RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part D Machinery Installations

Rules for the Survey and Construction of Steel Ships
Part D 2017 AMENDMENT NO.2
Guidance for the Survey and Construction of Steel Ships
Part D 2017 AMENDMENT NO.2

Rule No.92 / Notice No.96 25 December 2017
Resolved by Technical Committee on 26 July 2017

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An asterisk (*) after the title of a requirement indicates that there is also relevant information in the corresponding Guidance.

RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

RULES

Part D Machinery Installations

2017 AMENDMENT NO.2

Rule No.92 25 December 2017

Resolved by Technical Committee on 26 July 2017

An asterisk (*) after the title of a requirement indicates that there is also relevant information in the corresponding Guidance.

Rule No.92 25 December 2017
AMENDMENT TO THE RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

"Rules for the survey and construction of steel ships" has been partly amended as follows:

Part D MACHINERY INSTALLATIONS

Chapter 1 GENERAL

1.3 General Requirements for Machinery Installations

1.3.1 General*

Sub-paragraph -10 has been added as follows.

10 The exhaust gas treatment systems specified in the following **(1)** and **(2)** fitted onto machinery installations are to be to the satisfaction of the Society.
(1) Selective catalytic reduction (SCR) systems
(2) Exhaust gas cleaning systems (EGCS) (excluding those specified in **2.1.1-5**)

Chapter 2 DIESEL ENGINES

2.1 General

2.1.1 General*

Sub-paragraph -5 has been added as follows.

5 Diesel engines fitted with exhaust gas recirculation (EGR) systems are to be in accordance with requirements specified otherwise by the Society in addition to those in this Chapter.

Chapter 13 PIPING SYSTEMS

13.16 Exhaust Gas Piping Arrangements*

Paragraph 13.16.1 has been amended as follows.

13.16.1 Exhaust Gas Pipes from Diesel Engines
1 In principle, the exhaust gas pipes of two or more diesel engines are not to be connected together except in the following **(1)** and **(2)** cases:~~.~~ ~~In cases where these pipes are connected to a~~

~~common silencer, effective means are to be provided to prevent the exhaust gas from returning into any cylinders of non-operating engines.~~

(1) In cases where exhaust gas pipes of two or more diesel engines are connected to common silencers and effective means are provided to prevent any exhaust gas from returning into the cylinders of non-operating engines.

(2) In cases where exhaust gas pipes of two or more diesel engines are connected to common exhaust gas cleaning systems deemed appropriate by the Society.

2 Exhaust gas piping lines that are led overboard near the water line are to be so arranged as to prevent water from being siphoned back into the cylinders.

3 Boiler uptakes and exhaust piping lines from diesel engines are not to be connected together except in the following **(1)** and **(2)** cases:~~, except in cases where the boilers are arranged to utilize waste heat from the diesel engines.~~

(1) In cases where boilers are arranged to utilize waste heat from diesel engines.

(2) In cases where boiler uptakes and exhaust piping lines from diesel engines are connected to common exhaust gas cleaning systems deemed appropriate by the Society.

EFFECTIVE DATE AND APPLICATION

1. The effective date of the amendments is 1 January 2018.

2. Notwithstanding the amendments to the Rules, the current requirements apply to SCR systems, EGR systems and EGCS whose applications for approval are submitted to the Society before the effective date installed on ships for which the date of contract for construction* is before the effective date.

* "contract for construction" is defined in the latest version of IACS Procedural Requirement (PR) No.29.

IACS PR No.29 (Rev.0, July 2009)

1. The date of "contract for construction" of a vessel is the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. This date and the construction numbers (i.e. hull numbers) of all the vessels included in the contract are to be declared to the classification society by the party applying for the assignment of class to a newbuilding.

2. The date of "contract for construction" of a series of vessels, including specified optional vessels for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective owner and the shipbuilder.

For the purpose of this Procedural Requirement, vessels built under a single contract for construction are considered a "series of vessels" if they are built to the same approved plans for classification purposes. However, vessels within a series may have design alterations from the original design provided:

(1) such alterations do not affect matters related to classification, or

(2) If the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the shipbuilder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for approval.

The optional vessels will be considered part of the same series of vessels if the option is exercised not later than 1 year after the contract to build the series was signed.

3. If a contract for construction is later amended to include additional vessels or additional options, the date of "contract for construction" for such vessels is the date on which the amendment to the contract, is signed between the prospective owner and the shipbuilder. The amendment to the contract is to be considered as a "new contract" to which **1.** and **2.** above apply.

4. If a contract for construction is amended to change the ship type, the date of "contract for construction" of this modified vessel, or vessels, is the date on which revised contract or new contract is signed between the Owner, or Owners, and the shipbuilder.

Note:
This Procedural Requirement applies from 1 July 2009.

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

GUIDANCE

Part D Machinery Installations

2017 AMENDMENT NO.2

Notice No.96 25 December 2017

Resolved by Technical Committee on 26 July 2017

Notice No.96 25 December 2017
AMENDMENT TO THE GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

"Guidance for the survey and construction of steel ships" has been partly amended as follows:

Part D MACHINERY INSTALLATIONS

Amendment 2-1

D15 STEERING GEARS

D15.2 Performance and Arrangement of Steering Gears

Paragraph D15.2.7 has been amended as follows.

D15.2.7 Electrical Installations for Electric and Electrohydraulic Steering Gear

1 Motors for steering gear power units may be rated for intermittent power demand. In such cases, the rating is not to be less than specified in **(1)** or **(2)**. Furthermore, S3 and S6 are to be in accordance with *IEC* 60034-1 or *JIS C* 4034-1.

(1) For motors of electric steering gear power units : S3-40%

(2) For motors of electrohydraulic steering gear power units : S6-25%

2 In cases where steering gear circuits, fed through electronic inverter units which control steering gear turning speed controls and their currents, are limited to being not more than the rated current of such electronic inverters, the requirements to provide protection devices against excess current specified in **15.2.7-6, Part D of the Rules** may be omitted. In these cases, they are to comply with the following requirements:

((1) to (3) are omitted.)

EFFECTIVE DATE AND APPLICATION (Amendment 2-1)

1. The effective date of the amendments is 25 December 2017.

Amendment 2-2

D1 GENERAL

D1.3 General Requirements for Machinery Installations

D1.3.1 General

Sub-paragraph -5 has been added as follows.

5 With respect to the wording "the satisfaction of the Society" specified in **1.3.1-10, Part D of the Rules**, the following **(1)** and **(2)** apply:

(1) Selective catalytic reduction (SCR) systems are to comply with **Annex D1.3.1-5(1)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF SELECTIVE CATALYTIC REDUCTION SYSTEMS AND ASSOCIATED EQUIPMENT".

(2) Exhaust gas cleaning systems (EGCS) are to comply with **Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT".

D2 DIESEL ENGINES

D2.1 General

D2.1.1 General

Sub-paragraph -3 has been added as follows.

3 The wording "requirements specified otherwise by the Society" referred to in **2.1.1-5, Part D of the Rules** means **Annex D2.1.1-5** "Guidance for the Survey and Construction of Exhaust Gas Recirculation Systems and Associated Equipment".

D13 PIPING SYSTEMS

Section D13.16 has been added as follows.

D13.16 Exhaust Gas Piping Arrangements

D13.16.1 Exhaust Gas Pipes from Diesel Engines

1 The wording "common exhaust gas cleaning systems deemed appropriate by the Society" specified in **13.16.1-1(2)** and **13.16.1-3(2), Part D of the Rules** means systems complying with **1.4.1-6** of **Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT".

