

RULES

FOR THE CLASSIFICATION AND CONSTRUCTION OF SHIPS CARRYING LIQUEFIED GASES IN BULK

PART X SPECIAL REQUIREMENTS

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RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF SHIPS CARRYING LIQUEFIED GASES IN BULK

Rules for the Classification and Construction of Ships Carrying Liquefied Gases in Bulk of Russian Maritime Register of Shipping (RS, the Register) have been approved in accordance with the established approval procedure and come into force on 1 January 2022.

The present edition of the Rules is based on the 2021 edition taking into account the amendments developed immediately before publication.

The Rules establish requirements, which are specific for ships carrying liquefied gases in bulk, and supplement the Rules for the Classification and Construction of Sea-Going Ships and Rules for the Equipment of Sea-Going Ships of Russian Maritime Register of Shipping.

The Rules are published in the following parts:

Part I "Classification";

Part II "Ship Arrangement";

Part III "Stability. Subdivision. Freeboard";

Part IV "Cargo Containment";

Part V "Fire Protection";

Part VI "Systems and Piping";

Part VII "Electrical Equipment";

Part VIII "Instrumentation and Automation Systems";

Part IX "Materials and Welding";

Part X "Special Requirements".

REVISION HISTORY

(purely editorial amendments are not included in the Revision History)

For this version, there are no amendments to be included in the Revision History.

1 GENERAL

1.1 The requirements of this Part apply where reference is made in column 10 of the Table of Technical Requirements (refer to Annex 1) and supplement the general requirements of the Rules for the Classification and Construction of Ships Carrying Liquefied Gases in Bulk¹.

¹ Hereinafter referred to as "the LG Rules".

2 PERSONNEL PROTECTION

2.1 Suitable respiratory and eye protection for emergency escape purposes shall be provided for every person on board, subject to the following:

- .1** filter-type respiratory protection is unacceptable;
- .2** self-contained breathing apparatus shall have at least a duration of service of 15 min; and
- .3** emergency escape respiratory protection shall not be used for firefighting or cargo-handling purposes and shall be marked to that effect.

2.2 One or more suitably marked decontamination showers and eyewash stations shall be available on deck, taking into account the size and layout of the ship. The showers and eyewashes shall be operable in all ambient conditions.

3 MATERIALS OF CONSTRUCTION

3.1 Mercury, copper, zinc, copper-bearing alloys shall not be used as materials of construction for cargo tanks and associated pipelines, valves, fittings and other items of equipment which may be exposed to liquid cargo or its vapour.

3.2 Copper, silver, mercury, magnesium and other acetylide-forming metals shall not be used as materials of construction for cargo tanks and associated pipelines, valves, fittings and other items of equipment which may be exposed to liquid cargo or its vapour.

3.3 Aluminium and aluminium-bearing alloys shall not be used as materials of construction for cargo tanks and associated pipelines, valves, fittings and other items of equipment which may be exposed to liquid cargo or its vapour.

3.4 Copper, copper alloys, zinc or galvanized steel shall not be used as materials of construction for cargo tanks and associated pipelines, valves, fittings and other items of equipment which may be exposed to liquid cargo or its vapour.

3.5 Aluminium, copper and alloys of either shall not be used as materials of construction for cargo tanks and associated pipelines, valves, fittings and other items of equipment which may be exposed to liquid cargo or its vapour.

3.6 Copper and copper-bearing alloys with greater than 1 % copper shall not be used as materials of construction for cargo tanks, and associated pipelines, valves, fittings and other items of equipment which may be exposed to liquid cargo or its vapour.

4 INDEPENDENT TANKS

4.1 Products shall be carried in independent tanks only.

4.2 Products shall be carried in type C independent tanks and the requirements of 4.1.3, Part VI "Systems and Piping" shall be complied with.

The design pressure of the cargo tank shall take into account the pressure of any medium used to separate air from cargo, and/or vapour discharge unloading pressure.

