (incl. Heat Exchangers)**
   (1) Where provided, pressure vessles including heat exchangers are to comply with the requirements specified in **Pt 5 Ch 5, Sec. 3** of the **Rules for the Classification of Steel Ships**. However, a regenerator does not consider as a kind of heat exchanger.
3. **Electrical Systems**

For items not specified in this Section, the relevant requirements specified in **Pt 6** of the **Rules for the Classification of Steel Ships** apply.

(1) Electrical Motors and controlgears for motors
When the "**CEmC-OCCS(S)**" class notation is applied, motors and controlgears for motors are to be certified in accordance with the relevant requirements specified in **Pt 6** of the **Rules for the Classification of Steel Ships**.

(2) Circuit Protection Devices
Circuit breakers are to be installed for miscellaneous OCCS system electrical loads and are to be compatible with the prospective short circuit current level calculated at the switchboards.

Section 4 Carbon Capture System

401. General

1. Pipings of carbon capture system are to comply with **Ch 6 Pt 5** of the **Rules for the Classification of Steel Ships**, unless specified in this section otherwise.
2. The material for absorber, regenerator, absorbent storage tank and components of carbon capture system like heat exchangers, pipe fittings, pumps, valves is to be selected taking into account the the corrosive characteristics of the absorbent and working pressure and temperature of them.

402. Absorber

1. **Absorbent injection system**
   (1) Injection control system
   The amount of injected absorbent is to be appropriately controlled depending upon the load of fuel consumers or quantity of carbon emissions in consideration of the temperature of the exhaust gas at the inlet of absorber.
2. **Devices for monitoring amount of injected absorbent**

Device for monitoring the amount of injected absorbent when using the carbon capture system are to be provided at least one of the monitoring stations for at least one place among a bridge if a bridge control system is installed, engine control room, or machine control side.

3. Safety and alarm devices

The absorbent injection system is to be provided with safety and alarm devices to prevent the injection of absorbent when the temperature at the exhaust gas outlet of fuel consumers or the inlet of carbon capture system exceeds the preset level.

403. Exhaust Gas Piping System

1. General

(1) The sections of carbon capture system that are subjected to absorbent (e.g. the interior reaction chamber or absorbent piping/nozzles, etc.) are to be constructed of suitable corrosion resistant materials.

(2) Exhaust gas piping systems after carbon capture system are to be of a corrosion resistant material such as stainless steel or to be coated with a suitable corrosion resistant materials.

2. Safety and alarm devices

(1) Valves used in the carbon capture system are to comply with the relevant requirements specified in **Pt 5, Ch 6** of the **Rules for the Classification of Steel Ships**. The valves are to be constructed of corrosion resistant materials.

(2) Where bypass arrangements for carbon capture system are provided to comply with **305. 1.**, the bypass arrangement or changeover system is to be fail safe manner.

(3) Valves are to be installed in accessible locations, clear of or protected from obstructions, moving equipment, and hot surfaces, in order to permit regular inspection and periodic servicing.

3. Interconnection of exhaust gas piping

(1) Exhaust gas pipes from fuel consumers are generally to be routed separately and not interconnected.

(2) However, interconnected exhaust piping systems to a common carbon capture system may be accepted when complied with the followings:

(A) The materials are to be submitted with **104. 2** to demonstrate that the OCCS system is capable of accommodating the maximum combined exhaust flows of all the connected fuel consumers for the worst case scenario for that particular ship arrangement and operational profile.

(B) The specific means are to prevent the passage of exhaust gases to other fuel consumers or spaces.

(C) In case of dual fuel and/or gas only internal combustion engines which are required to have their own independent exhaust piping, carbon capture system with a common exhaust gas piping is to be accepted by Flag Administration.

4. Insulation

Hot surfaces of OCCS system and their associated equipment or systems likely to come into contact with the crew during operation are to be suitably guarded or insulated. Where the surface temperatures are likely to exceed 220°C and where any leakage, under pressure or otherwise, of fuel oil, lubricating oil, or other flammable liquid is likely to come into contact with the OCCS system or exhaust pipes, these surfaces are to be suitably insulated with non-combustible materials that are impervious to such liquids.

404. Absorbent Piping System

1. General

(1) Absorbent piping systems are to be arranged taking into account the corrosiveness, explosiveness, combustibility and impact on human life of the absorbent.

(2) Absorbent piping and venting systems are to be independent from the other piping system.

(3) Absorbent piping systems are not to pass through accommodation spaces, service spaces or control stations.

(4) Supply, transfer, and loading lines for absorbent systems are not to be located over boilers or in close proximity to steam piping, exhaust systems, hot surfaces required to be insulated, or other sources of ignition. Valves are to be in positions accessible to periodical inspection and

maintenance.