Annex D1.3.1-5(1) has been added as follows.

Annex D1.3.1-5(1) GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF SELECTIVE CATALYTIC REDUCTION SYSTEMS AND ASSOCIATED EQUIPMENT

1.1 General

1.1.1 Application

1 The requirements in this Guidance apply to selective catalytic reduction systems (hereinafter referred to as "SCR systems") and associated equipment.

2 Urea based ammonia (e.g., AUS 40 - 40%/60% urea/water aqueous urea solution specified in *ISO* 18611-1) is to be used as reductant agent in SCR systems. In cases where another reductant agent is used, however, special consideration is to be given to such systems in accordance with their respective designs as well as the following **(1)** and **(2)**:

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

(2) Anhydrous ammonia (99.5% or greater concentration of ammonia by weight) is not to be used as a reductant agent in SCR systems except in cases where the flag administration agrees to its use and the following **(a)** and **(b)** can be demonstrated:

  (a) It is not practicable to use an aqueous urea solution.

  (b) It is not practicable to use an aqueous ammonia.

3 In cases where a reductant agent specified in **(1)** or **(2)** of **-2** is used, arrangements for its loading, carriage and use are to be derived from a risk based analysis.

4 In addition to the requirements in this Guidance, the Society may apply special requirements as instructed by the flag administration of the ship or the governments of sovereign nations whose waters the ship navigates.

1.1.2 Equivalency

SCR systems, reductant agent tank or piping systems for reductant agents, etc. which do not comply with the requirements of this Guidance may be accepted provided that they are deemed by the Society to be equivalent to those specified in this Guidance.

1.1.3 Terminology

The terms used in this Guidance are defined as follows:

(1) "SCR system" means a system consisting of a SCR chamber and a reductant agent injection system.

(2) "SCR chamber" means an integrated unit containing one or more catalyst blocks into which flows exhaust gas from diesel engines without outflow and which receives its supply of the reductant agent from a reductant agent injection system.

(3) "Catalyst block" means a block of certain dimensions through which exhaust gas passes and which contains catalysts on its inside surfaces which reduce the NOx content of exhaust gas.

(4) "Reductant agent injection system" means a system which consists of equipment such as pumps for supplying reductant agents to nozzles, nozzles for injecting reductant agents and device(s) for controlling the flow rates of the reductant agents injected by the nozzles.

1.2 Class Surveys

1.2.1 Classification Surveys

1 Classification Survey during Construction

(1) Plans and documents for approval

The following plans and documents are to be submitted. However, the Society may require the submission of other detailed plans and documents.

(a) Particulars
(b) Specifications
(c) Material specifications
(d) General arrangement
(e) SCR chamber construction, including the arrangement of catalyst blocks
(f) Reductant agent storage tank construction and their arrangements
(g) Ventilation systems for compartments installed with equipment for using or handling reductant agent, such as its storage tanks, or for the compartments specified in **1.5.2-3**
(h) Detailed arrangements of injection nozzles of reductant agent injection systems
(i) Piping diagram
(j) Arrangements of control systems and diagram of hydraulic and electrical systems, including safety systems and alarm systems
(k) Plans and documents concerning automation
  i) List of measuring points
  ii) List of alarm points
  iii) Control systems and safety systems (list of controlled objects and controlled variables, list of conditions for safety systems, and kinds of control energy sources such as self-actuated, pneumatic and electric)
(l) The construction, arrangement and diagrams of electrical systems, including safety systems and alarm systems, of exhaust gas heating devices, if fitted
(m) Plans and documents for the control and monitoring systems of SCR systems, if the ships are provided with monitoring and control systems for periodically unattended machinery spaces.

(2) Plans and documents for reference

The following plans and documents are to be submitted. However, the Society may require the submission of other detailed plans and documents.

(a) Operation manual for SCR systems
(b) Operation manual for automatic control and safety systems
(c) Documents related to allowable back pressure
(d) Documents related to any studies and corresponding results explaining cases where bypass pipes are not fitted for SCR systems in accordance with **1.4.1-2(1)**
(e) Engineering analysis such as Failure Mode Effect Analysis (FMEA)

(3) Tests at Facilities (Shop tests)

(a) Reductant agent independent storage tanks are to be subjected to hydrostatic tests at a pressure corresponding to a water head of 2.5 *m* above the top plate.
(b) After completion of the fabrication process, piping, valves and pipe fittings, containing reductant agent, the design pressure of which exceeds 0.35 *MPa* are to be subjected to hydrostatic tests together with the welded fittings at a pressure equal to 1.5 times the design pressure.
(c) The pressure parts of reductant agent supply pumps are to be subjected to hydrostatic tests at a pressure equal to 1.5 times the design pressure or 0.2 *MPa*, whichever is greater. Tests

carried out in the presence of the Surveyor may be replaced by manufacturer's tests. In such cases, submission or presentation of test records may be required by the Society.

(d) For reductant agent supply pumps, shop trials are to be carried out according to test procedures deemed appropriate by the Society.

(e) Electrical motors and their corresponding control gears used for pumps fitted on SCR systems are to be tested in accordance with relevant requirements in **Part H of the Rules**. Shop tests for electrical motors whose continuous rated capacities are less than 100 *kW* and their corresponding control gears may be replaced by manufacturer tests. In such cases, submission or presentation of test records may be required by the Society.

(4) Tests after Installation On Board

(a) In cases where reductant agent is carried in tanks which form part of the ship's hull, the tanks are to be subjected to hydrostatic tests in accordance with **2.1.5(1), Part B of the Rules**. Where the specific gravities of the liquids used for the tests are less than those of the reductant agent, an appropriate additional head is to be considered.

(b) After installation on board, SCR systems are to be tested in accordance with the following:

i) Piping systems for reductant agent are to be subjected to leak tests at pressures equal to 1.5 times the design pressure or 0.4 *MPa*, whichever is greater.

ii) Operation tests of SCR systems to be carried out at maximum quantities of emitted exhaust gas

iii) Performance tests for control, safety and alarm devices

iv) Operation tests for changeover devices of exhaust gas pipes and the corresponding indicators.

(5) Documents to be Maintained On Board

At the completion of a Classification Survey during construction, the Surveyor confirms that instruction and operation manual of SCR systems, including cautionary notes for the safety of the operators, are on board the ship.

2 Classification Survey of Ships Not Built under Survey

(1) Plans and Documents

For ships subject to the Classification Survey of ships not built under survey, plans and documents necessary for registration to the Society are to be submitted according to the relevant requirements in **(1)** and **(2)** of **-1** above.

(2) Surveys

The tests listed in **1.2.2-3** are to be carried out.

(3) Documents to be Maintained On Board

At the completion of a Classification Survey of ships not built under survey, the Surveyor confirms that those specified in **-1(5)** above are on board the ship.

1.2.2 Periodical Surveys

1 Annual Surveys

The following **(1)** and **(2)** general examinations and tests are to be carried out:

(1) General examinations

(a) The general conditions of SCR systems are to be confirmed to be in good order.

(b) General examinations of ventilation systems for the reductant agent storage tank compartments specified in **1.5.3**.

(c) General examinations of safety and protective equipment listed in **1.8** are to be carried out.

(d) Instruction and operation manual of SCR systems is to be confirmed to be kept on board.