5 REFRIGERATION SYSTEMS

5.1 Only the indirect system described in 4.2.2.2, Part VI "Systems and Piping" shall be used.

5.2 For a ship engaged in the carriage of products which readily form dangerous peroxides, recondensed cargo shall not be allowed to form stagnant pockets of inhibited liquid. This may be achieved either by:

using the indirect system described in 4.2.2.2, Part VI "Systems and Piping" with the condenser inside the cargo tank; or

using the direct system or combined system described in 4.2.2.1 and 4.2.2.3, Part VI "Systems and Piping", or the indirect system described in 4.2.2.2 of the same Part with the condenser outside the cargo tank, and designing the condensate system to avoid any places in which liquid could collect and be retained. Where this is impossible inhibited liquid shall be added into such places.

5.3 If the ship shall carry consecutively products as specified in [5.2](#) with a ballast passage between, all uninhibited liquid shall be removed prior to the ballast voyage.

If a second cargo is to be carried between such consecutive cargoes, the reliquefaction system shall be thoroughly drained and purged before loading the second cargo. Purging shall be carried out using either inert gas or vapour from the second cargo, if compatible.

Practical steps shall be taken to ensure that polymers or peroxides do not accumulate in the ship's cargo system.

6 SEPARATE PIPING SYSTEMS

6.1 Separate piping systems shall be provided in accordance with the definition in 1.2.1, Part I "Classification".

7 CARGOES REQUIRING TYPE 1G SHIP

7.1 All butt-welded joints in cargo piping exceeding 75 mm in diameter shall be subject to 100 % radiography.

7.2 Gas sampling lines shall not be led into or through non-hazardous areas. Alarms referred to in 6.3, Part VIII "Instrumentation and Automation Systems" shall be activated when the vapour concentration reaches the threshold limiting value.

7.3 The alternative of using portable gas detection equipment in accordance with 6.10, Part VIII "Instrumentation and Automation Systems" shall not be permitted.

7.4 Cargo control rooms shall be located in a gas-safe space and, additionally, all instrumentation shall be of the indirect type.

7.5 Personnel shall be protected against the effects of a major cargo release by the provision of a space within the accommodation area that is designed and equipped to the satisfaction of the Register.

7.6 Notwithstanding the requirements of 1.5.4, Part II "Ship Arrangement", access to forecastle spaces shall not be permitted through a door facing the cargo area, unless airlock in accordance with 1.20, Part II "Ship Arrangement" is provided.

7.7 Notwithstanding the requirements of 1.5.8, Part II "Ship Arrangement", access to control rooms and machinery spaces of turret systems shall not be permitted through doors facing the cargo area.

8 EXCLUSION OF AIR FROM VAPOUR SPACES

8.1 Air shall be removed from the cargo tanks and associated piping before loading and then subsequently excluded by:

introducing inert gas to maintain a positive pressure. Storage or production capacity of inert gas shall be sufficient to meet normal operating requirements and relief valve leakage. The oxygen content of inert gas is at no time to be greater than 0,2 % by volume; or control of cargo temperatures such that a positive pressure is maintained at all times.

9 MOISTURE CONTROL

9.1 For gases, which are non-flammable and may become corrosive or react dangerously with water, moisture control shall be provided to ensure that cargo tanks are dry before loading and during discharge, dry air or cargo vapour is introduced to prevent negative pressures. Dry air is air which has a dewpoint of $-45\text{ }^{\circ}\text{C}$ or below at atmospheric pressure.

10 INHIBITION

10.1 Care shall be taken to ensure that the cargo is sufficiently inhibited to prevent polymerization at all times during the voyage.

11 PERMANENTLY INSTALLED TOXIC GAS DETECTORS

11.1 Gas sampling lines shall not be led into or through gas-safe spaces. Alarm shall be activated when the vapour concentration reaches the threshold limiting value.

11.2 The alternative of using portable equipment in accordance with 6.9, Part VIII "Instrumentation and Automation Systems" is not permitted.