(5) Absorbent piping systems are to be classified into Class I or Class II piping specified in **Pt 5, Ch 6** of **the Rules for the Classification of Steel Ships**, taking into account the toxicity and corrosive, regardless of temperature and pressure of working media. However, vent and drain pipes can be regarded as Class III.

(6) Absorbent piping systems are to be all welded as possible. In case of the flanged connections are to be screened or otherwise suitably protected to avoid absorbent spray or leakage.

(7) The remote-controlled isolation valves are to be installed between each component of absorbent piping system such as absorber, regenerator, etc.

(8) In case of loss of power, the remote-controlled valves are to be fail-closed, or to be kept in their position when a measure is arranged to close the valves.

(9) The remote-controlled valves are to be indicated their position open/close clearly and to be arranged with open/close indicator at the remote-control stations.

(10) The pipe leading to the overflow tank is to be installed top on nor near the top of the tanks. If it does not possible, the non-return valve is to be installed on the piping system.

2. Material

(1) Absorbent piping systems, absorbent waste/overflow tank, drip tray and other components contacting to absorbents are to be of a corrosion resistant material such as stainless steel or to be coated with a suitable corrosion resistant materials.

3. Drip tray

(1) Drip tray is to be installed for places where are a risk of leakage from relevant components such as pumps, filter, heat exchangers, flanges and valves.

(2) Drain pipes leading to the overflow tank or alarm system are to be arranged at the drip tray. The non-return valve is to be installed on the drain pipe.

4. Ventilation system

(1) If a absorbent tank is installed in a closed compartment, the area is to be served by an effective mechanical supply and exhaust ventilation system is independent from the ventilation system of accommodation, service spaces, or control stations. Warning notices requiring the ventilation of spaces prior to entrance shall be provided outside the compartment adjacent to each point of entry and inside the compartment.

(2) The capacity of ventilation system is as following standard per absorbent. The capacity is changeable based on the risk assessment in accordance with **302.** taking into account the toxicity, flammability, and explosive nature of the absorbent.
(A) Sodium hydroxide (NaOH): 6 air changes per hour
(B) Monoethanolamine (MEA), N-methyldiethanolamine (MDEA): 30 air changes per hour
(C) Diethanolamine (DEA): 45 air changes per hour

(3) The outlet of ventilation system for compartment where the storage tank is located is to terminate in a safe location on the open deck and the tank venting system is to be arranged to prevent entrance of water into the tank.

(4) Where an absorbent tank is located within an engine room, providing an effective movement of air in the vicinity of the tank, the ventilation system for the engine room can be replaced with the ventilation system complied with (1) to (3). If a dedicated ventilation system is provided, the system is to be operated continuously except when the storage tank is empty completely.

(5) When absorbent storage tank is formed as an integral tank, the ventilation system in (1) is to be provided to spaces which is the enclose and adjacent to the tank with possible leak points (e.g. manhole, fittings) from this tank. And the system is to be operatable outside of the spaces.

(6) In addition to (5), when absorbent piping systems pass through spaces normally accessed by a person, the ventilation system in (1) is to be provided for spaces even if the spaces are not in the adjacent area. However, the ventilation system is not required if the piping system is made of steel or other equivalent material with melting point above 925 degrees C and with fully welded joints.

405. Absorbent Storage Tank

1. The absorbent storage tank is to be arranged so that any leakage will be contained and prevented from making contact with heated surfaces. All pipes or other tank penetrations are to be provided with manual closing valves attached to the tank. 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 accessible even in the event of absorbent leakages.

2. The storage tank is to be located within the engine room or the enclosed compartments except for locating on open deck.

3. For portable absorbent storage tanks whose support structure (container frame or truck chassis) is standardized as a container for international transport, the storage tanks are to be in accordance with requirements for the Guidance for Freight Containers. In addition, the storage tanks are to be arranged in compliance with the International Maritime Dangerous Goods (IMDG) code and **Pt 8, Ch 12** of **the Rules for the Classification of Steel Ships**. Absorbents are to be classified depending on risks by toxicity and flammability of them. *(2024)*

4. The material of absorbent storage tank is to be complied with **404. 2.**

5. The venting system is to be provided suitable for the absorbent and are to terminate in a safe location on the open deck and the tank venting system is to be arranged to prevent entrance of water into the tank.

6. The storage tank is to be protected from temperatures applicable to the particular concentration absorbent.

7. Where absorbent is stored in integral tanks, the following are to be considered during the design and construction:
   (1) These tanks may be designed and constructed as integral part of the hull, (e.g. double bottom, wing tanks).
   (2) These tanks are to be segregated by cofferdams, void spaces, pump rooms, empty tanks or other similar spaces so as to not be located adjacent to accommodation, cargo spaces containing cargoes which react with chemical treatment fluids in a hazardous manner as well as any food stores, oil tanks and fresh water tanks.
   (3) These tanks are to be designed and constructed as per the structural requirements in accordance with **Pt 3 Ch 15** of the **Rules for the Classification of Steel Ships** for a deep tank construction.
   (4) These tanks are to be included in the ship's stability calculation.