(2) Performance tests

Performance tests are to be carried out for the following:

(a) Control, safety and alarm devices

(b) Changeover devices of exhaust gas pipes and the corresponding indicator
(c) Remote shut-off devices for reductant agent storage tank valves
(d) Remote stopping devices for reductant agent supply pumps
(e) Safety showers
(f) Eyewash

2 Intermediate Surveys

The general examinations and performance tests specified in **-1** above are to be carried out.

3 Special Surveys

The following **(1)** to **(4)** examinations and tests are to be carried out:

(1) The general examinations and performance tests specified in **-1** above are to be carried out.
(2) Internal examinations of reductant agent storage tanks
(3) In cases where reductant agent is carried in tanks which form part of the ship's hull, the pressure tests required for "cargo tank" in **Table B5.23-1**, **Part B of the Rules** are to be carried out. In cases where pressure tests at specified pressures have been conducted in the presence of the Master or any other representative personnel of the ship at suitable occasions prior to the survey, such pressure tests may be regarded as the pressure tests required for Special Surveys.
(4) The following **(a)** to **(c)** equipment is to be opened for examinations.
(a) SCR chamber
(b) Reductant agent supply pumps
(c) Other items as deemed necessary by the Society

4 Occasional Surveys

For ships where SCR systems specified in this Guidance are newly installed, surveys are to be carried out in accordance with **1.2.1-1**.

1.3 Design

1.3.1 General Requirements

1 In addition to the requirements in this Guidance, pipes, valves, pipe fittings and auxiliaries are to satisfy the requirements in **Chapter 12**, **Part D of the Rules**. In such cases, the term "sea water" is to be read as "reductant agent".

2 In addition to the requirements in this Guidance, air pipes and sounding pipes are to satisfy the requirements in **13.6** and **13.8, Part D of the Rules**. In such cases, the term "fuel oil" is to be read as "reductant agent".

3 In addition to the requirements in this Guidance, the control systems, safety systems and alarm systems of reductant agent injection systems are to satisfy the requirements in **Chapter 18, Part D of the Rules**.

4 Appropriate means are to be provided to allow continuous proper operation of diesel engines which are connected to SCR systems in case where a single component of the system or associated equipment fails or becomes otherwise inoperable.

1.3.2 Material

1 SCR systems and related piping systems for reductant agents, tanks, and other components (including pumps, valves, vents, other parts and their joints) which may come into contact with the reductant solution are to be of a suitable grade of non-combustible compatible material established to be suitable for the application.

2 Material used for exhaust gas heating devices are to be deemed appropriate by the Society.

1.4 SCR systems

1.4.1 SCR chamber

1 Consideration of Exhaust Gas Allowable Back Pressure and Temperature

SCR chambers suitable for diesel engines are to be installed, and the systems are to be arranged on exhaust gas pipes so that the back pressure and temperature do not exceed the allowable limits specified by the diesel engine manufacturer.

2 Changeover of Exhaust Gas Pipes

(1) In cases of SCR system failure as well as any blocking or clogging of SCR chambers, bypass pipes are to be provided except for such diesel engines connected to systems that can be satisfactory operated under the possible operating ranges of the engines without bypass pipes in the event of back pressure increases due to such a failure or blocking or clogging.

(2) For diesel engines with changeover arrangements from exhaust gas pipes in which a SCR chamber is installed to bypass pipes, changeover devices for those pipes are to be fitted at the branch positions of the pipes.

(3) The devices specified in **(2)** above are to be fitted with appropriate means to prevent the simultaneous closing of the exhaust pipes in which the SCR chamber is installed and bypass pipes, such as interlock devices so that the proper operation of the diesel engines emitting exhaust gas will be maintained.

(4) The devices specified in **(2)** above are to be provided with indicators which show which exhaust gas pipe is being used. These indicators are to be fitted at both local positions and control stations of SCR systems.

3 Maintenance Considerations

(1) Catalyst blocks are to be arranged so that they can be easily replaced.

(2) Sufficient space for replacing catalyst blocks is to be provided on board ship.

4 Maintaining the Quality of Catalytic Reactions

Consideration is to be given to SCR chambers so that any degradation of catalytic reactions due to the adherence of soot, etc. is prevented.

1.4.2 Reductant Agent Injection Systems

1 Injection Control

Reductant agent injection systems are to be fitted with interlock devices so that the reductant solution cannot 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.

2 Injection Amount Monitoring

Arrangements are to be provided to monitor the amount of reductant agent injected during use of the SCR system at control stations.

3 Injection Position

The reductant agent is to be injected so that hydrolysis is achieved after the injection and the appropriate denitration reaction is produced in the chamber.

4 Safety Devices and Alarm Devices

The reductant agent injection system is to be fitted with alarm devices and safety devices to stop the injection of reductant agent when the temperature at the outlets of engines or the inlets of SCR chambers exceed preset levels in order to avoid any self-ignition of ammonia gas caused by abnormal increases in exhaust gas temperatures.

1.5 Requirements for Construction and Arrangements, etc.

1.5.1 Construction and Arrangement

1 Reductant agent storage tanks may be located within the engine room.

2 Reductant agent storage tanks are 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) are to be taken into account to ensure that the contents of the reductant agent tank are maintained to avoid any impairment of the reductant agent during storage.

3 The reductant agent 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.

4 Storage tanks for reductant agents as well as any equipment using or handling reductant agents, such as reductant agent injection systems, are to be so arranged to prevent the spread of any spillage in the compartments where they are installed. For example, drip trays of a sufficient size are to be provided under such tanks and equipment.

5 Where reductant agent 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 coated with appropriate anti-corrosion coating.

(3) These tanks are to be designed and constructed as per the structural requirements applicable to hull and primary support members for deep tank construction after taking into account the specific gravity of reductant agent.

(4) These tanks are to be fitted with but not limited to level gauge, temperature gauge, high temperature alarm, low level alarm, etc.

(5) 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, service or machinery spaces, cargo spaces containing cargoes which react with reductant agent in a hazardous manner as well as any food stores, oil tanks and fresh water tanks.

(6) These tanks are to be included in the ship’s stability calculation.

6 Piping for reductant agent and venting systems are to be independent of other ship service piping and/or systems.

7 Piping systems for reductant agent are not to pass through or to extend into accommodation, service spaces, or control stations.

8 Piping systems for reductant agents are not to pass through or extend into any storage tanks for other liquids, except in cases where deemed appropriate by the Society.

9 The piping systems for reductant agents, excluding those near reductant agent injection nozzles, are not to be located immediately above or near equipment operating at high temperatures such as boilers, steam pipelines and exhaust gas pipes, etc. which are required to be insulated.

As far as practicable, such piping systems are to be arranged far from hot surfaces, electrical installations and other sources of ignition.

10 In cases where a reductant agent is produced from solid matter on board, the solid matter is to be stored at an appropriate location in consideration of the storage conditions specified by the manufacturer.

1.5.2 Closing Devices and Shut-down Systems

1 Reductant agent supply piping, which, if damaged, would allow reductant agent to escape from storage tanks situated above the double bottom, is to be fitted with a cock or valve directly on the tank capable of being closed from a safe position outside the space in which such tanks are situated in the event of a fire occurring in such a space. In the case of storage tanks situated in any shaft or pipe tunnel or similar space, valves on the tank are to be fitted, but an additional valve on the pipe or pipes outside the tunnel or similar space may be so fitted as to prevent the reductant agent from escaping in the event of fire. If such an additional valve is fitted in a machinery space, the valve is to be capable of being operated from a position outside said machinery space.