12 ETHYLENE OXIDE

12.1 Cargo piping system and vent piping system shall be completely separated from all other piping systems.

12.2 Hold spaces shall be inerted in accordance with [8.1](#).

12.3 Vapour spaces of cargo tanks shall be filled with nitrogen in accordance with [8.1](#) at a pressure equal to the difference between the cargo vapour pressure at 30 °C and the set pressure of the relief valve.

12.4 Ethylene oxide shall be discharged only by deepwell pumps or inert gas displacement.

12.5 Ethylene oxide shall be carried refrigerated only and maintained at temperatures of less than 30 °C.

12.6 Pressure relief valves of the cargo tanks shall be set at a pressure of not less than 0,55 MPa.

12.7 A jettisoning arrangement shall be provided to allow the emergency discharge of ethylene oxide in the event of uncontrollable self-reaction.

12.8 Aluminium and aluminium alloys, copper and copper alloys, silver and silver alloys, magnesium and magnesium alloys, stainless steel, cast iron, mercury, asbestos shall not be used as materials of construction.

13 METHYL ACETYLENE-PROPADIENE MIXTURES

13.1 Methyl acetylene-propadiene mixtures shall be suitably stabilized for transport. Additionally, upper and lower limits of temperature and pressure during the refrigeration shall be specified for the mixtures.

13.2 A ship carrying methyl acetylene-propadiene mixtures shall have an indirect refrigeration system as required in 4.2.2.2, Part VI "Systems and Piping".

Alternatively, a ship may utilize direct-expansion refrigeration system subject to pressure and temperature limitations depending on the composition of mixtures. In this case, for the example compositions given in column 1 of the Table of Technical Requirements (Annex 1), the following features shall be provided:

.1 a vapour compressor that does not raise the temperature and pressure of the vapour above 60 °C and 1,75 MPa, and that does not allow vapour to stagnate in the compressor while it continues to run;

.2 discharge piping from each compressor stage or each cylinder in the same stage of a reciprocating compressor shall have:

.2.1 two temperature-actuated shutdown switches set to operate at 60 °C or less;

.2.2 a pressure-actuated shutdown switch set to operate at 1,75 MPa or less;

.2.3 a safety relief valve set to relieve at 1,8 MPa or less and which vents to the vent system described in Section 5, Part VI "Systems and Piping";

.3 an alarm that gives an audible and visual warning to the cargo control room and to the navigation bridge when a high-pressure switch, or a high-temperature switch operates.

13.3 The piping system, including the cargo refrigeration system, for tanks to be loaded with methyl acetylene-propadiene mixtures shall be either independent or separate from piping and refrigeration systems for other tanks by the removal of spool pieces, valves or other pipe sections and the installation of blank flanges at these locations.

This segregation applies to all liquid and vapour vent pipes and any other possible connections, such as common inert gas supply lines.

14 NITROGEN

14.1 Materials of construction and insulation shall be resistant to the effects of high oxygen concentrations caused by condensation and enrichment at the low temperatures attained in parts of the cargo system.

Ventilation shall be provided in such areas where condensation may occur to avoid the stratification of oxygen-enriched atmosphere.

15 CHLORINE

15.1 Cargo tanks.

15.1.1 The capacity of each tank shall not exceed 600 m³ and the total capacity of all cargo tanks shall not exceed 1200 m³.

15.1.2 The tank design vapour pressure shall be not less than 1,35 MPa (see also 4.1.3, Part VI "Systems and Piping" and [4.2](#) of this Part).

15.1.3 Parts of tanks protruding above the upper deck shall be provided with protection against thermal radiation taking into account total engulfment by fire.

15.1.4 Each tank shall be provided with two pressure relief valves. A bursting disc shall be installed between the tank and the pressure relief valves. The rupture pressure of the bursting disc shall be 0,1 MPa lower than the opening pressure of the pressure relief valve, which shall be set at the design vapour pressure of the tank but not less than 1,35 MPa. The space between the bursting disc and the relief valve shall be connected through an excess flow valve to a pressure gauge and a gas detection system.

Provision shall be made to keep this space at or near the atmospheric pressure during normal operation.

15.1.5 Outlets from pressure relief valves shall be arranged in such a way as to minimize the hazards on board the ship as well as to the environment.