8. The absorbent storage tank is to be provided with temperature and level monitoring arrangements. A high temperature and high/low level alarm system be provided.

9. Drain trays of adequate size led to the overflow tank are to be provided under the absorbent storage tank.

10. The absorbent tanks are to be arranged so that they can be emptied of the fluids.

11. **Loading of absorbent**
   (1) When absorbent is loaded by the dedicated manifold, piping system is to be connected from manifold to the storage tank. The isolation valve is to be provided at the manifold.
   (2) When the manifold is arranged, the drip tray is to have a sufficient capacity to ensure that the maximum amount of spill according to the risk assessment can be handled.
   (3) The tray is to be fitted with a drain valve to enable rain water to be drained over the ship's side.

406. Regenerator(Stripper, Desorber)

Interior pipes of regenerator is to be complied with **Pt 5, Ch 5, 120.** of the **Rules for the Classification of Steel Ships**.

407. Overflow or Waste absorbent Tank

1. The material of overflow or waste absorbent tank is to be complied with **404. 2.**

2. The absorbent waste tank is to be independent from other tanks, except in cases where these this tank is also used as the overflow tanks.

3. The vent piping of the overflow or waste absorbent tanks are to be complied with 405. 4.

4. The overflow tank is to be arranged with a high level alarm.

5. Sounding arrangements are to be provided for the absorbent waste tank in accordance with **Pt 5, Ch 6, 203.** of the **Rules for the Classification of Steel Ships**.

408. Absorbent Leakage Detection

When absorbent leakage is detected in accordance with **404. 3.** (2), an alarm is to be initiated at the remote control location such as bridge control system and engine control room and at the local control location.

409. Fire Protection and Extinction

1. Where absorbor, desoprtion system or absorbent storage tank are installed in spaces other than engine-room, in determining fire integrity of divisions to adjacent spaces, the each space is to be categorized and applied **Pt 8, Ch 7, Sec. 1** of the **Rules for the Classification of Steel Ships** as follows:

(1) for ships carrying more than 36 passengers;
  (A) In case of amine-based absorbents, "⑪ Auxiliary machinery spaces, cargo spaces, cargo and other oil tanks and other similar spaces of moderate fire risk" in **Pt 8 Ch 7**, **102. 3** (2) (B) of the **Rules for the Classification of Steel Ships**,
  (B) In case of NaOH as absorbents, "⑩ Tanks, voids and auxiliary machinery spaces having little or no fire risk" in **Pt 8, Ch 7, 102. 3** (2) (B) of the **Rules for the Classification of Steel Ships**, or
  (C) Other than (A) and (B), it is to be determined by the Society.

(2) for ships carrying not more than 36 passengers and cargo ships: "⑦ Other machinery spaces" in **Pt 8, Ch 7**, **102. 4** (2) (B), **Pt 8, Ch 7**, **103. 3** (2) (B) and **Pt 8, Ch 7**, **104. 2** (2) (B) of the **Rules for the Classification of Steel Ships**.

2. Fire Fighting

(1) The spaces where the absorbent storage tanks are installed is to be provided two(2) sets of portable fire-extinguisher complied with FSS code taken into account the flammability and explosiveness of the absorbent. However, the fire extinguisher can be omitted when fixed fire exinguishing systems are arranged.

(2) When fixed fire-extinguishing systems are arranged in the spaces where the absorbent storage tanks are installed, the following systems may be considered for the spaces:
  (A) Fixed high-expansion foam fire-extinguishing system complying with FSS code suitable for extinguishing amine-based absorbent, or
  (B) Fixed pressure water-spraying fire-extinguishing system complying with FSS code

Section 5 Carbon Storage System

501. General

1. Equipment for CO2 storage system such as compressors, coolers, separators, and dryers is to be located in a dedicated space or compartment.

2. Spaces where CO2 storage system or piping systems are arranged are to be fitted with an extraction type of mechanical ventilation system designed to take air from the bottom of the space and to be sized to provide at least 6 air changes per hour. *(2024)*

3. Enclosed spaces where CO2 liquefaction systems with flammable refrigerant are arranged are to be fitted with an extraction type of mechanical ventilation system capable of at least 30 air changes per hour. But, the capacity of ventilation system may be adjusted depending on the risk assessment in **302.** *(2024)*

4. Where the spaces or compartments arranged CO2 liquefaction system with flammable refrigerant are to be regarded as hazardous spaces, electric equipment installed in the spaces or compartments are to be complied with **Pt 6, Ch1, Sec 1** of **the Rules for the Classification of Steel Ships** *(2024)*

