RUSSIAN MARITIME REGISTER OF SHIPPING

Version: 01.03.2023

RULES

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

PART VIII

INSTRUMENTATION AND AUTOMATION SYSTEMS

ND No. 2-020101-176-E

St. Petersburg
2023

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 2023.

The present edition of the Rules is based on the 2022 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".

The Annexes to the Rules are published separately.

REVISION HISTORY[1]
(purely editorial amendments are not included in the Revision History)

Amended paras/chapters/ sections	Information on amendments	Number and date of the Circular Letter	Entry-into-force date
Para 6.3.5	Requirements for fixed gas detection system have been aligned with the provisions of the International Code of the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)	315-23-1892c of 13.02.2023	01.03.2023
Para 6.7	Requirements of the para have been aligned with the provisions of the IGC Code	315-23-1825c of 27.09.2022	01.01.2023

[1] Amendments and additions introduced at re-publication or by new versions based on circular letters or editorial amendments.

1 GENERAL

1.1 Each cargo tank shall be provided with means for indicating level, pressure and temperature of the cargo.

Pressure gauges and temperature indicating devices shall be installed in the liquid and vapour piping systems, in cargo refrigerating installations and in the inert gas system according to the requirements of this Part of the Rules for the Classification and Construction of Ships Carrying Liquefied Gases in Bulk[1].

1.2 Where a secondary barrier is required, permanently installed instrumentation shall be provided to detect liquid cargo leaks when the primary barrier fails to be liquid-tight or when liquid cargo is in contact with the secondary barrier. This instrumentation may consist of appropriate gas detecting devices according to Section 6.

However, the instrumentation need not be capable of locating the area where liquid cargo leaks through the primary barrier or where liquid cargo is in contact with the secondary barrier.

1.3 If the loading or unloading of the ship is performed by means of remotely controlled valves and pumps, all controls and indicators associated with a given cargo tank shall be concentrated in one control position.

1.4 Instruments shall be tested to ensure reliability under the working conditions, and recalibrated at regular intervals. Test procedures for instruments and the intervals between recalibration shall be in accordance with manufacturer's recommendations.

[1] Hereinafter referred to as "the LG Rules".

2 LEVEL INDICATORS FOR CARGO TANKS

2.1 Each cargo tank shall be fitted with one or several liquid level gauging devices arranged to ensure that a level reading is always obtainable whenever the cargo tank is operational. The devices shall be designed to operate throughout the design pressure range of the cargo tank and at temperatures within the cargo operating temperature range.

Where only one liquid level gauge is fitted it shall be arranged so that it can be maintained in an operational condition without the need to empty or gas-free the tank. In order to assess whether or not only one level gauge is acceptable, phrase "can be maintained" means that any part of the level gauge other than passive parts can be overhauled while the cargo tank is in service. For this purpose, passive parts are those parts assumed not subject to failures under normal service conditions.

2.2 Cargo tank liquid level gauges may be of the following types subject to any special requirements for particular cargoes shown in column 8 of the Table of Technical Requirements (refer to Annex 1):

.1 indirect devices, which determine the amount of cargo by means such as weighing or pipe flow meters;

.2 closed devices, which do not penetrate the cargo tank, such as devices using radioisotopes or ultrasonic devices;

.3 closed devices, which penetrate the cargo tank, but which form part of a closed system and keep the cargo from being released, such as pneumatic devices, float type systems, electronic probes, magnetic probes.

If a closed gauging device is not mounted directly on the tank it shall be provided with a shut-off valve located as close as possible to the tank;

.4 restricted devices, which penetrate the tank and when in use permit a small quantity of cargo vapour or liquid to escape to the atmosphere. When not in use, the devices shall be kept completely closed. The design and installation of these devices shall ensure that no dangerous escape of cargo can take place when opening the device. The area of the openings being uncovered during gauging shall not exceed 7 mm^2.

2.3 Sighting ports with a suitable protective cover and situated above the liquid level with an internal scale may be allowed by the Register as a secondary means of gauging for cargo tanks having a design vapour pressure not higher than 70 kPa.