Leakage from the relief valves shall be led through the absorption plant to reduce the gas concentration as far as possible.

The relief valve exhaust line shall be arranged at the forward end of the ship to discharge outboard at deck level with an arrangement to select either port or starboard side, with a mechanical interlock to ensure that one line is always open.

15.1.6 The Register may require that chlorine is carried in refrigerated state at a specified or maximum pressure.

15.2 Cargo piping systems.

15.2.1 Cargo discharge shall be performed by means of compressed chlorine vapour from shore, dry air or another acceptable gas or fully submerged pumps. The pressure in the vapour space of the tank during discharging shall not exceed 1,05 MPa.

Cargo discharge compressors on board ships are not permitted.

15.2.2 The design pressure of the cargo piping system shall be not less than 2,1 MPa. The internal diameter of the cargo pipes shall not exceed 100 mm.

Only pipe bends shall be accepted for compensation of pipeline thermal movement. The use of flanged joints shall be restricted to a minimum, and when used the flanges shall be of the welding neck type with tongue and groove.

15.2.3 Relief valves of the cargo piping system shall discharge to the absorption plant and in this case the back pressure in the vent lines as specified in 3.19.2, Part VI "Systems and Piping" shall be taken into account.

15.3 Materials.

15.3.1 The cargo tanks and cargo piping systems shall be made of steel suitable for the cargo and for a temperature of –40 °C, even if a higher transport temperature is intended to be used.

15.3.2 The tanks shall be thermally stress relieved. Mechanical stress relief shall not be accepted as an equivalent.

15.4 Instrumentation.

15.4.1 The ship shall be provided with a chlorine absorbing plant with connections to the cargo piping system and the cargo tanks. The absorbing plant shall be capable of neutralizing at least 2 % of the total cargo capacity at a reasonable absorption rate.

15.4.2 During the gas-freeing of cargo tanks, vapours shall not be discharged to the atmosphere.

15.4.3 A gas detection system shall be provided capable of monitoring chlorine concentrations of at least 1 ppm by volume. Suction points shall be located:

- near the bottom of the hold spaces;
- in the pipes from the safety relief valves;
- at the outlet of the gas absorbing plant;
- at the inlet to the ventilation systems for the accommodation, service and machinery spaces and control stations;
- on deck at the forward end, in the middle and at the after end of the cargo area (required to be used only during cargo handling and gas-freeing operations).

Audible and visual alarms activated when chlorine vapours reach concentration of more than 5 ppm shall be provided in spaces listed in 6.3, Part VIII "Instrumentation and Automation Systems", as well as in the wheelhouse.

15.4.4 Each cargo tank shall be fitted with high-pressure alarm giving an audible alarm at a pressure equal to 1,05 MPa.

15.5 Personnel protection.

15.5.1 The enclosed space required by [7.5](#) shall meet the following requirements:

.1 the space shall be easily and quickly accessible from the weather decks and from accommodation spaces by means of air locks, and shall be capable of being rapidly closed gastight;

.2 one of the decontamination showers required by [2.2](#) shall be located near the weather deck airlock to the space;

.3 the space shall be designed to accommodate the entire crew of the ship and be provided with a source of uncontaminated air for a period of not less than 4 h; and

.4 one set of oxygen therapy equipment shall be carried in the space.

15.6 Filling limits for cargo tanks.

15.6.1 The requirements of 3.20.4.2, Part VI "Systems and Piping" do not apply when it is intended to carry chlorine.

15.6.2 The chlorine content of the gas in the vapour space of the cargo tank after loading shall be greater than 80 % by volume.

16 VINYL CHLORIDE

16.1 Sufficient inhibitor shall be added into the product to prevent its polymerization during the voyage.

16.2 In cases where no or insufficient inhibitor has been added, any inert gas used for the purposes of [Section 8](#) shall contain not more oxygen than 0,1 %. Before loading is started, inert gas samples from the tanks and piping shall be analysed.

16.3 When vinyl chloride is carried, a positive pressure shall always be maintained in the tanks, also during ballast voyages between successive carriages.