5. Devices for continuously monitoring of CO2 accumulation is to be installed in spaces or compartment where CO2 liquefaction system or piping systems pass.
6. It should be provided to monitor the purity of collected CO2 as possible.
7. CO2 storage tank and piping systems are to satisfy **Pt 7, Ch 5, 1721.** and **1722.** of **Rules for the Classification of Steel Ships**. *(2024)*

502. CO2 Piping System

1. Liquefied carbon dioxide piping systems may be applied on Ch 7, Sec 3 of Rules for the Classification of Ships Using Low-flashpoint Fuels.
2. The (gaseous) CO2 piping systems are regarded as Class I piping systems complied with **Pt 5, Ch 6** of **the Rules for the Classification of Steel Ships**.
3. The CO2 piping systems are to be independent from the other piping system.
4. The CO2 piping systems for storage, transferring and unloading containing liquefied CO2 storage tank are not to pass through accommodation spaces, service spaces or control stations.
5. In case of loss of power, the remote-controlled valves are to be fail-closed, or to be kept in their position when a measure is arranged to close the valves.
6. The remote-controlled valves are to be indicated their position open/close clearly and to be arranged with open/close indicator at the remote-control stations.
7. The CO2 pipings are to be at least 0.8 m inboard from the ship's sides.

503. CO2 liquefication system *(2024)*

1. The liquefaction system to store captured CO2 is to comply with requirements for refrigerating machinery **Pt 6, Ch 1** of **the Rules for the Classification of Steel Ships**. However, **Pt 6, Ch 1 301. 2** of **the Rules for the Classification of Steel Ships** is only applied to ships assigned "**CEmC-OCCS(R)**" notation.
2. When using a refrigerant other than the one determined in the rules of **1.**, the liquefaction system is to be designed in consideration of the toxicity and flammability of the refrigerant.

504. CO2 storage tanks

1. Arrangement of CO2 storage tanks

(1) CO2 storage tanks are to be located in open decks, a dedicated CO2 tank room or compartment.
(2) The requirements of **Ch 5, 302.** of **Rules for the Classification of Ships Using Low-flashpoint Fuels** are to be applied to protect CO2 storage tanks from external damage due to collision or grounding.

2. Design of CO2 storage tanks

(1) Liquefied CO2 storage tanks are to be independent tank type C designed in accordance with **Ch 6** of **Rules for the Classification of Ships Using Low-flashpoint Fuels.**
(2) The CO2 storage tanks and pressure relief devices are to be designed to prevent venting of CO2 except in emergency situations.
(3) The liquid level indicating device, pressure monitoring device and temperature indicating device of the CO2 storage tank are to be installed and controlled in accordance with the relevant requirements in **Pt 7, Ch 5, Sec 13** of **Rules for the Classification of Steel Ships**.
(4) Each CO2 storage tank is to be monitored for its state of charge and protected from overfilling. The high liquid level alarm device is to be operated at a position that does not exceed the filling limit, and the emergency stop specified in table 7.6.1 is to activate remotely controlled valves to close CO2 supply pipe connected to the storage tank.
(5) The pressure of the liquefied CO2 storage tank is to be maintained at least 0.05 MPa above the triple point for the CO2 mixture. The "triple point" for pure CO2 occurs at 0.52 MPa absolute and -56.5 °C.

(6) The liquefied CO2 tanks' pressure and temperature are to be maintained at all times within their design range by means acceptable to the Society, e.g. by one of the following methods. The pressure and temperature control system is to be capable of withstanding the full vapour pressure, taking into account the conditions in which all CO2 storage tanks are filled and the ship's operating profile.
(A) reliquefaction of CO2 vapours
(B) liquid CO2 cooling
(C) pressure accumulation

(7) If the reference temperature of the CO2 storage tank complies with the requirements defined in **Pt 7, Ch 5, 1501. 3** of **Rules for the Classification of Steel Ships**, the maximum filling limit of CO2 stroage tanks are not to be greater than 98% at reference temperature.

(8) All materials used for liquefied CO2 storage tanks and piping systems are to be suitable for the lowest temperatures that may occur in service. This lowest temperature refers to the saturation temperature of CO2 at the set pressure of the automatic safety device.

(9) The CO2 storage system design is to take into account the composition of CO2, impurities and water content, including the effect on the "triple point" of CO2 and corrosiveness.

(10) Detailed operating and maintenance manuals are to be provided with overall operating procedures between dry-docking of CO2 storage tanks and associated compression, cooling and liquefaction system. Operating procedures are to include at least cooling down, unloading, gas freeing, pressure/temperature control, emergency shutdown, maintenance and inspection.

3. Design of portable CO2 storage tanks *(2024)*

(1) Portable CO2 storage tanks are to comply with the follows as well as the requirements in 2 above.