2 Reductant agent supply pumps are to be provided with stopping devices installed inside the space in which they are installed and, in addition, in a location outside such a space which will not be cut off in the event of fire in said space.

3 In cases where exhaust gas heating devices fitted with burners and blowers are installed, stopping devices for the burners and blowers are to be installed inside the space in which they are installed and, in addition, in a location outside such a space which will not be cut off in the event of fire in said space.

1.5.3 Ventilation Systems

1 If storage tanks for reductant agent or equipment for using or handling reductant agent, such as reductant agent injection systems, 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 accommodation, service spaces, or control stations. The ventilation system is to be capable of being controlled from outside the compartment and is to be maintained in operation continuously except when the storage tank is empty and has been thoroughly air purged. If the ventilation stops, an audible and visual alarm is to be provided outside the compartment adjacent to each point of entry and inside the compartment, together with a warning notice requiring the use of such ventilation.

2 Notwithstanding the requirements specified in **-1** above, where storage tanks for reductant agent or equipment for using or handling reductant agent, such as the reductant agent injection systems are 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 equipment and is to be maintained in operation continuously except when the storage tank is empty and has been thoroughly air purged.

3 In cases where reductant agent is stored within tanks which form part of the ship’s hull, enclosed compartments normally entered by ship personnel which are located adjacent to such tanks are to be provided with mechanical exhaust ventilation systems. These ventilation systems are to be capable of giving at least 20 air changes per hour and of being operated from outside the compartment.

1.5.4 Venting Systems of Reductant Agent Storage Tank

1 Reductant agent storage tanks are to be arranged so that they can be emptied of urea, purged and vented.

2 The vent pipes of reductant agent storage tanks are to terminate in a safe location on the weather deck in consideration of the emission of ammonia gas from the vent outlets in the event of fire near the tanks. Tank venting systems are to be arranged to prevent entrance of water into reductant agent storage tanks.

1.5.5 Safety Devices and Alarm Devices

1 In cases where changeover devices for exhaust gas pipes are fitted, devices which automatically open bypass sides of the changeover devices in the event of any of the following **(1)** and **(2)** failures are to be fitted.

(1) Abnormal increases of the exhaust gas pressures at the inlet or the differential pressures across the catalyst blocks. (To be operated within allowable limits of engine back pressure)

(2) Abnormal increase of the exhaust gas temperature at the outlet

2 Alarm devices, to be activated in the event of any of the abnormal conditions given in **Table 1**, are to be provided at control stations.

Table 1 Alarm points for SCR system(1)

Monitored Variables	
Liquid levels in tank for reductant agent	H L
Temperature in tank for reductant agent	H L
Exhaust gas pressure at inlet (2)	H
Exhaust gas temperature at inlet	H L
Exhaust gas temperature at outlet(3)	H
Power loss of control, alarm, monitoring or safety devices	○

Notes:

(1) "H" and "L" mean "high" and "low". "○" means abnormal condition occurred.

(2) Differential pressure across catalyst block may be accepted in lieu.

(3) Alarms may be omitted in cases where means are provided to prevent damage by soot fire.

3 SCR systems are to be fitted with monitoring devices at control stations, and these devices are to be capable of indicating the information listed in the following **(1)** to **(4)**:

(1) Liquid levels in tanks for reductant agent

(2) Temperatures in tanks for reductant agent

(3) Exhaust gas temperatures at inlets

(4) Pressures at inlets or differential pressures across catalyst block

4 Additional safety, alarm and monitoring systems may be required to be fitted based upon engineering analysis results, such as Failure Mode Effect Analysis (FMEA), for SCR systems.

1.6 Electrical Installations

1.6.1 General

1 Capacities of main sources of electrical power are to cover maximum electric demand during SCR system operation, including normal seagoing conditions, cargo loading and unloading conditions, and departure and arrival conditions.

2 For items not specified in **-1** above, electrical installations are to comply with relevant requirements specified in **Part H of the Rules**.

1.7 Exhaust Gas Heating Device

In cases where exhaust gas heating devices equipped with burners are installed for the purpose of raising the temperatures of the exhaust gas from engines, the requirements in **1.7.1** to **1.7.3** 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.

1.7.1 Construction and Arrangement

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

2 Appropriate measures are to be taken to prevent the frames of burners from coming in direct contact with the exhaust gas from the engines.

3 Appropriate measures are to be taken to prevent any unburnt fuel from engines from entering into exhaust gas heating devices when the SCR system is not in use. In cases where an on-off damper is installed in the flue gas line of the exhaust gas heating device, an indicator which shows the condition of the damper is to be provided.

4 Temperature measurement devices for the combustion gas at the outlets of exhaust gas heating devices or the exhaust gas at the inlets of SCR chambers are to be provided.

5 A blower of adequate capacity is to be so provided that the temperature of the exhaust gas rises to the required level.

6 Combustion chambers and gas flue lines of exhaust gas heating device are to constructed in accordance with the following **(1)** and **(2)**:

(1) Main parts of combustion chambers are to be constructed with appropriate materials.

(2) Means to inspect and clean combustion chambers and flue lines are to be provided.

7 The construction and control of burners are to comply with the following **(1)** to **(5)**:

(1) The fuel supply is to be appropriately controlled so that the temperature of the exhaust gas from engines is heated to a temperature in which the catalysis is able to effectively function.

(2) They are to be so arranged that the combustion chamber is capable of being pre-purged before ignition.

(3) They are to be so arranged that the fuel supply does not precede the operation of the ignition system in cases where an automatic ignition system is adopted.

(4) They are to be capable of controlling the amount of fuel supplied in cases where an automatic fuel supply system is provided.

(5) The ignition of the main burner and pilot burner, etc. is to follow their planned sequence in cases where an automatic combustion control device is provided.

1.7.2 Installation Considerations

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

(1) ship motions or any vibrations caused by machinery installations;

(2) external forces caused by the piping or any other supports fitted onto the exhaust gas heating device; and

(3) thermal expansions due to temperature fluctuation.

1.7.3 Safety Devices and Alarm Devices

1 Each exhaust gas heating device is to be fitted with a safety device which automatically shuts off the fuel supply to all burners in any of the following **(1)** and **(2)** cases:

(1) 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 is above or below the preset temperature for normal operation of the SCR system; or

(2) when the flame is extinguished.

2 Each exhaust gas heating device is to be fitted with an alarm device which operates in any of the following **(1)** to **(6)** cases:

(1) 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 is above or below the preset temperature for normal operation of the SCR system;

(2) when the flame is extinguished;
(3) when the power supply to the alarm device is stopped;
(4) when the fuel injection pressure to the furnace falls, in the case where fuel supply is of pressure injection type;
(5) when the blowers stop; or
(6) other cases deemed necessary by the Society

1.8 Safety and Protective Equipment

For the protection of crew members, the ship is to have on board at least the following suitable protective equipment and installations. Their locations and numbers are to be derived from the detailed installation arrangements. Locations where such equipment is stored or installed are to be clearly marked so as to be easily identifiable.

(1) Personnel protective equipment
  (a) Large apron of chemical-resistant material
  (b) Special gloves with long sleeves
  (c) Suitable footwear
  (d) Suitable protective equipment consisting of coveralls and tight-fitting goggles or face shields or both
(2) Self-contained breathing apparatus (capable of functioning for at least 30 minutes)
(3) Eyewash
(4) Safety shower
(5) Stretcher

1.9 Additional Requirements for Periodically Unattended Machinery Spaces, etc.

Ships registered with the notation **MC** or **M0** affixed in accordance with the Rules for Automatic and Remote Control Systems are to satisfy the requirements in **1.9.1** and **1.9.2**, in addition to the requirements in **1.3** to **1.8**.