2.4 Tubular glasses shall not be used as level indicators.

Gauge glasses of the robust type as fitted on high-pressure boilers and fitted with excess flow valves may be allowed by the Register for deck tanks.

3 LIQUID LEVEL ALARMS

3.1 Except as provided in 3.2, each cargo tank shall be fitted with a high liquid level alarm operating independently of other liquid level indicators and giving an audible and visual warning, when activated, to the cargo control room and to the wheelhouse. On receiving such warning, the operator on board who is in charge of the loading operations shall inform the personnel of the shore terminal about interruption of the loading.

Besides, another device operating independently of the high liquid level alarm shall automatically shut down shipboard pumps and/or automatically actuate an emergency shutdown valve in a manner which will both avoid excessive liquid pressure in the cargo main and prevent the tank from becoming liquid full. The emergency shutdown valve shall comply with the requirements of 3.2, Part VI "Systems and Piping". Information on the availability of such device shall be submitted to the Administration of the shore terminal before the loading.

Where arrangements are provided for overriding the overflow control system, they shall be such that inadvertent operation is prevented. When this override is operated, continuous visual indication shall be given at the relevant control station(s) and the navigation bridge.

3.2 Except as provided in Part X "Special Requirements", a high liquid level alarm and automatic shutoff of cargo tank filling are not required when the cargo tank:

is a pressure tank with a volume not more than 200 m^3; or

is designed to withstand the maximum possible pressure during the loading operation and such pressure is below that of the start-to-discharge pressure of the cargo tank relief valve.

4 PRESSURE GAUGES

4.1 The vapour space of each cargo tank shall be provided with a pressure gauge which shall incorporate an indicator in the cargo control room. In addition, a high-pressure alarm and, if vacuum protection is fitted, a low-pressure alarm, shall be provided on the navigation bridge. Maximum and minimum allowable pressures shall be marked on the indicators.

4.2 Each cargo pump discharge line and each liquid and vapour cargo manifold shall be provided with a pressure gauge.

4.3 Local-reading manifold pressure gauges shall be provided to indicate the pressure between stop valves and hose connections to the shore.

4.4 Hold spaces and interbarrier spaces without open connection to the atmosphere shall be provided with pressure gauges.

4.5 The pressure gauge blowing-off pipes shall be carried to a safe place.

4.6 For cargo tanks fitted with PRVs which can be set at more than one set pressure in accordance with 3.16.6, Part VI "Systems and Piping", high-pressure alarms shall be provided for each set pressure.

5 TEMPERATURE INDICATING DEVICES

5.1 Each cargo tank shall be provided with at least two devices for indicating cargo temperatures, one placed at the bottom of the cargo tank and the second near the top of the tank, below the highest allowable liquid level.

The temperature indicating devices shall be marked to show the lowest temperature at which the cargo tank may be used.

5.2 When a cargo is carried in cargo tanks with a secondary barrier at a temperature lower than –55 °C, temperature indicating devices shall be provided within the insulation or on the hull structure adjacent to the cargo tanks.

The devices shall give readings at regular intervals and, where applicable, audible warning of temperatures approaching the lowest for which the hull steel is suitable.

5.3 If cargo is carried at temperatures lower than –55 °C, the cargo tank boundaries, if appropriate for the design of the cargo tank, shall be fitted with temperature indicating devices as follows:

.1 a sufficient number of devices to establish that an unsatisfactory temperature gradient does not occur;

.2 on one tank a number of devices in excess of those required in 5.3.1 in order to monitor the initial cool down procedure. These devices may be either temporary or permanent.

5.4 The number and position of temperature indicating devices shall be sufficient for making substantiated decisions on the state of the cargo and its containment systems.

6 GAS DETECTORS

6.1 In accordance with column 7 of Table of Technical Requirements (refer to Annex 1), depending on the cargo to be carried, gas detectors of RS-approved type and compliant with IEC 60079-29-1:2016 shall be installed.