(2) For portable CO2 tanks whose support structure (container frame or truck chassis) is standardized as container for international transport, tanks are to be in accordance with requirements for thermal container and/or tank container specified in **Guidance for Freight Containers**. Where the support structure is not standardized for international transport, the applicable tests specified in **Guidance for Freight Containers** can be appropriately adjusted or omitted in consideration of the load that can occur during stacking and loading/unloding operations of the portable CO2 storage tank.

(3) Portable CO2 tanks are to be located in dedicated areas fitted with:
(A) mechanical protection of the tanks depending on location and cargo operations; and
(B) if located on open deck: spill protection and measures to prevent the temperature rise of the storage tanks in case of fire in adjacent area.

(4) Portable CO2 tanks are to be secured to the deck while connected to the ship systems. The arrangement for supporting and fixing the tanks are to be designed for the maximum expected static and dynamic inclinations, as well as the maximum expected values of acceleration, taking into account the ship characteristics and the position of the tanks.

(5) Consideration is to be given to the strength and the effect of the portable CO2 tanks on the ship's stability.

(6) Connections to the ship's fuel piping systems are to be made by means of approved flexible hoses or other suitable means designed to provide sufficient flexibility.

(7) Arrangements are to be provided to limit the quantity of fuel spilled in case of inadvertent disconnection or rupture of the non-permanent connections.

(8) The pressure relief system of portable CO2 tanks is to be connected to a fixed venting system.

(9) Control and monitoring systems for portable CO2 tanks are to be integrated in the ship's control and monitoring system. Safety system for portable CO2 tanks is to be integrated in the ship's safety system (e.g. shutdown systems for tank valves, leak/gas detection systems).

(10) Safe access to tank connections for the purpose of inspection and maintenance is to be ensured.

505. Leakage Detection

1. At least two sets of CO2 detectors are to be arranged in an enclosed space where there is a possibility of leakage of CO2

2. If carbon dioxide is detected in excess of 1%, an alarm is to be initiated at the remote control location such as bridge control system and engine control room and at the local control location.

3. At least two sets of portable CO2 detection devices are to be provided on board.

4. Where flammable refrigerants are used for CO2 liquefaction system, leakage detection systems are to be arranged in the space installed CO2 liquefaction system.

506. Fire Protection and Extinction *(2024)*

1. Where carbon storage system including CO2 liquefaction system are installed in spaces other than engine-room, in determining fire integrity of divisions to adjacent spaces, the each space is to be categorized and applied **Pt 8, Ch 7, Sec. 1** of the **Rules for the Classification of Steel Ships**, taking into account the flammability of refrigerants.
2. Where flammable refrigerants are used for CO2 liquefaction system, spaces where the CO2 liquefaction system are installed is to be provided with fixed fire extinguishing systems suitable for the refrigerants.
3. Where flammable refrigerants are used for CO2 liquefaction system, spaces where the CO2 liquefaction system is installed are to be provided with a fixed fire detection and fire alarm system.

Section 6 System Design

601. General

1. The control system of carbon capture and storage system may consist of an integrated system or independent control systems.
2. The control system shall be designed so that a single failure of the control system does not affect personnel safety and ship safety.

602. Control and monitoring systems

1. Automatic control, monitoring, alarm and safety systems shall be installed on carbon capture and storage system to ensure that the design parameters are not exceeded under all operating conditions of fuel consumers, and OCCS system. For ships assigned with the notation for automatic and remote control systems in accordance with **Pt 9, Ch 3** of **Rules for the Classification of Steel Ships**, the alarm and monitoring systems shall be integrated with the ship's centralized monitoring and control systems.
2. Temperature, pressure, and flow in OCCS system and related systems shall be controlled and monitored as follows:
   (1) Local control and monitoring systems shall be provided for safe operation, maintenance and effective control in case of emergency or remote control failure.
   (2) The control system shall be designed to identify failures of process systems and equipment. The control and monitoring systems shall comply with the requirements of **Pt 9, Ch 3, 302. 4** of **Rules for the Classification of Steel Ships**.
   (3) For the safe and effective operation of the OCCS system, the necessary parameters shall be displayed on the local and at the remote control location, including the followings:
      (A) The operating status of the pumps, fans, blowers and motors of the carbon capture and storage system
      (B) Level indication of absorber and absorbent storage tanks
      (C) Level indication for CO2 storage tank of carbon storage system
      (D) Pressure indication for CO2 storage tank of carbon storage system
      (E) Level indication of CO2 storage tanks for carbon storage system
      (F) Parameters required for the safe operation of OCCS system
3. Each control, monitoring, and safety system shall be powered via a separate circuit. Each of these circuits shall be protected against short circuit and monitored for power failures.