1.9.1 Requirements for MC ships

For ships registered with the notation **MC**, the following devices are to be included as the "any other devices considered necessary by the Society" specified in **3.2.2(11), Rules for Automatic and Remote Control Systems**.

(1) the monitoring devices of reductant agent injection systems and the changeover devices of exhaust gas pipes which comprise the SCR system
(2) the monitoring devices of the on-off devices for exhaust gas heating devices (in cases where exhaust gas heating devices are fitted)
(3) an alarm system which indicates the activation of the safety devices specified in **1.4.2-4** and **1.7.3** as well as the alarm systems required by said provisions

1.9.2 Requirements for M0 ships

For ships registered with the notation **M0**, the alarm devices provided in accordance with **1.9.1(3)** are to satisfy the requirements of **4.3.3, Rules for Automatic and Remote Control Systems** in addition to the requirements of **1.9.1**.

Annex D1.3.1-5(2) has been added as follows.

Annex D1.3.1-5(2) GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT

1.1 General

1.1.1 Application

1 The requirements in this Guidance apply to exhaust gas cleaning systems and associated equipment installed to reduce sulphur oxides and particular matter emitted from fuel oil combustion units such as reciprocating internal combustion engines and boilers, and which use sodium hydroxide solutions.

2 In cases where exhaust gas cleaning systems which use chemical agents other than those specified in **-1** above are used, special consideration is to be given to such systems in accordance with their respective designs.

3 In cases where exhaust gas cleaning systems which do not use chemical agents are used, the term "liquids containing sodium hydroxide solutions" is to be read as "liquids which have passed through scrubber chambers" (excluding **-9** and **-10** of **1.5.1**).

4 Exhaust gas cleaning systems and associated equipment used in exhaust gas recirculation systems are to comply with **Annex D2.1.1-5** "Guidance for the Survey and Construction of Exhaust Gas Recirculation Systems and Associated Equipment".

5 In addition to the requirements in this Guidance, the Society may apply special requirements as instructed by the flag administration of the ship or the governments of sovereign nations whose waters the ship navigates.

1.1.2 Equivalency

Exhaust gas cleaning systems which do not comply with the requirements of this Guidance may be accepted provided that they are deemed by the Society to be equivalent to those specified in this Guidance.

1.1.3 Terminology

The terms used in this Guidance are defined as follows:

(1) "Exhaust gas cleaning system" means a system which consists of storage tanks for residues, etc., washwater supply pumps, sodium hydroxide solution supply pumps, washwater injection systems and scrubber chambers.

(2) "Scrubber chamber" means an integrated unit which discharges the washwater, into which flows exhaust gas from fuel oil combustion units and which receives the washwater supply from the washwater injection system.

(3) "Washwater" means freshwater or sea water (including cases where sodium hydroxide is added) which is injected into scrubber chambers or exhaust gas inlets, and includes liquids which have passed through scrubber chambers.

(4) "Washwater injection systems" means a system which consists of equipment such as pumps for supplying washwater to nozzles, nozzles for spraying washwater and devices for controlling the flow rates.

(5) "Residue" means a substance generated by exhaust gas cleaning systems resulting from the cleaning of exhaust gas, except for any liquids allowed to be discharged overboard .

1.2 Class Surveys

1.2.1 Classification Surveys

1 Classification Survey during Construction

(1) Plans and documents for approval

The following plans and documents are to be submitted. However, the Society may require the submission of other detailed plans and documents.

(a) Particulars
(b) Specifications
(c) Material specifications
(d) General arrangement
(e) Construction of scrubber chamber
(f) Construction of storage tanks for sodium hydroxide solution/liquid containing sodium hydroxide solution and their arrangements.
(g) Ventilation systems for compartments installed with equipment for using or handling sodium hydroxide solutions, such as storage tanks, or for the compartments specified in **1.5.2-3**
(h) Piping diagram
(i) Arrangements of control systems and diagrams of hydraulic and electrical systems, including safety systems and alarm systems
(j) Plans and documents concerning automation
  i) List of measuring points
  ii) List of alarm points
  iii) Control systems and safety systems (list of controlled objects and controlled variables, list of conditions for safety systems, and kinds of control energy sources such as self-actuated, pneumatic and electric)
(k) Plans and documents for the control and monitoring systems of exhaust gas cleaning systems, if the ships are provided with monitoring and control systems for periodically unattended machinery spaces

(2) Plans and documents for reference

The following plans and documents are to be submitted. However, the Society may require the submission of other detailed plans and documents.

(a) Operation manual for exhaust gas cleaning systems
(b) Operation manual for automatic control and safety systems
(c) Documents related to allowable back pressure
(d) Documents related to any studies and corresponding results explaining cases where bypass pipes are not fitted for exhaust gas cleaning systems in accordance with **1.4.1-3(1)**
(e) Engineering analysis such as Failure Mode Effect Analysis (FMEA)

(3) Tests at Facilities (Shop tests)

(a) Sodium hydroxide solution independent storage tanks are to be subjected to hydrostatic tests at a pressure corresponding to a water head of 2.5 *m* above the top plate.
(b) After completion of the fabrication process, piping, valves and pipe fittings, for liquids containing sodium hydroxide solutions, design pressure of which exceeds 0.35 *MPa* are to be subjected to hydrostatic tests together with the welded fittings at a pressure equal to 1.5 times the design pressure.
(c) The pressure parts of sodium hydroxide solution supply pumps and washwater supply pumps are to be subjected to hydrostatic tests at a pressure equal to 1.5 times the design pressure or 0.2 *MPa*, whichever is greater. Tests carried out in the presence of the Surveyor

may be replaced by manufacturer's tests. In such cases, submission or presentation of test records may be required by the Society.

(d) For sodium hydroxide solution supply pumps and washwater supply pumps, shop trials are to be carried out according to test procedures deemed appropriate by the Society.

(e) Electrical motors and their corresponding control gears used for sodium hydroxide solution supply pumps and washwater supply pumps are to be tested in accordance with relevant requirements in **Part H of the Rules**. Shop tests for electrical motors whose continuous rated capacities are less than 100 *kW* and their corresponding control gears may be replaced by manufacturer tests. In such cases, submission or presentation of test records may be required by the Society.

(4) Tests after Installation On Board

(a) In cases where sodium hydroxide solutions are carried in tanks which form part of the ship's hull, the tanks are to be subjected to hydrostatic tests in accordance with **2.1.5(1)**, **Part B of the Rules**. Where the specific gravities of the liquids used for the tests are less than those of the sodium hydroxide solution, an appropriate additional head is to be considered.

(b) After installation on board, exhaust gas cleaning systems are to be tested in accordance with the following:

i) Piping systems for liquids containing sodium hydroxide solutions are to be subjected to leak tests at pressures equal to 1.5 times the design pressure or 0.4 *MPa*, whichever is greater.

ii) Operation tests of exhaust gas cleaning systems to be carried out at maximum quantities of emitted exhaust gas.

iii) Performance tests for control, safety and alarm devices

iv) Operation tests for changeover devices of exhaust gas pipes and the corresponding indicators.

(5) Documents to be Maintained On Board

At the completion of a Classification Survey during construction, the Surveyor confirms that instruction and operation manual of exhaust gas cleaning systems, including cautionary notes for the safety of the operators, are on board the ship.