6.2 The positions of fixed sampling heads shall be determined with due regard to the density of the vapours of the products intended to be carried and the dilution from compartment purging or ventilation.

6.3 A permanently installed gas detection system shall be provided for:

.1 cargo pump rooms;

.2 cargo compressor rooms;

.3 motor rooms for cargo pumps;

.4 cargo control rooms unless considered as gas-safe spaces;

.5 other enclosed and semi-enclosed spaces in the cargo area where vapour may accumulate including hold spaces and interbarrier spaces for independent tanks other than type C;

.6 ventilation hoods and gas ducts where required by Section 11, Part VI "Systems and Piping";

.7 air locks;

.8 spaces in gas-fired internal combustion engines (refer to 11.15.3.3, Part VI "Systems and Piping").

Audible and visual alarms from the gas detection system shall be located in the cargo control room, on the navigation bridge and at the gas detector readout location.

6.4 Gas detectors may be located in the cargo control room, on the navigation bridge or at other suitable locations.

When gas detectors are located in a gas-safe space the following conditions shall be met:

.1 gas-sampling lines shall be fitted with flame arresters. Sampled gas shall be discharged to the atmosphere via a special discharge pipe situated in a safe location;

.2 penetrations of the gas-sampling lines through gastight bulkheads shall be of approved type and have the same fire integrity as the bulkhead concerned;

.3 each gas-sampling line shall be fitted with a manually operated shut-off isolating valve installed on the gastight bulkhead on the gas-safe side;

.4 gas detection equipment shall be located in a special tight steel cabinet. One measuring point shall be within the cabinet. When the dangerous gas concentration within the cabinet reaches 30 % of the lower flammable limit, gas supply to the gas detector shall be automatically cut off;

.5 gas-sampling lines are generally not be led through the spaces outside the gas-dangerous zone. If the cabinet for gas detection cannot be located on a gastight bulkhead, gas-sampling lines shall be as short as possible, made of steel or equivalent material and have no detachable connections, except for connections with the gas detection cabinet and isolating valves on the gastight bulkhead.

6.5 Gas detectors shall be capable of sampling and analysing for each sampling head location sequentially at intervals not exceeding 30 min, except that in the case of gas detection for the ventilation hoods and gas ducts referred to in 6.3.6 sampling shall be continuous.

Common sampling lines to gas detectors are not be fitted.

6.6 Pipes running from sampling heads shall not be led through gas-safe spaces except as permitted by 6.4.

6.7 For the spaces listed in 6.3, alarms shall be activated for flammable products when the vapour concentration reaches 30 % of the lower flammable limit. For crankcases of

internal combustion engines that can run on gas (refer to 6.3.8), alarms shall be activated before the vapour concentration reaches 100 % of the lower flammable limit.

6.8 In case of flammable products, where cargo containment systems other than independent tanks are used, hold spaces and interbarrier spaces shall be provided with a permanently installed gas detection system capable of measuring gas concentrations of 0 to 100 % by volume.

6.9 In case of toxic gases, hold spaces and interbarrier spaces shall be provided with a permanently installed piping system for obtaining gas samples from the spaces and areas. Gas from these spaces shall be sampled and analysed from each sampling head location by means of fixed or portable equipment at intervals not exceeding 4 h and in any event before personnel enter the space and at 30-min intervals when they remain therein.

6.10 In case of toxic or both toxic and flammable products, the Register may authorize the use of portable equipment for detection of toxic gases in the spaces listed in 6.3 as an alternative to a permanently installed gas detection system, if such equipment is used before personnel enter these spaces and at 30-min intervals while they remain therein.

The portable equipment is not required for the products, for which column 10 of the Table of Technical Requirements (refer to Annex 1) refers to Section 11, Part X "Special Requirements".

6.11 Gas detectors shall be so designed that they may readily be tested. Testing and calibration shall be carried out at regular intervals. Permanent connections shall be fitted for testing and calibration by metrological services.

6.12 Every ship shall be provided with at least two sets of portable gas detectors approved by the Register and suitable for the products to be carried.