17 DIETHYL ETHER AND VINYL ETHYL ETHER

17.1 In case of unloading by means of pumps, the cargo shall be discharged only by hydraulically operated submerged pumps. These pumps shall be of a type designed to avoid liquid pressure against the shaft gland.

17.2 Inert gas displacement may be used for discharging cargo from type C independent tanks provided the cargo system is designed for the expected pressure.

18 PROPYLENE OXIDE AND MIXTURES OF ETHYLENE OXIDE-PROPYLENE OXIDE WITH ETHYLENE OXIDE CONTENT OF NOT MORE THAN 30 % BY WEIGHT

18.1 Products transported under the requirements of the present Section shall be acetylene-free.

18.2 Tanks for the carriage of these products shall be of steel or stainless steel construction.

18.3 All valves, flanges, fittings and accessory equipment shall be of a type suitable for use with these products and shall be constructed of steel or stainless steel or other material acceptable to the Register.

The chemical composition of all materials to be used shall be submitted to the Register for approval before manufacture.

Discs or disc faces, seats and other wearing parts of valves shall be made of stainless steel containing not less than 11 % chromium.

18.4 Gaskets shall be constructed of materials which do not react with, dissolve in, or lower the autoignition temperature of these products and which are fire-resistant and possess adequate mechanical behaviour.

The surface presented to the cargo shall be polytetrafluoroethylene (PTFE) or materials giving a similar degree of safety by their inertness.

Spirally-wound stainless steel with a filler of PTFE or similar fluorinated polymer may be accepted by the Register.

18.5 Insulation and packing if used shall be of material which does not react with, dissolve in, or lower the autoignition temperature of these products.

18.6 The following materials are generally found unsatisfactory for gaskets, packing and similar uses in containment systems for these products and shall undergo testing before being approved by the Register:

neoprene or natural rubber if it comes into contact with the products;

asbestos or binders used with asbestos;

materials containing oxides of magnesium, such as mineral wools.

18.7 Filling and discharge piping shall be extended to within 100 mm of the bottom of the tank or any sump.

18.8 The products shall be loaded and discharged in such a manner that venting of the tanks to atmosphere does not occur. If vapour return to shore is used during tank loading, the vapour return system connected to a containment system for the product shall be independent of all other containment systems.

"Independent" means that a piping or venting system is in no way connected to another system and there are no means available for the potential connection to other systems.

18.9 During discharging operations, the pressure in the cargo tank shall be maintained above 7 kPa.

18.10 The cargo shall be discharged only by hydraulically operated submerged pumps, or inert gas displacement. Each cargo pump shall be arranged to ensure that the product does not heat significantly if the discharge line from the pump is shut off or otherwise blocked.

18.11 Tanks carrying these products shall be vented independently of tanks carrying other products. Facilities shall be provided for sampling the tank contents without opening the tank to atmosphere.

18.12 Cargo hoses used for transfer of these products shall be marked "FOR ALKYLENE OXIDE TRANSFER ONLY".

18.13 Hold spaces shall be monitored for these products. Hold spaces surrounding type A and B independent tanks are also to be inerted and monitored for oxygen. The oxygen content of these spaces shall be maintained below 2 %. Portable sampling equipment is permitted.

18.14 Prior to disconnecting shore-lines, the pressure in liquid and vapour lines shall be relieved through suitable valves installed in the loading header. Liquid and vapour from these lines shall not be discharged to atmosphere.

18.15 Cargo tanks shall be designed for the maximum pressure expected to be encountered during loading, carriage or unloading of cargo.

18.16 Tanks for the carriage of propylene oxide with a design vapour pressure of less than 60 kPa and tanks for the carriage of ethylene oxide-propylene oxide mixtures with a design vapour pressure of less than 120 kPa shall have a cooling system to maintain the cargo below the reference temperature.

18.17 For type C independent tanks, the pressure relief valve settings shall be not less than 21 kPa and not greater than 0,7 MPa for the carriage of propylene oxide and not greater than 0,53 MPa for the carriage of ethylene oxide-propylene oxide mixtures.