2 Classification Survey of Ships Not Built under Survey

(1) Plans and Documents

For ships subject to the Classification Survey of ships not built under survey, plans and documents necessary for registration to the Society are to be submitted according to the relevant requirements in **(1)** and **(2)** of **-1** above.

(2) Surveys

The tests listed in **1.2.2-3** are to be carried out.

(3) Documents to be Maintained On Board

At the completion of a Classification Survey of ships not built under survey, the Surveyor confirms that those specified in **-1(5)** above are on board the ship.

1.2.2 Periodical Surveys

1 Annual Surveys

The following **(1)** and **(2)** general examinations and tests are to be carried out:

(1) General examinations

(a) The general conditions of exhaust gas cleaning systems are to be confirmed to be in good order.

(b) General examinations of safety and protective equipment listed in **1.7** are to be carried out.

(c) Instruction and operation manual of exhaust gas cleaning systems is to be confirmed to be kept on board.

(2) Performance tests

Performance tests are to be carried out for the following:

(a) Control, safety and alarm devices
(b) Changeover devices of exhaust gas pipes and the corresponding indicator
(c) Remote shut-off devices for sodium hydroxide solution storage tank valves
(d) Remote stopping devices for sodium hydroxide solution supply pumps
(e) Safety showers
(f) Eyewash

2 Intermediate Surveys

The general examinations and performance tests specified in **-1** above are to be carried out.

3 Special Surveys

The following **(1)** to **(4)** examinations and tests are to be carried out:

(1) The general examinations and performance tests specified in **-1** above are to be carried out.
(2) Internal examinations of sodium hydroxide solution storage tanks
(3) In cases where sodium hydroxide solutions are carried in tanks which form part of the ship's hull, the pressure tests required for "cargo tank" in **Table B5.23-1**, **Part B of the Rules** are to be carried out. In cases where pressure tests at specified pressures have been conducted in the presence of the Master or any other representative personnel of the ship at suitable occasions prior to the survey, such pressure tests may be regarded as the pressure tests required for Special Surveys.
(4) The following equipment is to be opened for examinations.
    (a) Sodium hydroxide solution supply pumps and washwater supply pumps
    (b) Other items as deemed necessary by the Society

4 Occasional Surveys

For ships where exhaust gas cleaning systems specified in this Guidance are newly installed, surveys are to be carried out in accordance with **1.2.1-1**.

1.3 Design

1.3.1 General Requirements

1 In addition to the requirements in this Guidance, pipes, valves, pipe fittings and auxiliaries are to satisfy the requirements in **Chapter 12**, **Part D of the Rules**. In such cases, the term "sea water" is to be read as "liquids containing sodium hydroxide solutions". However, pipes containing sodium hydroxide solutions only are to be classified as Group I.

2 In addition to the requirements in this Guidance, air pipes and sounding pipes are to satisfy the requirements in **13.6** and **13.8** (excluding **13.6.1-5** and **13.6.2-3**), **Part D of the Rules**. In such cases, the term "fuel oil" is to be read as "liquids containing sodium hydroxide solutions".

3 In addition to the requirements in this Guidance, the control systems, safety systems and alarm systems of exhaust gas cleaning systems are to satisfy the requirements in **Chapter 18, Part D of the Rules**.

4 Appropriate means are to be provided to allow continuous proper operation of fuel oil combustion units such as diesel engines and boilers which are connected to exhaust gas cleaning systems in case where a single component of the system or associated equipment fails or becomes otherwise inoperable.

1.3.2 Material

Materials used for exhaust gas cleaning systems are to be selected in consideration of notch ductility at operating temperatures and pressures, their corrosive effects and the possibility of hazardous reactions.

1.4 Exhaust Gas Cleaning Systems

1.4.1 Construction of Exhaust Gas Cleaning Systems

1 Considerations for exhaust gas allowable back pressure and temperature

Exhaust gas cleaning systems suitable for fuel oil combustion units are to be installed, and the systems are to be arranged so that the back pressure and temperature do not exceed the allowable limits specified by the fuel oil combustion unit manufacturer.

2 Considerations for exhaust gas heating

Exhaust gas cleaning systems are to be provided with suitable means to ensure the systems do not suffer any damage caused by exhaust gas heating even when the exhaust gas cleaning system is not cleaning exhaust gas with washwater, or are to be provided with devices at their exhaust gas inlets to shut down the exhaust gas supply.

3 Changeover of exhaust gas pipes

(1) In cases of exhaust gas cleaning system failure as well as any blocking or clogging of scrubber chambers, bypass pipes are to be provided except for such fuel oil combustion units connected to systems that can be satisfactory operated under the possible operating ranges of the units without bypass pipes in the event of back pressure increases due to such a failure or blocking or clogging.

(2) For fuel oil combustion units with changeover arrangements from exhaust gas pipes in which a scrubber chamber is installed to bypass pipes, changeover devices for those pipes are to be fitted at the branch positions of the pipes.

(3) The devices specified in **(2)** above are to be fitted with appropriate means to prevent the simultaneous closing of the exhaust pipes in which the scrubber chamber is installed and bypass pipes, such as interlock devices so that the proper operation of the fuel oil combustion units emitting exhaust gas will be maintained.

(4) The devices specified in **(2)** above are to be provided with indicators which show which exhaust gas pipe is being used. These indicators are to be fitted at both local positions and control stations.

4 Exhaust gas cleaning systems are to be fitted with appropriate means to prevent the reverse flow of washwater from scrubber chambers to fuel oil combustion units.

5 Pipes for overboard discharges of washwater used in exhaust gas cleaning systems are to be entirely separate from other pipes. The position and direction of the discharge is to be arranged so as to preserve the integrity of hull and propeller, etc.

6 In principle, exhaust gas pipes of fuel oil combustion units, such as diesel engines and boilers, are not to be connected to common exhaust gas cleaning systems except where exhaust pipes of more than one fuel oil combustion units are required to be connected to common exhaust gas cleaning systems and the systems satisfy the following requirements in addition to **-3**.

(1) The exhaust gas cleaning systems are to be fitted with appropriate devices to prevent the reverse flow of exhaust gas to fuel oil combustion units such as other engines and boilers.

(2) The devices specified in **(1)** above are to be fitted with appropriate means to prevent the simultaneous closing of the bypass pipes and the exhaust pipes in which the scrubber chamber is installed, such as interlock devices so that the proper operation of the fuel oil combustion units, such as engines and boilers, emitting exhaust gas will be maintained.

(3) The devices specified in **(1)** above are to be provided with indicators which show which exhaust gas pipe is being used. These indicators are to be fitted at both local positions and control stations.
(4) Safety measures are to be provided for preventing the propagation of fire between fuel oil combustion units, such as diesel engines and boilers, connected to common exhaust gas cleaning systems.

1.5 Requirements for Construction and Arrangements, etc.

1.5.1 Construction and Arrangement

1 Sodium hydroxide solution storage tanks may be located within the engine room.

2 Sodium hydroxide solution storage tanks are 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.

3 Drip trays of a sufficient size are to be provided under storage tanks for liquids containing sodium hydroxide solutions as well as any equipment using or handling such liquids, such as pumps, to prevent the spread of any spillage in the compartments where they are installed.

4 The drip trays specified in **-3** above are to be fitted with drain pipes which lead to appropriate tanks, such as residue tanks, which are fitted with high level alarm, or are to be fitted with alarms for leak detection.

