RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

RULES

Part N Ships Carrying Liquefied Gases in Bulk

2023 AMENDMENT NO.1

Rule No.29 30 June 2023

Resolved by Technical Committee on 25 January 2023

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

Rule No.29 30 June 2023
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 N SHIPS CARRYING LIQUEFIED GASES IN BULK

Amendment 1-1

Chapter 16 USE OF CARGO AS FUEL

16.1 General (IGC Code 16.1)

Paragraph 16.1.1 has been amended as follows.

16.1.1 General*

1 Except as provided for in **16.9**, methane (*LNG*) is the only cargo whose vapour or boil-off gas may be utilized in machinery spaces of category **A**, and, in these spaces, it may be utilized only in systems such as boilers, inert gas generators, internal combustion engines, gas combustion unit and gas turbines.

2 In addition to **-1** above, engines designed to directly inject methane gas fuel (boil-off gases and cargo vapour) precompressed to a high pressure into cylinders at a high pressure upon termination of the compression stroke and then ignite with an appropriate source of ignition for due combustion (hereinafter referred to as "high pressure gas-fuelled engines") as well as gas fuel supply systems are to be in accordance with **Annex 16.1.1-2**.

3 In addition to **-1** above, trunk-piston type engines supplied with low pressure natural gas as fuel (hereinafter referred to as "low pressure gas-fuelled engines") and gas fuel supply systems are to be in accordance with **Annex 16.1.1-3**.

Annex 16.1.1-2 has been added as follows.

Annex 16.1.1-2 HIGH PRESSURE GAS-FUELLED ENGINES

Chapter 1 GENERAL

1.1 Scope

1 The Guidance applies to engines so designed to directly inject methane gas fuel (boil-off gases and cargo vapour) precompressed to a high pressure into cylinders at a high pressure upon termination of the compression stroke and then ignite with an appropriate source of ignition for due combustion (hereinafter referred to as "high pressure gas-fuelled engines") as well as gas fuel supply systems in accordance with the requirements in **16.1.1, Part N of the Rules**.

2 High pressure gas-fuelled engines and gas fuel supply system are to comply with the relevant requirements of **Part D** and **Part N of the Rules**, in addition to the requirements of this Guidance and **Chapter 16, Part N of the Rules**.

3 High pressure gas-fuelled engines are to be in accordance with those requirements for low pressure gas-fuelled engines specified in **Annex 16.1.1-3** which the Society deems appropriate.

1.2 Equivalency

High pressure gas-fuelled engines which do not comply with the requirements of this Guidance may be accepted provided that they are deemed to be equivalent to those specified in this Guidance by the Society.

1.3 Drawings and Data

The drawings and data to be submitted are as follows.

(1) Drawings and data for approval
- (a) Drawings and data specified in **2.1.3-1(1), Part D of the Rules**
- (b) Drawings and data specified in **18.1.3(1)(a)**, **(b)** and **(e), Part D of the Rules**
- (c) Gas fuel injection valves
- (d) High pressure oil pipe for actuating gas fuel injection valves with its shielding
- (e) Gas fuel injection pipe with its shielding
- (f) High pressure oil pipe for sealing gas fuel injection valves with its shielding
- (g) Arrangements of gas detectors
- (h) Combustion monitoring device
- (i) Gas fuel injection valve actuating device
- (j) Governor
- (k) Engine control system diagram (including monitor, safety and alarm devices) for gas fuel combustion operation
- (l) Gas leak protective device at connections between engines and gas fuel supply piping
- (m) Gas fuel make-up plant (including construction, equipment, and control systems)
- (n) Gas fuel supply piping system (including details of valves and pipe fittings) and protective device for gas leak from them
- (o) Automatic control and remote control systems for gas fuel supply system
- (p) Other drawings and data as deemed necessary by the Society according to the type of high pressure Gas-fuelled engines

(2) Drawings and data for reference

(a) Drawings and data specified in **2.1.3-1(2), Part D of the Rules**

(b) Instruction manuals (including procedures for onboard maintenance, inspection and overhaul)

(c) Stress analysis of gas fuel supply piping system

(d) Other drawings and data as deemed necessary by the Society

(3) Drawings and data for reference

Items specified in **2.1.3-1, Part D of the Rules**, which are intended for inspection and testing (indicated by "○" in **Table D2.1(1)** and **Table D2.1(2), Part D of the Rules**).