603. Emergency Stop System

1. An emergency stop system shall be installed that operates independently of the control and alarm

systems. The emergency stop system shall have the following functions:

(1) A means shall be provided for indicating the parameter that causes the emergency stop.
(2) When an emergency stop is triggered, an alarm shall be initiated at the normal control location and at the local control location.
(3) If the operation of an equipment or device is stopped due to an emergency stop, the equipment or device shall not automatically restart before being manually reset.

2. Monitoring and safety systems shall be in accordance with **Table 7.6.1**.

Table 7.6.1 Monitoring and safety functions for OCCS system

Parameters	Display	Alarm activated	Automatic Shutdown
Fan/blower motors for OCCS system (when installed)	Run	Stop	
By-pass or changeover valve of carbon capture system(when installed)	Position		
Exhaust gas temperature after absorber (except if dry running can be used)	●	H	HH
Differential pressure across absorber		H	HH
Pump for carbon capture system	Run	Stop	
Pressure for carbon capture system		L	
Level in absorber, Regenerator		H	HH
Temperature of absorbent storage tank		H	
Level of absorbent storage tank	●	L/H	
Level of drip tray for onboard carbon capture and storage system		H	
Level of absorbent overflow tank		H	
Pump/Compressor for carbon storage system	Run	Stop	
Level or Loading rate of CO2 storage tank	●	H	HH
Pressure for liquefied CO2 storage tank	●	L/H	LL/HH
Temperature for liquefied CO2 storage tank	●	L/H	LL/HH
power supply fail of control, alarm, monitoring or safety device	-	Fail	

Section 7 Safety and Personnel Protective Equipment.

701. For the protection of crew members, the vessel shall have on board suitable protective equipment consisting of aprons, gloves with long sleeves, boots, coveralls of chemical-resistant material, and chemical safety goggles or face shields or both. And, the quantity to be supplied is to be at least two sets.

702. Eyewasher and safety showers are to be provided near the manifold for loading absorbent. If several manifolds are installed on the same deck, one could be installed if the manifold can be easily accessed to eyewasher and safety shower from the manifold. *(2024)*

Section 8 Survey

801. General

1. This section is applied to inspection for installation of OCCS system.

802. Production and Installation Survey

1. Inspection and verification that the foundations and attachments of the principal components of the OCCS system are in accordance with the approved plans and particulars.
2. Piping systems are to be examined and tested in accordance with **Pt 5, Ch 6, Sec. 14** of the **Rules for the Classification of Steel Ships**.
3. Electrical equipment are to be examined and tested in accordance with **Pt 6, Ch 1** of the **Rules for the Classification of Steel Ships**.
4. Following tests may be incorporated with the tests required by **Pt 5, Ch 2, 211.** of the **Rules for the Classification of Steel Ships**.
5. Instrumentation is to be tested to confirm proper operation as per its predetermined set points.
6. Pressure relief and safety valves installed on the unit are to be tested.
7. Control system and shutdowns are to be tested for proper operation.
8. The components of the OCCS system are to be tested and inspected in accordance with **Table 7.8.1**.

Table 7.8.1 Test and Survey for components of OCCS system

No.	Components	Type approval	Drawing approval	Test and Survey
1	Carbon-dioxdie emission monitoring system	●(6)		
2	Control panel for OCCS system	●(6)	●	●
3	Pump (incl. motors and controlgears for motors(1),(2)		●(8)	●
4	Compressor/Blower (incl. motors and controlgears for motors)(1),(2)		●(8)	●
5	Absorber, Regenerator body(1),(3),(7)			●
6	Heat exchanger(4)		●(9)	●
7	Abosbent storage tank, absorbent waste tank, overflow tank(1),(5)			●

Note.
(1) For the applicable class notation '**CEmC-OCCS(S)**' in **Table 7.1.1**
(2) Components for the continual operation of the OCCS system are to be tested in accordance with the requirements specified in **Pt 5, Ch 6 & Pt 6** of the **Rules for the Classification of Steel Ships**.
(3) The entire length of both longitudinal and circumferential welded joints and exhaust gas pipe or wash water pipe joints on scrubber body are to be subjected to liquid penetrant testing(PT). Where considered necessary by the Surveyor, additional non-destructive test may be required.
(4) It shall be inspected based on the **Rules for the Classification of Steel Ships** of **Pt 5 Ch 5 Sec 3**.
(5) Storage tank that do not form part of the hull are to be subjected to a hydraulic test at a head pressure of 2.5 m on the tank top plate, together with the attachment after manufacture.
(6) Where equipment specified in **Guidance relating to the Rules for the Classification of Steel Ships Pt 6, Ch 1** and **Ch 2, 301.1** is installed, Regardless of class notation, the type approval product is to be installed.
(7) When ships install carbon capture and storage system without by-pass arrangement of carbon capture system required in **305.** pre-scrubber body(when applied) and absorber is to be performed non-destructive examinations irrespective of notation in **105.**
(8) Only applicable for rated output 100kW and above
(9) Only applicable for PV-1 and PV-2

803. Annual Survey

The annual survey of ships installed with OCCS system is to be included the followings:

1. External examination of all components, including absorber and desorption system etc.

2. Performance test of the instrumentation, control, monitoring, and safety equipment including indicators and alarms.

3. Performance test of Changeover devices of exhaust gas pipes and the corresponding indicator

4. Operation test of Remote control valves for absorbent or CO2 storage tanks

5. General examinations of safety and protective equipment

6. Performance test of eyewash and decontamination showers

7. Warning notices as per **404. 4.**

8. Performance test of extract fan (refer to **304. 2.**)

804. Intermediate Survey

Requirements as required by the Annual Survey in **803.** above are to be surveyed.

