

Exhaust Gas Cleaning Systems

Amended Rules

Rules for the Survey and Construction of Steel Ships Part D

Reason for Amendment

On 1 January 2020, the upper limit of the sulphur content of fuel oil specified in regulation 14 of Annex VI of the MARPOL Convention was changed from 3.5 % to 0.5 %. In response, the number of ships fitted with Exhaust Gas Cleaning Systems (EGCS) has increased.

Consequently, specific requirements for the storage and handling of chemicals used by EGCS were discussed by IACS. As a result, IACS adopted UR M81 in January 2021.

Accordingly, relevant requirements were amended based upon IACS UR M81.

In addition, some requirements for EGCS were amended as part of a comprehensive review of the Rules for the Survey and Construction of Steel Ships so as to align them with actual practice.

Outline of Amendment

The main contents of this amendment are as follows:

- (1) Added EGCS using calcium hydroxide are used are included in the applicable target.
- (2) Added requirements for the materials used for storage tanks and piping systems of chemical treatment fluids.
- (3) Clarified the spaces for which ventilation systems and warning notices are required.
- (4) Clarified requirements for the installation locations of eyewashes and safety showers.
- (5) Clarified that shop trial tests for chemical treatment fluid supply pumps may be replaced by manufacturer tests.

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

Part D MACHINERY INSTALLATIONS

Chapter 22 EXHAUST GAS CLEANING SYSTEMS AND ASSOCIATED EQUIPMENT

22.1 General

Paragraph 22.1.1 has been amended as follows.

22.1.1 Application

1 The requirements in this chapter 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 or calcium hydroxide (hereinafter referred to “chemical treatment fluid” in this chapter) that has corrosive properties or which are otherwise considered to represent a hazard to personnel.

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.~~ safety measures are to be taken according to the result of a risk assessment to be conducted to analyse the risks, in order to eliminate or mitigate the hazards to personnel brought by the use of such exhaust gas cleaning systems, to an extent equivalent to systems complying with this chapter.

3 In cases where exhaust gas cleaning systems which do not use chemical agents are used, the term “liquids containing ~~sodium hydroxide solutions~~ chemical treatment fluid” is to be read as “liquids which have passed through scrubber chambers”; this, however, does not apply to -4, -9 and -10 of 22.4.1, 22.7.1-2 and 22.7.2-2(1).

4 (Omitted)

5 (Omitted)

Paragraph 22.1.2 has been amended as follows.

22.1.2 Terminology

The terms used in this chapter 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~~ chemical treatment fluid supply pumps, washwater injection systems and scrubber chambers.

(2) (Omitted)

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

(4) (Omitted)

(5) (Omitted)

Paragraph 22.1.3 has been amended as follows.

22.1.3 Drawings and Data to be Submitted

(1) Plans and documents for approval

 ((a) to (e) are omitted.)

- (f) Construction of storage tanks for ~~sodium hydroxide solution~~ chemical treatment fluid or liquid containing ~~sodium hydroxide solution~~ chemical treatment fluid and their arrangements.
- (g) Ventilation systems for compartments installed with equipment for using or handling ~~sodium hydroxide solutions~~ chemical treatment fluid, such as storage tanks, or for the compartments specified in 22.4.2-3
- (h) Piping diagrams (including details of watertight bulkheads and penetrations of fire-resisting divisions)
- (i) to (l) are omitted.)
- (2) Plans and documents for reference
 - ((a) to (e) are omitted.)
 - (f) The results of risk assessments conducted to analyse the risks specified in 22.1.1-2
 - ~~(g)~~ Other drawings considered necessary by the Society

22.2 Design

Paragraph 22.2.1 has been amended as follows.

22.2.1 General Requirements

1 In addition to the requirements in this chapter, pipes, valves, pipe fittings and auxiliaries are to satisfy the requirements in **Chapter 12**. In such cases, the term “sea water” is to be read as “liquids containing ~~sodium hydroxide solutions~~ chemical treatment fluid”. However, ~~pipes containing sodium hydroxide solutions only are to be classified as Group I~~ 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 specified in Chapter 12. 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.

2 In addition to the requirements in this chapter, 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). In such cases, the term “fuel oil” is to be read as “liquids containing ~~sodium hydroxide solutions~~ chemical treatment fluid”.

(-3 and -4 are omitted.)

Paragraph 22.2.2 has been amended as follows.

22.2.2 Material

1 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.