Chapter 2 CONSTRUCTION AND EQUIPMENT OF HIGH PRESSURE GAS-FUELLED ENGINES

2.1 General

1 High pressure gas-fuelled engines are to be dual fuel system types capable of operating on oil fuel and gas fuel, or gas-only system types.

2 High pressure gas-fuelled dual fuel engines are to be capable of supplying oil fuel to each cylinder in amounts sufficient for maintaining stable combustion of gas fuel under any conditions.

3 High pressure gas-fuelled engines are to be capable of maintaining stable operations even under any of the following **(1)** to **(3)** conditions:

(1) switching from one fuel to another (in the cases of dual fuel engines),

(2) rapid load fluctuations, and

(3) minimum load conditions during gas combustion.

4 Only oil fuel is, in principle, to be used when operation of high pressure gas-fuelled dual fuel engines is unstable.

5 High pressure gas-fuelled dual fuel engines are to be capable of quickly switching from gas combustion mode to oil fuel only combustion mode.

2.2 Construction and Strength

2.2.1 Gas Fuel Injection Valves

1 Gas fuel injection valves are to have satisfactory operating characteristics and durability for the assumed service period.

2 Gas fuel injection valves are to be provided with a sealing system to effectively prevent gas fuel from leaking through spaces around valve spindles.

3 Gas fuel injection valves are to be provided with an effective cooling system.

2.2.2 Gas Fuel Injection Valve Actuating System

1 The gas fuel injection valve actuating system is to be reliably functional and operational.

2 When operating gas fuel injection valves equipped with an actuating oil piping system and a sealing oil piping system, the high pressure sections of these systems which are installed on the engine body are to be provided with protections against splash of actuating oil in accordance with the requirements in **2.5.4, Part D of the Rules**.

3 Appropriate means are to be provided if the gas fuel injection valve actuating oil is required to be kept clean.

2.2.3 Cylinder Covers

1 The shape of combustion chambers and the arrangements of gas fuel injection valves and oil fuel (or pilot oil) injection valves are to be such that reliable ignition and combustion of gas fuel are ensured.

2 The portion of the cylinder covers where gas fuel injection valves and oil fuel injection valves are fitted are to be so constructed as to prevent leakage of gas fuel and unburnt gases in the cylinders.

2.3 Safety Systems

2.3.1 Combustion Monitoring Device

1 When high pressure gas-fuelled engines are operated on gas fuel, the following items are, in

principle, to be monitored and the gas fuel supply to the engines is to be automatically cut off in case of any abnormal conditions concerning the following **(1)** through **(4)** are detected.

(1) Function of gas fuel injection valves

(2) Function of pilot oil fuel injection valves (in case of dual fuel engine)

(3) Function of exhaust gas valves

(4) Exhaust gas temperatures at each cylinder outlet

2 When high pressure Gas-fuelled engines are operated on gas fuel, the following items are to be monitored as standard.

(1) Abnormalities in each cylinder pressure

(2) Blow-by through exhaust valves

2.3.2 Protection against Explosions

1 Relief valves of an approved type are to be provided for the crankcase in accordance with **2.4.3, Part D of the Rules**.

2 Unless designed with the strength to withstand the worst case overpressure due to ignited gas leaks, scavenge spaces and exhaust system are to be fitted with suitable pressure relief systems in accordance with **16.7.1-4, Part D of the Rules**.

3 The relief valves for cylinders installed in accordance with the requirements of **2.4.2, Part D of the Rules**, are to be provided with a system to monitor certain closing of the valves as far as practicable.

4 Effective gas detecting systems to detect gas fuel leaks are to be fitted at the following locations **(1)** through **(4)**. If the sensors of these gas detecting systems are fitted to the high pressure gas-fuelled engine body, they are to be double as far as practicable.

(1) The lower space of each piston or the scavenging air manifolds of the crosshead-type high pressure gas-fuelled engines.

(2) The crankcase of the trunk piston-type high pressure gas-fuelled engines. In this case, the sensors may be required at more than one location depending on the shape of crankcase.

(3) The void space between gas fuel injection lines and shielding systems specified in **2.4.3**, except the case of the same void space common to the void space of protective pipes for the gas fuel supply piping system or ducts specified in **3.2.3-2(1)** to **(2)**.

(4) Other locations considered necessary by the Society.