18.18 The piping system for tanks to be loaded with these products shall be completely separate from piping systems for all other tanks, including empty tanks, and from all cargo compressors.

If the piping system for the tanks to be loaded with these products is not independent as defined in [18.8](#) the required piping separation shall be accomplished by the removal of spool pieces, valves, or other pipe sections and the installation of blank flanges at these locations.

The required separation applies to all liquid and vapour piping, liquid and vapour vent lines and any other possible connections such as common inert gas supply lines.

18.19 The products may be transported only in accordance with cargo-handling plans approved by the Register.

Each intended loading arrangement shall be shown on a separate cargo-handling plan.

Cargo-handling plans shall show the entire cargo piping system and the locations for installation of blank flanges needed to meet the above piping separation requirements.

A copy of each approved cargo-handling plan shall be kept on board the ship.

The Certificate shall include reference to the approved cargo-handling plans.

18.20 Before each initial loading of these products, a certificate verifying that the required piping separation has been achieved shall be obtained from a competent authority representative and carried on board the ship.

Each connection between a blank flange and pipeline flange shall be fitted with a wire and seal by the responsible person to ensure that inadvertent removal of the blank flange is impossible.

18.21 The maximum allowable tank filling limits for each tank shall be indicated for each loading temperature which may be applied and for the applicable maximum reference temperature, on a list to be approved by the Register. A copy of the list shall be permanently kept on board by the master.

18.22 The cargo shall be carried under suitable protective padding of nitrogen gas. Nitrogen of commercially pure quality (99,9 % by volume) shall be used for padding.

An automatic nitrogen make-up system shall be installed to prevent the tank pressure falling below 7 kPa in the event of product temperature fall due to ambient conditions or malfunctioning of refrigeration system.

Sufficient nitrogen shall be available on board to satisfy the demand of the automatic pressure control.

A battery of nitrogen bottles connected to the cargo tanks through a pressure reduction valve satisfies the intention of the expression "automatic" in this context.

18.23 The cargo tank vapour space shall be tested prior to and after loading to ensure that the oxygen content is 2 % by volume or less.

18.24 A water spray system of such capacity and arrangement as to blanket effectively the area surrounding the exposed deck cargo piping and the tank domes shall be provided in areas where loading and unloading operations are performed.

The arrangement of piping and nozzles shall be such as to give a uniform distribution rate of 10 l/min per m².

The water spray system shall be capable of both local and remote manual operation and the arrangement shall ensure that any spilled cargo is washed away. Additionally, a water hose with pressure to the nozzle, when ambient temperatures permit, shall be connected ready for immediate use during loading and unloading operations.

19 AMMONIA

19.1 Anhydrous ammonia may cause stress corrosion cracking in containment and process systems made of carbon-manganese steel or nickel steel. To minimize the risk of this occurring, measures detailed in [19.2 — 19.8](#) shall be taken, as appropriate.

19.2 Where carbon-manganese steel is used, cargo tanks, process pressure vessels and cargo piping shall be made of fine-grained steel with a specified minimum yield strength not exceeding 355 MPa and with an actual yield strength not exceeding 440 MPa. One of the following constructional or operational measures is also to be taken.

19.2.1 Material with a specified minimum tensile strength not exceeding 410 MPa shall be used.

19.2.2 Cargo tanks, piping, etc., shall be post-weld stress relief heat treated.

19.2.3 Carriage temperature shall be maintained at a temperature close to the product's boiling point of $-33\text{ }^{\circ}\text{C}$ but in no case at a temperature above $-20\text{ }^{\circ}\text{C}$.

19.2.4 The ammonia shall contain not less than 0,1 % w/w water.

19.3 If carbon-manganese steels with higher yield properties are used other than those specified in [19.2](#), the cargo tanks, piping, etc., shall be given a post-weld stress relief heat treatment.

19.4 Process pressure vessels and piping of the condensate part of the refrigeration system shall be given a post-weld stress relief heat treatment when made of materials mentioned in [19.1](#).