5 Where sodium hydroxide solution 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 coated with appropriate anti-corrosion coating.
(3) These tanks are to be designed and constructed as per the structural requirements applicable to hull and primary support members for deep tank construction after taking into account the specific gravity of sodium hydroxide solution.
(4) These tanks are to be fitted with but not limited to level gauge, temperature gauge, high temperature alarm, high and low level alarm, etc.
(5) 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, service or machinery spaces, cargo spaces containing cargoes which react with sodium hydroxide solutions in a hazardous manner as well as any food stores, oil tanks and fresh water tanks.
(6) These tanks are to be included in the ship’s stability calculation.

6 Piping for liquids containing sodium hydroxide solutions and venting systems are to be independent of other ship service piping and/or systems.

7 Piping systems for liquids containing sodium hydroxide solutions are not to pass through or to extend into accommodation, service spaces, or control stations.

8 Piping systems for liquids containing sodium hydroxide solutions are not to pass through or to extend into any storage tanks for other liquids, except where deemed appropriate by the Society.

9 Piping systems for liquids containing sodium hydroxide solutions, excluding those near nozzles spraying washwater, are to be so arranged to prevent any outflows or leakage from the piping system from coming into contact with any high temperature equipment surfaces. Such piping systems are especially not to be located immediately above or near equipment such as boilers, steam pipes or exhaust gas pipes.

10 Storage tanks for liquids containing sodium hydroxide solutions are to satisfy the following requirements:

(1) The tanks are to be so arranged to prevent liquids containing sodium hydroxide solutions escaping or leaked from the tanks from coming into contact with high temperature equipment surfaces. Such tanks are especially not to be located immediately above or near equipment such as boilers, steam pipes or exhaust gas pipes.
(2) In cases where shore connections with standard couplings are fitted onto filling-up pipe lines, proper protection against any spraying of sodium hydroxide solutions, such as effective enclosures, is to be provided in consideration of the sodium hydroxide solution spraying out during filling-up operations.

11 Discharge pipes from storage tanks for liquids containing sodium hydroxide solutions are to be fitted with stop valves directly on the tank.

12 Piping systems for sodium hydroxide solutions which, if damaged, would allow the solution to escape from storage tanks are to be fitted with cocks or valves directly onto the tank. Such cocks or valves are to be capable of being closed from accessible positions even in the event of solution leakages.

13 Residue tanks are to satisfy the following requirements:

(1) Residues removed from washwater used in scrubber chambers are to be stored in tanks independent of the oil residue (sludge) tanks fitted in accordance with **Chapter 2, Part 3 of the Rules for Marine Pollution Prevention Systems**. In addition, such residues are to be discharged to appropriate reception facilities.
(2) Manholes or access holes in a sufficient size are to be provided at such locations that each part of the tank can be cleaned without difficulties.
(3) Tank capacities are to be decided in consideration of the number and kinds of installed exhaust gas cleaning systems as well as the maximum number of days between ports where residue can be discharged ashore.

1.5.2 Ventilation Systems

1 If storage tanks for sodium hydroxide solutions or equipment for using or handling sodium hydroxide solutions, such as solution supply pumps, 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 accommodation, service spaces, or control stations. The ventilation system is to be capable of being controlled from outside the compartment. If the ventilation stops, an audible and visual alarm shall be provided outside the compartment adjacent to each point of entry and inside the compartment, together with a warning notice requiring the use of such ventilation.

2 Notwithstanding the requirements specified in **-1** above, where storage tanks for sodium hydroxide solutions or equipment for using or handling sodium hydroxide solutions, such as the solution supply pump are 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 equipment and is to be maintained in operation continuously except when the storage tank is empty and has been thoroughly air purged.

3 In cases where sodium hydroxide solutions are stored within tanks which form part of the ship's hull, enclosed compartments normally entered by ship personnel which are located adjacent to such tanks are to be provided with mechanical exhaust ventilation systems. These ventilation systems are to be capable of giving at least 20 air changes per hour and of being operated from outside the compartment.

1.5.3 Safety Devices and Alarm Devices

1 Exhaust gas cleaning systems are to be fitted with safety devices which are capable of automatically stopping exhaust gas washwater supply pumps and sodium hydroxide solution pumps in the event of any of the following failures:

(1) Abnormal increase of the liquid level in the scrubber
(2) Abnormal increase of the pressure at the inlet or the differential pressure across the scrubber chamber (in cases where changeover devices for exhaust gas pipes are not fitted)

2 In cases where changeover devices for exhaust gas pipes are fitted, devices capable of automatically opening bypass sides of changeover devices in the event of any of the following failures are to be fitted.

(1) Abnormal increase of the liquid level in the scrubber
(2) Abnormal increase of the exhaust gas pressure at the inlet or the differential pressure across the scrubber chamber
(3) Abnormal increase of the exhaust gas temperature at the outlet

3 Alarm devices, to be activated in the event of any of the abnormal conditions given in **Table 1**, are to be provided at control stations.

4 Exhaust gas cleaning systems are to be fitted with monitoring devices at control stations, and these devices are to indicate the information listed in **(1)** to **(5)**:

(1) Liquid levels in scrubber chambers
(2) Liquid levels in tanks for sodium hydroxide solutions
(3) Temperatures in tanks for sodium hydroxide solutions
(4) Exhaust gas temperatures at outlets
(5) Pressures at inlets or differential pressures across scrubber chambers

5 Additional safety, alarm and monitoring systems may be required to be fitted based upon engineering analysis results, such as Failure Mode Effect Analysis (FMEA), for exhaust gas cleaning systems.

Table 1 Alarm points for exhaust gas cleaning system(1)

Monitored Variables	
Liquid level in scrubber chamber	H
Temperature of washwater supply (in cases where the washwater includes sodium hydroxide solutions)	H
Liquid levels in tank for sodium hydroxide solution	H L
Temperature in tank for sodium hydroxide solution	H L
Exhaust gas pressure at the inlet (2)	H
Exhaust gas temperature at the outlet	H
Power loss of control, alarm, monitoring or safety devices	○

Notes:
(1) "H" and "L" mean "high" and "low". "○" means abnormal condition occurred.
(2) Differential pressure across scrubber chamber may be accepted in lieu.

1.6 Electrical Installations

1.6.1 General

1 Capacities of main sources of electrical power are to cover maximum electric demand during exhaust gas cleaning system operation, including normal seagoing conditions, cargo loading and unloading conditions, and departure and arrival conditions.

2 For items not specified in **-1** above, electrical installations are to comply with relevant requirements specified in **Part H of the Rules**.

1.7 Safety and Protective Equipment

1.7.1 General

1 The safety and protective equipment specified in **(1)** to **(4)** is to be stored at locations outside the compartment containing the exhaust gas cleaning system and easily accessible in the event of any leakages of liquids containing sodium hydroxide solutions. The safety and protective equipment is to cover all skin so that no part of the body is unprotected. The locations at which the equipment is stored are to be clearly marked so as to be easily identifiable.

(1) Large apron of chemical-resistant material
(2) Special gloves with long sleeves
(3) Suitable footwear
(4) Suitable protective equipment consisting of coveralls and tight-fitting goggles or face shields or both

2 Eyewash and safety showers are to be located in the vicinity of sodium hydroxide solution filling stations and sodium hydroxide solution supply pumps.