2.3.3 Governor

1 Governors for high pressure gas-fuelled engines are to be capable of being operated during gas fuel combustion mode. In the case of dual fuel engines, the governors are additionally to be capable of being operated either during gas and oil fuel (or pilot oil) combustion mode, and/or oil fuel only combustion mode.

2 The governors of **-1** above are to comply with the requirements in **2.4.1-1, Part D of the Rules** in each mode of operations.

3 High pressure gas-fuelled dual fuel engines are to be operated in any one of the modes specified in the following **(1)** to **(3)**:

(1) controllable gas fuel supply and fixed oil fuel (pilot oil) supply,

(2) controllable oil fuel (pilot oil) supply and fixed gas fuel supply, or

(3) controllable gas fuel and oil fuel supplies.

2.4 Accessory Equipment

2.4.1 Exhaust Gas Systems

The exhaust gas pipes of high pressure gas-fuelled engines are not to be connected to the exhaust gas pipes or the exhaust pipes of other engines or systems.

2.4.2 Starting Systems

Starting air branch pipes to each cylinder are to be provided with effective flame arresters.

2.4.3 Gas Fuel Injection Pipes

1 Gas fuel injection pipes (only those attached to engines) are to be provided with effective shielding against gas fuel spillage due to pipe failure.

2 Space between the gas fuel injection pipes and shielding is to be provided with means according to the requirements in **3.2.3-2(1)** to **(2)**.

3 When flexible tubes are used as shielding, they are to be of an approved type.

2.4.4 Cylinder Lubrication

Cylinder lubricating systems for high pressure gas-fuelled engines are to be capable of maintaining adequate alkali values and cylinder oil feeding rates according to the mode of operation on oil fuel only and also the modes of operation specified in **2.3.3-3(1)** to **(3)** as standard.

Chapter 3 GAS FUEL SUPPLY SYSTEMS

3.1 Gas Fuel Make-up Plants

3.1.1 General

1 Gas fuel make-up plants and oil fuel supply systems for high pressure gas-fuelled engines are to be capable of sustaining main engine operation so that at least normal navigation can be maintained even if one of the fuel systems for gas fuel or oil fuel fails.

2 High pressure gas compressors, pumps and heat exchangers forming gas fuel make-up plant are to comply with requirements specified separately by the Society.

3 Pressure vessels and piping systems composing a gas fuel make-up plant are to comply with the requirements of **Chapter 5, Part N of the Rules**.

4 High pressure gas-fuelled engines are to be provided with an appropriate system capable of reducing to allowable levels the pulsation of gas fuel supply pressures caused by high pressure gas compressors for gas fuel supply.

5 If the heating medium of gas fuel heat exchangers returns to spaces other than cargo spaces, it is to be so arranged that the heating medium is returned through degassing tanks located in cargo spaces. The degassing tanks are to be provided with a gas detecting system to issue alarms on detecting gas leaks. Vent outlets of the degassing tanks are to be provided with flame screens and the openings are to be located at safe positions.

3.2 Gas Fuel Supply Piping Systems

3.2.1 Materials

1 Materials of pipes, valves and pipe fittings of the gas fuel supply piping system are to comply with the relevant requirements in **Part K of the Rules**.

2 In addition to **-1** above, when design temperatures are lower than 0°C, the requirements in **Table N6.4, Part N of the Rules** are also to be complied with,

3 Notwithstanding the requirements in **-1** and **-2** above, the materials conforming to *JIS* standard or other standards as deemed appropriate by the Society may be used for pipes, valves and pipe fittings used in accessory piping systems or instrument piping systems with an outside diameter of not more than 25 *mm*.

4 Consideration is to be given to the cooling effects caused by bursting of the high pressure gas fuel in the event of a failure of the piping system, when the materials of gas fuel supply piping systems are selected.

3.2.2 Construction and Strength

1 Gas fuel supply piping systems are to be supported effectively by hull structures or engine frames considering the weight of the piping system, and deflections and vibrations of the hull.

2 Gas fuel supply piping systems are to be ensured to have sufficient construction strength by carrying out stress analysis considering the stresses produced by the weight of the piping system, internal pressure, heat contraction and hull deflections.

3 For all valves and expansion joints used in gas fuel supply lines, approval of use is to be obtained in accordance with requirements specified otherwise by the Society or with requirements for prototype tests specified otherwise by the Society.

4 Joints between the gas fuel supply lines are to be butt-welded joints with complete penetration, except where specially approved by the Society.