805. Special Survey

In addition to all the requirements for Annual Survey in **803.**, the following items are to be surveyed.

1. Opening up examination of pumps, exhaust fans and blowers
2. Internal examination of absorbent storage tank and absorber
3. Operation test of absorbent injection control valves
4. Internal examination of CO2 storage tank
5. Visual inspection of CO2 storage tanks and insulation in way of chocks, supports, keys and other parts which consist of the foundation of tanks. (Removal of insulation may be required in order to verify the condition of the tank or the insulation itself if found necessary by the Surveyor)
6. Non-destructive inspection of the main structural members, tank shell and highly stressed parts, if deemed necessary by the Surveyor. (However, for type C tanks, this does not mean that non-destructive testing can be dispensed with totally.)
7. Tightness tests of all CO2 storage tanks
8. A hydraulic or hydro-pneumatic test where findings of **4** to **7** or an examination of the voyage records raises doubts as to the structure integrity of CO2 storage tanks. (For integral tanks and for independent tank type A and B, the test pressure is to be carried out in accordance with proper pressure based on design of each tank. For independent tank type C, the test pressure is not to be less than 1.25 times the MARVS.)
9. At every other special survey (i.e., 2nd, 4th, 6th, etc) all independent CO2 storage type C are to be either:
   (1) Hydraulically or hydro-pneumatically tested to 1.25 times MARVS, followed by non-destructive testing in accordance with (C), or
   (2) Subjected to a thorough, planned non-destructive testing. This testing is to be carried out in accordance with a programme specially prepared for the tank design. (At least 10 % of the length of the welded connections in each of the above mentioned areas is to be tested. This testing is to be carried out internally and externally as applicable. Insulation is to be removed as necessary for the required non-destructive test.)
10. Visual inspection as far as practicable of all storage tank spaces and insulation, secondary barriers(if appicable) and tank supporting structures ⚓

CHAPTER 8 Onboard Carbon capture and storage system Ready Ships

Section 1 General

101. General

1. This Chapter applies to ships which are prepared for conversion with the design or the partial installation related with OCCS system mentioned in **Ch 7** during the new building phase or in-service.

2. This Chapter contains levels of readiness for OCCS system and requirements applicable thereto, and the scope of preparation is defined by the agreement between the shipowner and the shipbuilder.

3. This Chapter defines ready levels of OCCS system in three steps.

4. The definitions of terms in this chapter are to be as specified in **Ch.7 103**.

102. Class Notation

1. General

(1) The class notations specified in **2.~4.** may be assigned depending on the ready levels for OCCS system.

(2) The requirements for each class notation in this Section are to comply with **Sec 3**.

2. OCCS Ready D(A)

(1) **OCCS Ready D(A)** as an additional special feature notation may be assigned to ships whose OCCS system concept design is prepared for evaluation of the basic suitability.

(2) **OCCS Ready D(A)** is not to be assigned to ships having **OCCS Ready D**.

3. OCCS Ready D

OCCS Ready D as an additional special feature notation may be assigned to ships for which the generic design is prepared.

4. OCCS Ready I

(1) **OCCS Ready I** as an additional special feature notation may be assigned to ships for which parts of the systems are installed with the detailed design in addition to the generic design.

(2) In assignment of the **OCCS Ready I**, the characters corresponding to the installed items may be assigned in the bracket one or a combination of them in addition to **OCCS Ready I**. The characters corresponding to the installed items are as follows:
- (A) Absorbent storage Tank - AT
- (B) Structural Reinforcement for AT - SRat
- (C) CO2 storage Tank - CT
- (D) Structural Reinforcement for CT - SRct
- (E) Absorbent System - AS
- (F) Absorbent Loading system - ASl
- (G) CO2 piping System - CS
- (H) CO2 Unloading system - CSu
- (I) Absorber - AB
- (J) Regenarator - RG
- (K) Pre-scrubber - PS
- (L) CO2 Liquefaction system - LQ
- (M) Exhaust gas system - EX

(3) For example, OCCS Ready I(AT, SRct) may be assigned to the ship on which Absorbent storage tank with structural reinforcement for OCCS system are installed.