6.13 A suitable instrument for the measurement of oxygen levels in inert atmosphere shall be provided.

6.14 Gas detectors intended for detecting gas in accommodation spaces, service spaces and control stations shall have a measuring range within the limits of the maximum allowable concentrations of gases for the carriage of which the ship is intended.

6.15 In addition to the requirements specified in 6.3, on board the ships fitted with the regasification unit the gas detection system be extended with a sufficient number of gas detectors of continuous monitoring type provided for:

regasification units;
metering units;
suction drum;
export manifold;
storage tanks for flammable fluids or gases, if fitted on the weather deck;
ventilation inlets to gas safe spaces;
odorization units;
turret compartment.

6.16 Oxygen deficiency monitoring equipment shall be installed in enclosed or semi-enclosed spaces containing equipment that may cause an oxygen-deficient environment (such as nitrogen generators, inert gas generators or nitrogen cycle refrigerant systems).

Two oxygen sensors shall be positioned at appropriate locations in the space or spaces containing the inert gas system for all gas carriers, irrespective of the carriage of cargo indicated by an "O" in column 7 of the Table of Technical Requirements (refer to Annex 1).

7 AUTOMATION SYSTEMS

7.1 The requirements of this Section shall apply where automation systems are used to provide instrumented control, monitoring/alarm or safety functions required by the LG Rules.

7.2 Automation systems shall be designed, installed and tested in compliance with the LG Rules and IEC 60092-504:2016 "Electrical installations in ships — Automation, control and instrumentation".

7.3 Hardware shall be applied suitable for use in the marine environment.

7.4 Software shall be designed and documented for ease of use, including testing, operation and maintenance.

7.5 The user interface shall be designed such that the equipment under control can be operated in a safe and effective manner at all times.

7.6 Automation systems shall be arranged such that a hardware failure or an error by the operator does not lead to an unsafe condition. Adequate safeguards against incorrect operation shall be provided.

7.7 Appropriate segregation shall be maintained between control, monitoring/alarm and safety functions to limit the effect of single failures. This shall be taken to include all parts of the automation systems that are required to provide specified functions, including connected devices and power supplies.

7.8 Automation systems shall be arranged such that the software configuration and parameters are protected against unauthorized or unintended change.

7.9 A management of change process shall be applied to safeguard against unexpected consequences of modification. Records of configuration changes and approvals shall be maintained on board.

7.10 Processes for the development and maintenance of integrated systems shall be in compliance with ISO/IEC/IEEE 15288:2015 "Systems and software engineering — System life cycle processes", and ISO 17894:2005 "Ships and marine technology — Computer applications — General principles for the development and use of programmable electronic systems in marine applications". These processes shall include appropriate risk identification and management.

7.11 System integration.

7.11.1 Essential safety functions shall be designed such that risks of harm to personnel or damage to the installation or the environment are reduced to a level acceptable to the Administration, both in normal operation and under fault conditions. Functions shall be designed to fail-safe. Roles and responsibilities for integration of systems shall be clearly defined and agreed by relevant parties.

7.11.2 Functional requirements of each component subsystem shall be clearly defined to ensure that the integrated system meets the functional and specified safety requirements and takes account of any limitations of the equipment under control.

7.11.3 Key hazards of the integrated system shall be identified using appropriate risk-based techniques. The designer shall develop and submit for approval the procedure for failure mode and effects analysis (FMEA) (in compliance with IEC 60812:2018 "Failure modes and effects analysis (FMEA and FMECA)").

7.11.4 The integrated system shall have a suitable means of reversionary control.

7.11.5 Failure of one part (module, hardware or subsystem unit) of the integrated system shall not affect the functionality of other parts, except for those functions directly dependent on the defective part. The total communication failure between parts of the integrated system shall not affect the parts functionality in independent mode.

7.11.6 Operation with an integrated system shall be at least as effective as it would be with individual stand-alone equipment or systems.

7.11.7 The integrity of essential machinery or systems, during normal operation and fault conditions, shall be demonstrated. The failures may be realistically simulated to demonstrate a failure detection and the system response.

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