5 Pipe joints other than welded joints at the locations specially approved by the Society are to comply with the appropriate Standards recognized by the Society, or those whose structural strength

has been verified through tests and analysis as deemed appropriate by the Society.

6 For butt-welded joints specified in **-4** above, post-weld heat treatment is to be performed in accordance with **5.9.2, Part N of the Rules**.

3.2.3 Protection against Gas Fuel Leaks

1 Gas fuel supply piping systems are not to be led through the accommodation spaces, service spaces, and control stations.

2 If either of the following items **(1)** and **(2)** are relevant, the piping system may be led through or led into the spaces other than that specified in **-1** above.

(1) The system complying with **16.4.3(1), Part N of the Rules**, and in addition, with **(a)** to **(c)** given below:

(a) The pressure in the space between concentric pipes is monitored continuously, an alarm is to be issued and automatic double block and bleed valves specified in **16.4.5, Part N of the Rules** and the master gas valve specified in **16.4.6** are to be closed before the pressure drops to below the inner pipe pressure (however, the automatic double block and bleed valve connected to vent outlet is to be opened).

(b) Construction and strength of the outer pipes are to comply with the requirements in **5.4.4** and **5.11.4, Part N of the Rules**.

(c) It is to be so arranged that the inside of the gas fuel supply piping system between the master gas valve and the high pressure Gas-fuelled engine is to be automatically purged with inert gas, when the master gas valve is closed.

(2) The system complying with **16.4.3(2), Part N of the Rules**, and in addition with **(a)** through **(e)** given below:

(a) Materials, construction and strength of outer pipes of double wall pipes or ducts and mechanical ventilating systems are to be sufficiently durable against bursting and rapid expansion of high pressure gases following the inner pipe failure.

(b) The capacity of mechanical ventilating systems is to be determined considering the flow rate of gas fuel and construction and arrangement of protective pipes or ducts, as deemed appropriate by the Society.

(c) The air intakes of mechanical ventilating systems are to be provided with non-return devices effective for gas fuel leaks. However, if the air intakes are opened directly to exposed spaces and located at places free from risk of ignition of leaked gas fuel, these requirements may be dispensed with.

(d) The number of flange joints of outer pipes of double wall pipes or ducts is to be minimized.

(e) Measure specified in **(1)(c)** above.

Chapter 4 CONTROL SYSTEMS AND SAFETY SYSTEMS

4.1 General

1 Control systems for operating high pressure gas-fuelled engines using gas fuel are to comply with the requirements in **18.1** to **18.3** and **18.7, Part D of the Rules**.

2 High pressure gas compressors and pumps for supplying gas fuel in the gas fuel make-up plant are to be provided with the following safety systems:

(1) Remote stopping devices from readily accessible places and the position from which the main engine is normally controlled.

(2) Automatic stopping device actuated when the suction pressure of boil-off gas or cargo liquids drops to below the predetermined value according to the cargo tank construction system, before the tank pressure reaches the set pressure of negative pressure relief valves for cargo tanks.

(3) Emergency shut-down specified in **Table N18.1, Part N of the Rules**.

(4) Volumetric compressors are to be fitted with pressure relief valves discharging into the suction line of the compressor. The size of the pressure relief valves is to be determined in such away that, with the delivery valve kept close, the maximum pressure will not exceed the maximum working pressure by more than 10%.

3 The exit temperature and pressure of gas fuel at the gas fuel make-up plant are to be automatically controlled. Visual and audible alarm device are also to be provided such as to be activated when the temperature and pressure exceed the preset ranges.

4.2 High Pressure Gas-fuelled engines of Ships to which the Rules for Automatic and Remote Control Systems Apply

High pressure gas-fuelled engines of ships to which the requirements in **1.1.1 of the Rules for Automatic and Remote Control Systems** apply are to comply with the requirements in **3.2, 3.3** and **4.2** of the same **Rules**, in addition to the following requirements **(1)** and **(2)**:

(1) High pressure gas-fuelled engines are to be provided with safety system which automatically cut off gas fuel supply, and in addition, automatically transfer the mode of operation to oil fuel alone or stops the engines when abnormalities **(a)** to **(d)** given below occur. However, automatic cut off of gas fuel supply with the automatic double block and bleed valves specified in **16.4.5, Part N of the Rules** may be accepted.
   (a) When abnormalities specified in **2.3.1-1** or **-2** are detected.
   (b) When gas fuel leaks are detected by gas detecting devices specified in **3.2.3-2(2)**.
   (c) When high pressure gas compressors or pumps for supplying gas fuel stopped for reasons specified in **4.3** (excluding however, the case in which arrangement is made for automatic starting of a stand-by compressor when the working compressor fails).
   (d) Other cases as deemed necessary by the Society.