2 Storage tanks and pipes/piping systems for chemical treatment fluids which transfer undiluted chemical treatment fluids are to be of steel or other equivalent material with a melting point above 925 °C.

3 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.

Note:

Several metals are incompatible with the chemical treatment fluids, e.g. NaOH is incompatible with zinc, aluminum, etc.

22.4 Requirements for Construction and Arrangements, etc.

Paragraph 22.4.1 has been amended as follows.

22.4.1 Construction and Arrangement

~~1 Sodium hydroxide solution~~ Chemical treatment fluids storage tanks may be located within the engine room.

~~2 Sodium hydroxide solution~~ Chemical treatment fluids storage tanks are to be protected from excessively high or low temperatures applicable to the particular concentration of the ~~solution~~ fluids. Depending on the operational area of the ship, this may necessitate the fitting of heating and/or cooling systems.

~~3 Sodium hydroxide solutions~~ chemical treatment fluids 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 (Omitted)

~~5~~ 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.

~~6~~ 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.

~~57~~ Where ~~sodium hydroxide solution~~ chemical treatment fluids is stored in tanks which form part of the ship's hull, the following (1) to (64) 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 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.

(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 or service 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.~~

~~(64)~~ These tanks are to be included in the ship's stability calculation.

~~68~~ The chemical treatment fluid Piping for liquids containing ~~sodium hydroxide solutions~~ and venting systems are to be independent of other ship service piping and/or systems.

~~79~~ The chemical treatment fluid Piping systems for liquids containing ~~sodium hydroxide solutions~~ are not to pass through or to extend into accommodation, service spaces, or control stations.

~~810~~ Piping systems for liquids containing ~~sodium hydroxide solutions~~ chemical treatment fluids are not to pass through or to extend into any storage tanks for other liquids, except where deemed

appropriate by the Society.

~~911~~ Piping systems for liquids containing ~~sodium hydroxide solutions~~ chemical treatment fluids, 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.

~~102~~ Storage tanks for liquids containing ~~sodium hydroxide solutions~~ chemical treatment fluids are to satisfy the following requirements:

- (1) The tanks are to be so arranged to prevent liquids containing ~~sodium hydroxide solutions~~ chemical treatment fluids 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~~ chemical treatment fluids, such as effective enclosures, is to be provided in consideration of the sodium hydroxide solution spraying out during filling-up operations.

~~113~~ Discharge pipes from storage tanks for liquids containing ~~sodium hydroxide solutions~~ chemical treatment fluids 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.

~~134~~ ~~Residue~~ Tanks for residues generated from the exhaust gas cleaning process 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.~~ 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.
- (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. In the absence of precise data, a figure of 30 days is to be used.
- (4) Where residue tanks used in closed loop chemical treatment systems are also used as the overflow tanks for chemical treatment fluids storage tank, the requirements for storage tanks apply.

~~145~~ (Omitted)

~~156~~ For distance pieces fitted onto the piping systems specified in -~~145~~ above, where materials other than hull construction materials are used and where two or more kinds of different metallic materials are arranged adjacent to each other, appropriate measures are to be taken to prevent bimetallic corrosion.

~~17~~ The following connections are to be screened or provided with other appropriate means, and fitted with drip trays to prevent the spread of any spillage where they are installed:

- (1) Detachable connections between pipes (flanged connections and mechanical joints, etc.);
- (2) Detachable connections between pipes and equipment such as pumps, strainers, heaters, valves; and
- (3) Detachable connections between equipment mentioned in (1) and (2) above.

18 The drip trays specified in -17 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. In cases where such tank is an integral tank, -7(1) and (2) above are to be applied to the tank(the term “these tanks” is to be read as “appropriate tanks, such as residue tanks”).

Paragraph 22.4.2 has been amended as follows.

22.4.2 Ventilation Systems

1 If storage tanks for sodium hydroxide solutions, chemical treatment fluids 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 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. ~~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.~~A warning notice requiring the use of such ventilation before entering the compartment is to be provided outside the compartment adjacent to each point of entry.

2 Notwithstanding the requirements specified in -1 above, where storage tanks for sodium hydroxide solutions, chemical treatment fluids 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, ventilation systems for enclosed compartments normally entered by ship personnel which are located adjacent to such tanks are to be capable of giving at least 20 air changes per hour and of being operated from outside the compartment in accordance with the following (1) or (2).~~ The requirements specified in -1 also apply to the following closed compartments normally entered by persons:

- (1) ~~In cases where the tanks are adjacent to the engine room, the requirements of -2 above apply 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~~
- (2) ~~In cases where the tanks are adjacent to enclosed compartments normally entered by ship personnel, the requirements of -1 above apply 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 °C and with fully welded joints.~~

Paragraph 22.4.3 has been added as follows.