19.5 The required tensile and yield properties of the welding consumables shall exceed those of any tank or piping material to be welded.

19.6 Nickel steel containing more than 5 % nickel and carbon-manganese steel not complying with the requirements of [19.2](#) and [19.3](#) are particularly susceptible to stress corrosion cracking and shall not be used in containment and piping systems for the processing and carriage of the ammonia.

19.7 Nickel steel containing not more than 5 % nickel may be used provided the carriage temperature complies with the requirements specified in [19.2.3](#).

19.8 In order to minimize the risk of ammonia stress corrosion cracking, it is advisable to keep the dissolved oxygen content below 2,5 ppm w/w. This can best be achieved by reducing the average oxygen content in the tanks prior to the introduction of liquid ammonia to less than the values given in [Table 19.8](#).

Table 19.8

Carriage temperature, in $^{\circ}\text{C}$	Oxygen content, in % by volume
-30 and below	0,90
-20	0,50
-10	0,28
0	0,16
10	0,10
20	0,05
30	0,03
Note. Oxygen percentage for intermediate temperatures may be obtained by linear interpolation.	

20 VAPOUR RETURN PIPELINES

20.1 Pipelines shall be provided to return vapour to the shore installation during loading operations.

21 TOXIC PRODUCTS

- 21.1** Toxic products shall have individual piping systems.

22 FLAME SCREENS ON VENT OUTLETS

22.1 Cargo vent outlets shall be provided with permanent or readily renewable and effective flame screens or safety heads preventing the passage of sparks and flame into the cargo tanks, when carrying a cargo specified in this Part. In the design of flame screens and vent heads the possibility of the blockage of these devices by the freezing of cargo vapour or by icing up in adverse weather conditions shall be provided.

Ordinary protection screens shall be fitted after removal of the flame screens.

23 MAXIMUM ALLOWABLE QUANTITY OF CARGO PER TANK

23.1 When carrying a cargo specified in this Part, the quantity of the cargo shall not exceed 3000 m³ in any one tank.

24 INCOMPATIBLE CARGOES

24.1 Incompatible cargoes are substances which react dangerously one with another and form new dangerous substances.

24.2 During simultaneous transportation of two or more cargoes, which can react dangerously one with another, separate gas piping and gas discharge from cargo systems having no permanent connection with each other and both complying with operational safety criteria specified in [24.3](#) shall be provided. In case of simultaneous transportation of two or more cargoes not reacting with one another but whose vapour properties require isolated systems, the said systems may be separated by shutoff valves.

24.3 Operational safety of the system and its auxiliary devices shall be such that:

.1 in case of a single failure of mechanical elements or non-static regulation system elements, pressure and temperature in the cargo tank remain in the design values range not impacting other essential functions;

.2 no redundancy of piping systems is needed;

.3 heat exchangers necessary for maintaining pressure and temperature in the design values range have a redundant heat exchanger except for the cases when their heat power output exceeds that necessary for pressure regulation by more than 25 %, and they can be repaired onboard the ship without external resources. If an additional pressure and temperature regulation device independent of the heat exchanger is provided onboard, the redundant heat exchanger is not necessary; and

.4 for any substance used in the cargo heating or cooling system, means for the detection of toxic or flammable vapour leakage into the safe space or overboard in accordance with the requirements of Section 6, Part VIII "Instrumentation and Automation Systems". Any outlet of such leakage detection device shall be in the safe zone and be fitted with a flame arrester.

**25 CARRIAGE OF CARGOES IDENTIFIED (*) IN THE TABLE OF TECHNICAL
REQUIREMENTS (ANNEX 1)**

25.1 In case where cargoes identified (*) in the Table of Technical Requirements (refer to Annex 1) are carried, the ship is also to meet the applicable requirements of the Rules for the Classification and Construction of Chemical Tankers.