(2) High pressure gas-fuelled engines are to be provided with a system which automatically reduces speed or transfers the mode of operation to oil fuel alone and issues an alarm in the event of the following **(a)** through **(g)**:
   (a) Abnormal gas fuel temperature
   (b) Abnormal gas fuel supply pressure
   (c) Abnormalities in high pressure gas compressors for gas fuel supply specified in **4.3(2)**.
   (d) Activation of alarms specified in **3.2.3-2(1)(a)** or **(2)**.
   (e) Low inert gas supply pressures for purging gas fuel pipe lines
   (f) Low pressures of hydraulic pneumatic sources loss of electric power supply for gas fuel

combustion control

(g) Others as deemed necessary by the Society.

4.3 Gas Fuel Make-up Plant for Ships to which the Rules for Automatic and Remote Control Systems Apply

Gas fuel make-up plants of ships to which the requirements of **1.1.1 of the Rules for Automatic and Remote Control Systems** apply are to comply with the following requirements **(1)** and **(2)**:

(1) High pressure gas compressors for gas fuel supply are to be provided with safety devices specified in the following **(a)** through **(f)**:

(a) Emergency shut-down devices specified separately by the Society

(b) Device for reciprocating compressors to avoid continuous operation within the barred speed range

(c) Automatic stopping device at overspeeds

(d) Automatic stopping device at low lubricating oil pressure

(e) Automatic stopping device at abnormal high discharge pressures

(f) Automatic stopping device at abnormal low temperatures at boil-off gas heater outlets

(2) High pressure gas compressors for gas fuel supply are to be provided with alarm devices activated in the cases specified separately by the Society and in the event of the abnormal conditions specified in **-1** above.

Chapter 5 TESTS

5.1 Approval of Use

For each type of high pressure gas-fuelled engine, approval of use is to be obtained by the engine designer (licensor) in accordance with requirements specified separately by the Society.

5.2 Shop Test

5.2.1 Hydrostatic Tests

The parts and accessory equipments of high pressure gas-fuelled engines, which are exposed to pressures, are to be subjected to hydrostatic tests in accordance with the requirements of **2.6.1-1, Part D of the Rules**.

5.2.2 Shop Trials

High pressure gas-fuelled engines are to be tested as specified in **2.6.1-4, Part D of the Rules**. To implement surveys of tests, in lieu of traditional ordinary surveys where the Surveyor is in attendance, the Society may approve survey methods which it considers to be able to obtain information equivalent to that obtained through traditional ordinary surveys.

5.3 Tests after Installation On Board

The control systems of high pressure gas-fuelled engines and related equipments are to be subjected to tests in accordance with the requirements of **18.7.3, Part D of the Rules** or the requirements of **2.2.4 of the Rules for Automatic and Remote Control Systems** according to the kind of Installations Character.

5.4 Sea Trials

1 Performance of control systems of high pressure gas-fuelled engines and related equipment is to be verified during operations using gas fuel depending upon their installation characters in accordance with the requirements of **2.2.5 of the Rules for Automatic and Remote Control Systems**: relevant requirements are to be applied mutatis mutandis.

2 Sea trials specified in **2.3.1, Part B** are to be carried out for operations using the oil fuel only. In addition, however, either the testing items as considered to be necessary by the Society are to be carried out to verify the control performance of engine operations using the gas fuel.

Annex 16.1.1-3 has been added as follows.

Annex 16.1.1-3 LOW PRESSURE GAS-FUELLED ENGINES

Chapter 1 GENERAL

1.1 Scope

1 The Guidance applies to trunk-piston type engines supplied with low pressure natural gas as fuel (hereinafter referred to as "low pressure gas-fuelled engines") and gas fuel supply systems in accordance with the requirements of **16.1.1, Part N of the Rules**.

2 Low pressure gas-fuelled engines and gas fuel supply systems are to comply with relevant requirements of **Part D** and **Part N of the Rules**, in addition to the requirements of this Guidance and **Chapter 16, Part N of the Rules**.