1.8 Additional Requirements for Periodically Unattended Machinery Spaces, etc.

Ships registered with the notation **MC** or **M0** affixed in accordance with the Rules for Automatic and Remote Control Systems are to satisfy the requirements in **1.8.1** and **1.8.2**, in addition to the requirements in **1.3** to **1.7**.

1.8.1 Requirements for MC ships

For ships registered with the notation **MC**, remote control devices and monitoring devices of exhaust gas cleaning systems and changeover devices of exhaust gas pipes are to be included as the "any other devices considered necessary by the Society" specified in **3.2.2(11), Rules for Automatic and Remote Control Systems**. In cases where exhaust gas cleaning systems and changeover devices of exhaust gas pipes are controlled fully automatically, alarm devices indicating abnormal conditions of related devices may be accepted.

1.8.2 Requirements for M0 ships

For ships registered with the notation **M0**, the alarm devices provided in accordance with **1.8.1** are to satisfy the requirements of **4.3.3, Rules for Automatic and Remote Control Systems** in addition to the requirements of **1.8.1**.

Annex D2.1.1-5 has been added as follows.

Annex D2.1.1-5 GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS RECIRCULATION SYSTEMS AND ASSOCIATED EQUIPMENT

1.1 General

1.1.1 Application

1 The requirements in this Guidance apply to exhaust gas recirculation systems and associated equipment installed to reduce nitrogen oxides emitted from reciprocating internal combustion engines.

2 Special consideration is to be given to exhaust gas recirculation systems to which the requirements in this Guidance are not applicable in accordance with their respective designs.

3 In addition to the requirements in this Guidance, the Society may apply special requirements as instructed by the flag administration of the ship or the governments of sovereign nations whose waters ships navigate.

1.1.2 Equivalency

Exhaust gas recirculation systems which do not comply with the requirements of this Guidance may be accepted provided that they are deemed by the Society to be equivalent to those specified in this Guidance.

1.1.3 Terminology

In addition to terms specified in **1.1.3 of the Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT", the term used in this Guidance is defined as follows:

(1) "Exhaust gas recirculation systems" means systems which clean a part of exhaust gas emitted from an engine in a scrubber chamber and recirculate the cleaned exhaust gas into the engine.

1.2 Class Surveys

1.2.1 Classification Surveys

1 In addition to the requirement of **1.2.1** of the **Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT", the following plans and documents for reference are to be submitted. In such cases, "exhaust gas cleaning system" is to be read as "exhaust gas recirculation system".

(1) Specifications of blowers fitted onto exhaust gas recirculation systems
(2) Assembly of exhaust gas recirculation systems (except in cases where it is submitted in accordance with **Chapter 2, Part D of the Rules**)
(3) Construction and arrangement of thermal insulation for exhaust gas pipes fitted onto exhaust gas recirculation systems (except in cases where it is submitted in accordance with **Chapter 2, Part D of the Rules**)

2 For tests at facilities (shop tests), in addition to the requirement of **1.2.1-1(3)** of the **Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT", the following tests are to be carried out as:

(1) Starting and stopping test of exhaust gas recirculation systems
(2) Test for load response
(3) Emergency stop test
(4) Test at normal load with exhaust gas recirculation systems running
(5) Other tests deemed necessary by the Society

3 Pressure receiving parts on the cooling systems for blowers fitted onto exhaust gas recirculation systems and cooling side of heat exchangers fitted onto the exhaust gas recirculation systems are to be subjected to hydrostatic tests at a pressure equal to 1.5 times the maximum working pressure.

4 At the sea trials specified in **2.1.3**, **Part B of the Rules**, running tests of engines are to be carried out with exhaust gas recirculation systems in operation, and the satisfactory operation of the engine and exhaust gas recirculation system are to be confirmed.

1.2.2 Periodical Surveys

The requirements of **1.2.2** of the **Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT" are to be applied. In such cases, "exhaust gas cleaning system" is to be read as "exhaust gas recirculation system".

1.3 Design

1.3.1 General Requirements

1 The requirements of **1.3.1** of the **Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT" are to be applied. In such cases, "exhaust gas cleaning system" is to be read as "exhaust gas recirculation system".

2 Heat exchangers fitted onto exhaust gas recirculation systems are to comply with **Chapter 10, Part D of the Rules**.

1.3.2 Materials

The requirements of **1.3.2** of the **Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT" are to be applied. In such cases, "exhaust gas cleaning system" is to be read as "exhaust gas recirculation system".

1.4 Exhaust Gas Cleaning Systems

1.4.1 Construction of Exhaust Gas Cleaning Systems

1 The requirements of **1.4.1** (excluding **-3** and **-6**) of the **Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT" are to be applied.

2 Devices to shut down the exhaust gas supply to exhaust gas pipes in which a scrubber is fitted are to be provided.

1.5 Requirements for Construction and Arrangements, etc.

1.5.1 Construction and Arrangement

In addition to **1.5.1** of the **Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT", the following **(1)** and **(2)** requirements are to be applied:

(1) Consideration is to be given to ensure that recirculating exhaust gas does not have any adverse effect on engine performance and safety due to corrosion and fouling, etc.

(2) Consideration is to be given to ensure taken that temperature of the intake air/scavenging air introduced into cylinders does not exceed the allowable temperatures specified by engine manufacturers.

1.5.2 Ventilation Systems

The requirements of **1.5.2** of the **Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT" are to be applied.

1.5.3 Safety Devices and Alarm Devices

The requirements of **1.5.3** of the **Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT" are to be applied.

1.6 Electrical Installations

1.6.1 General

The requirements of **1.6.1** of the **Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT" are to be applied.

1.7 Safety and Protective Equipment

1.7.1 General

The requirements of **1.7.1** of the **Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT" are to be applied.

1.8 Additional Requirements for Periodically Unattended Machinery Spaces, etc.

The requirements of **1.8** of the **Annex D1.3.1-5(2)** "GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT" are to be applied.

EFFECTIVE DATE AND APPLICATION (Amendment 2-2)

1. The effective date of the amendments is 1 January 2018.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to SCR systems, EGR systems and EGCS whose applications for approval are submitted to the Society before the effective date installed on ships for which the date of contract for construction* is before the effective date.

* "contract for construction" is defined in the latest version of IACS Procedural Requirement (PR) No.29.

IACS PR No.29 (Rev.0, July 2009)

1. The date of "contract for construction" of a vessel is the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. This date and the construction numbers (i.e. hull numbers) of all the vessels included in the contract are to be declared to the classification society by the party applying for the assignment of class to a newbuilding.

2. The date of "contract for construction" of a series of vessels, including specified optional vessels for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective owner and the shipbuilder.

For the purpose of this Procedural Requirement, vessels built under a single contract for construction are considered a "series of vessels" if they are built to the same approved plans for classification purposes. However, vessels within a series may have design alterations from the original design provided:

(1) such alterations do not affect matters related to classification, or

(2) If the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the shipbuilder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for approval.

The optional vessels will be considered part of the same series of vessels if the option is exercised not later than 1 year after the contract to build the series was signed.

3. If a contract for construction is later amended to include additional vessels or additional options, the date of "contract for construction" for such vessels is the date on which the amendment to the contract, is signed between the prospective owner and the shipbuilder. The amendment to the contract is to be considered as a "new contract" to which **1.** and **2.** above apply.

4. If a contract for construction is amended to change the ship type, the date of "contract for construction" of this modified vessel, or vessels, is the date on which revised contract or new contract is signed between the Owner, or Owners, and the shipbuilder.

Note:
This Procedural Requirement applies from 1 July 2009.