26 MIXED C4 CARGOES

26.1 Cargoes that may be carried individually under the requirements of the IGC Code, notably butane, butylenes and butadiene, may be carried as mixtures subject to the provisions of this section. These cargoes may variously be referred to as "Crude C4", "Crude butadiene", "Crude steam-cracked C4", "Spent steam-cracked C4", "C4 stream", "C4 raffinate", or may be shipped under a different description. In all cases, the material safety data sheets (MSDS) shall be consulted as the butadiene content of the mixture is of prime concern as it is potentially toxic and reactive. While it is recognized that butadiene has a relatively low vapour pressure, if such mixtures contain butadiene they shall be regarded as toxic and the appropriate precautions applied.

26.2 If the mixed C4 cargo shipped under the terms of this section contains more than 50 % (mole) of butadiene, the inhibitor precautions in [10.1](#) shall apply.

26.3 Unless specific data on liquid expansion coefficients is given for the specific mixture loaded, the filling limit restrictions of 3.7, Part VI "Systems and Piping" shall be calculated as if the cargo contained 100 % concentration of the component with the highest expansion ratio.

27 CARBON DIOXIDE: HIGH PURITY

27.1 Uncontrolled pressure loss from the cargo can cause "sublimation" and the cargo will change from the liquid to the solid state. The precise "triple point" temperature of a particular carbon dioxide cargo shall be supplied before loading the cargo, and will depend on the purity of that cargo, and this shall be taken into account when cargo instrumentation is adjusted. The set pressure for the alarms and automatic actions described in this section shall be set to at least 0,05 MPa above the triple point for the specific cargo being carried. The "triple point" for pure carbon dioxide occurs at 0,5 MPa gauge and $-54,4^{\circ}\text{C}$.

27.2 There is a potential for the cargo to solidify in the event that a cargo tank relief valve, fitted in accordance with 3.16, Part VI "Systems and Piping", fails in the open position. To avoid this, a means of isolating the cargo tank safety valves shall be provided and the requirements of [3.16.7.2](#) do not apply when carrying this carbon dioxide. Discharge piping from safety relief valves shall be designed so they remain free from obstructions that could cause clogging. Protective screens shall not be fitted to the outlets of relief valve discharge piping, so the requirements of 5.8, Part VI "Systems and Piping", do not apply.

27.3 Cargo tanks shall be continuously monitored for low pressure when a carbon dioxide cargo is carried. An audible and visual alarm shall be given at the cargo control position and on the bridge. If the cargo tank pressure continues to fall to within 0,05 MPa of the "triple point" for the particular cargo, the monitoring system shall automatically close all cargo manifold liquid and vapour valves and stop all cargo compressors and cargo pumps. The emergency shutdown (ESD) system may be used for this purpose.

27.4 All materials used in cargo tanks and cargo piping system shall be suitable for the lowest temperature that may occur in service, which is defined as the saturation temperature of the carbon dioxide cargo at the set pressure of the automatic safety system described in [27.1](#).

27.5 Cargo hold spaces, cargo compressor rooms and other enclosed spaces where carbon dioxide could accumulate shall be fitted with continuous monitoring for carbon dioxide build-up. This fixed gas detection system replaces the requirements of Section 6, Part VIII "Instrumentation and Automation Systems", and hold spaces shall be monitored permanently even if the ship has type C cargo containment.

28 CARBON DIOXIDE: RECLAIMED QUALITY

28.1 The requirements of [Section 28](#) apply to this cargo. the materials of construction used in the cargo system shall also take account of the possibility of corrosion, in case the reclaimed quality carbon dioxide cargo contains impurities such as water, sulphur dioxide, etc., which can cause acidic corrosion or other problems.

29 CARGO PUMPS AND DISCHARGE ARRANGEMENTS

29.1 The vapour space of cargo tanks equipped with submerged electric motor pumps shall be inerted to a positive pressure prior to loading, during carriage and during unloading of flammable liquids.

29.2 The cargo shall be discharged only by deepwell pumps or by hydraulically operated submerged pumps. These pumps shall be of a type designed to avoid liquid pressure against the shaft gland.

29.3 Inert gas displacement may be used for discharging cargo from type C independent tanks, provided the cargo system is designed for the expected pressure.

Russian Maritime Register of Shipping

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Part X
Special Requirements**

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