22.4.3 Venting Systems of Storage Tanks for Chemical Treatment Fluids

1 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 tank for chemical treatment fluids.

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

Paragraph 22.4.3 has been renumbered to 22.4.4, and Paragraph 22.4.4 has been amended as follows.

22.4.34 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

chemical treatment fluids 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 (Omitted)
- 3 Alarm devices, to be activated in the event of any of the abnormal conditions given in **Table D22.1**, are to be provided at control stations of exhaust gas cleaning systems.
- 4 Exhaust gas cleaning systems are to be fitted with monitoring devices at control stations for exhaust gas cleaning systems, 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~~ chemical treatment fluids
 - (3) Temperatures in tanks for ~~sodium hydroxide solutions~~ chemical treatment fluids (where the heating and/or cooling systems specified in -6 are provided)
 - (4) Exhaust gas temperatures at outlets
 - (5) Pressures at inlets or differential pressures across scrubber chambers
- 5 (Omitted)
- 6 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.

Table D22.1 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 <u>chemical treatment fluids</u>) ⁽²⁾	H
Liquid levels in tank for sodium hydroxide solution <u>chemical treatment fluids</u>	H L
Temperature in tank for sodium hydroxide solution <u>chemical treatment fluids</u> ⁽³⁾	H L
Exhaust gas pressure at the inlet ⁽⁴⁾	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) To detect high washwater temperature due to abnormal conditions of heat exchangers; however, alarms need not be fitted in cases where heat exchangers are not used.
- (3) This alarm is not required when heating and/or cooling systems are not provided.
- (4) Differential pressure across scrubber chamber may be accepted in lieu.

22.6 Safety and Protective Equipment

Paragraph 22.6.1 has been amended as follows.

22.6.1 General

1 For the protection of crew members, ~~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~~the

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

2 Personnel protective equipment is to consist of the following.

- (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

~~23~~ Eyewash and safety showers are to be located in the vicinity of sodium hydroxide solution filling stations and sodium hydroxide solution supply pumps. provided, the location and number of eyewash stations and safety showers are to be derived from the detailed installation arrangements. As a minimum, the following stations are to be provided:

- (1) In the vicinity of transfer or treatment pump locations for chemical treatment fluids. If there are multiple transfer or treatment pump locations on the same deck then one eyewash and safety shower station may be considered for acceptance provided that the station is easily accessible from all such pump locations on the same deck.
- (2) 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.
- (3) An eyewash station and safety shower is to be provided in the vicinity of any part of the system where a spillage/drainage of chemical treatment fluids may occur and in the vicinity of system connections/components of the fluids that require periodic maintenance.

22.7 Tests

Paragraph 22.7.1 has been amended as follows.

22.7.1 Tests at Facilities (Shop tests)

1 ~~Sodium hydroxide solution~~Chemical treatment fluids 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 pressures corresponding to the maximum heights of fluid columns in overflow pipes, with a minimum of 2.4 m above the top plate taking into consideration the specific density of the treatment fluid.

2 After completion of the fabrication process, piping, valves and pipe fittings, for liquids containing ~~sodium hydroxide solutions~~chemical treatment fluids, 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.

3 The pressure parts of ~~sodium hydroxide solution~~chemical treatment fluids 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.

4 For ~~sodium hydroxide solution~~chemical treatment fluids supply pumps and washwater supply pumps, shop trials are to be carried out according to test procedures deemed appropriate by the Society. 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.

5 Electrical motors and their corresponding control gears used for ~~sodium hydroxide solution~~chemical treatment fluids supply pumps and washwater supply pumps are to be tested in accordance with relevant requirements in **Part H**. 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.

Paragraph 22.7.2 has been amended as follows.

22.7.2 Tests after Installation On Board

1 In cases where ~~sodium hydroxide solutions~~chemical treatment fluids 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**. Where the specific gravities of the liquids used for the tests are less than those of the ~~sodium hydroxide solution~~chemical treatment fluids, an appropriate additional head is to be considered.

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

- (1) Piping systems for liquids containing ~~sodium hydroxide solutions~~chemical treatment fluids (except overboard discharge pipes) are to be subjected to leak tests at pressures equal to 1.5 times the design pressure or 0.4 MPa, whichever is greater.
- ((2) to (4) are omitted.)