Section 2 Requirements for Ready Levels

201. General

1. This Section prescribes plans to be submitted and consideration for preparing(refer to **205.**) OCCS system. The design and installation of structures and systems are to be in accordance with applicable requirements in **Ch 7**.
2. Drawing approval and survey for OCCS system ready are not accepted as Drawing approval and survey for conversion of the system. When the ship is converted, drawing approval and survey are to be carried out in accordance with **Ch 7** in force at the time of the ship conversion. Approved Drawings and certifications from new building stage may be used as reference for conversion.

202. General Level that fits Concept Design Review (OCCS Ready D(A))

1. Plans and documents required for an Approval in Principle (AIP) are to be submitted for **OCCS Ready D(A).** List of plans and documents to be submitted may be mediated after consultation with the Society.
2. The plans and documents required in this Section is to be marked "OCCS Ready" to separate them from the normal plans and documents of new building.

203. General Level that fits the preparation of a Generic Design (OCCS Ready D)

1. This paragraph prescribes plans and documents to be submitted for **OCCS Ready D**. The detail requirements for designs are to be in accordance with applicable requirements in Ch 7.
2. The plans and documents required in this paragraph is to be marked "OCCS Ready" to separate them from the normal plans and documents of new building.
3. Where parts of plans and documents required in this paragraph are not available, alternative documents may be accepted by the Society's review.
4. Plans and documents
   (1) General arrangement of ship
   (2) Arrangement, installation, layout of the OCCS system
   (3) Arrangement of machinery space where OCCS system are installed
   (4) Arrangement and capacity of tanks for absorbent, CO2 and washwater, etc (if applicable)
   (5) Arrangement of exhaust gas system
   (6) Documentation detailing the effect on electric load
   (7) Documentation detailing the effect on Load Line and Stability
   (8) Documentation of risk identification

204. Level that fits the Installation of Parts of Systems (OCCS Ready I)

1. Plans and documents

(1) OCCS Ready I includes the approval of the detailed drawings and the installation of the specific equipment mounted on the ship and is classified as a separate system as shown below. However, if approved by the Society, the some modifications may be made depending on the type of equipment.
   (A) Absorbent storage Tank - AT
   (B) Structural Reinforcement for AT - SRat
      - Hull plans showing the foundation and attachments of accessories to the vessel's structure, including scantlings, welding details, and foundation details of principal components
   (C) CO2 storage Tank - CT
   (D) Structural Reinforcement for CT - SRct
      - Hull plans showing the foundation and attachments of accessories to the vessel's structure, including scantlings, welding details, and foundation details of principal components
   (E) Absorbent System - AS
      - Detailed drawings of carbon capture system and related equipment including piping diagram and fittings and tank(s)

(F) CO2 piping System - CS
- Detailed drawings of CO2 storage system and related equipment including piping diagram and fittings and tank(s)

(G) Absorber - AB
(H) Regenarator - RG
(I) Pre-scrubber - PS
(J) CO2 Liquefaction system - LQ *(2024)*
- Detailed drawings of CO2 Liquefaction system and related equipment including piping diagram and fittings and tank(s)

205. Consideration for preparing OCCS system

1. The engine casings are to be designed and arranged considering size of absorber, regenerator and monitoring system.

2. The machinery space are to be designed and arranged considering related carbon capture and storage system and tanks if applicable.

3. The sea suction and overboard discharge outlets are to be designed considering installation of absorbent system, CO2 storage system, washwater system(when pre-scubber is provided) and related component if applicable.

4. In calculating the capacity of the generator and switch board, the electric load/switch board that is increased/added due to the installation of OCCS system are to be considered and reflected in the submitted plans and/or documents in **203.** and **204.**

5. The effects of stability and load line due to the installation of OCCS system are to be considered and reflected in the drawings submitted in **203.** and **204.**

6. Ships for which parts of the systems are installed with the detailed design, an additional risk assessment should be conducted in accordance with **302.** of **Ch 7** depending on installed equipment or systems.

7. In the calculation of fire extinguishing agents for fixed fire extinguishing systems for machinery space, the increase or decrease in the volume of the machinery is to be considered due to the installation of OCCS system.

8. Consideration is to be given to fire extinguishing equipment which is required to be installed or maintained in the machinery space due to installation of OCCS system.

Section 3 Survey

301. Classification survey during construction

The shop test and onboard test are to be in accordance with **Ch 7**.

302. Periodical surveys

Periodical surveys in application of this Section, the general condition of the relevant systems installed on board is to be examined visually at periodical surveys for the vessels having **OCCS Ready I** notation. The systems are to be surveyed and evaluated for the condition at time of conversion, and the scope of test will be defined depending on time elapsed from new building and maintenance level of the systems. ⚓

GUIDANCE FOR PREVENTION SYSTEMS OF POLLUTION FROM SHIPS

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