3 The following requirements specified in **Part GF of the Rules** as well as other requirements specified separately by the Society apply to low pressure gas-fuelled engines regardless of ship type, ship size and ship service area except where explicitly specified otherwise.

(1) **2.1-5(3)**
(2) **2.2.3-1**
(3) **2.4.4-4(2)**
(4) **2.4.4-4(3)(b)**
(5) **4.1-7**

1.2 Equivalency

Low pressure gas-fuelled engines which do not comply with the requirements of this Guidance may be accepted provided that they are deemed to be equivalent to those specified in this Guidance by the Society.

1.3 Drawings and Data

The drawings and data to be submitted are as follows.

(1) Drawings and data for approval
  (a) Drawings and data specified in **2.1.3-1(1), Part D of the Rules**
  (b) Drawings and data specified in **18.1.3(1)(a)**, **(b)** and **(e), Part D of the Rules**
  (c) Gas fuel injection valves and actuating systems
  (d) Gas fuel injection pipe and shielding arrangements
  (e) Arrangement of gas detectors
  (f) Combustion monitoring device
  (g) Governor
  (h) Engine control system diagram (including monitor, safety and alarm systems) for gas fuel combustion operation
  (i) Gas leak protection system at connections between engines and gas fuel supply piping systems
  (j) Gas fuel make-up plant (including construction, equipment, and control systems)
  (k) Gas fuel supply piping system (including details of valves and pipe fittings) and protective device for gas leaks from them
  (l) Automatic control and remote control systems for gas fuel supply systems

(m) Pilot fuel injection devices or injection arrangements
(n) Schematic layout or other equivalent documents of gas system on the engine
(o) Gas piping system (including double-walled arrangement where applicable)
(p) Parts for gas admission system
The documentation to contain specifications for pressures, pipe dimensions and materials.
(q) Arrangement of explosion relief valves for crankcase (if required by **2.4.3, Part D of the Rules**), charge air manifold and exhaust gas manifold, as applicable
(r) Schematic layouts or other equivalent documents for fuel oil systems (main and pilot fuel systems) of the engine (in the case of dual fuel engines)
(s) Assembly drawings for the shielding of high pressure fuel pipes of pilot fuel system (in the case of gas only engines)
(t) Other drawings and data as deemed necessary by the Society according to the type of low pressure gas-fuelled engines

(2) Drawings and data for reference
(a) Drawings and data specified in **2.1.3-1(2), Part D of the Rules**
(b) Other drawings and data as deemed necessary by the Society

(3) Drawings and data for the purpose of inspecting and testing engines
Items specified in **2.1.3-1, Part D of the Rules**, which are intended for inspection and testing (indicated by "○" in **Table D2.1(1)** and **Table D2.1(2), Part D of the Rules**).

1.4 Terms

1 *Certified safe type* means electrical equipment that is certified in accordance with the recommendation published by the International Electrotechnical Commission (*IEC*), in particular publication *IEC* 60092-502:1999, or with recognized standards at least equivalent. The certification of electrical equipment is to correspond to the category and group for methane gas.

2 *Double block and bleed valve* means valves which have the functionality specified in **16.4.5, Part N of the Rules**.

3 *Dual fuel engine* means an engine that can burn natural gas as fuel simultaneously with liquid fuel, either as pilot oil or bigger amount of liquid fuel (gas mode), and also has the capability of running on liquid diesel fuel oil only (Diesel mode).

4 *Engine room* is a machinery space or enclosure containing gas fuelled engine(s).

5 *Gas* means a fluid having a vapour pressure exceeding 0.28 *MPa* absolute at a temperature of 37.8℃.

6 *Gas admission valve* is a valve or injector on the engine, which controls gas supply to the cylinder(s) according to the cylinder(s) actual gas demand.

7 *Gas only engine* means an engine that can be operated only with gas fuel and cannot be switched to oil-fuelled operation.

8 *Gas piping* means piping containing gas or air / gas mixtures, including venting pipes.

9 *Gas Valve Unit* (*GVU*) is a set of manual shutoff valves, actuated shut-off and venting valves, gas pressure sensors and transmitters, gas temperature sensors and transmitters, gas pressure control valve and gas filter used to control the gas supply to each gas consumer. It also includes a connection for inert gas purging.

10 *Low pressure gas* means gas with a pressure up to 1 *MPa*.

11 *Lower Heating Value* (*LHV*) means the amount of heat produced from the complete combustion of a specific amount of fuel, excluding latent heat of vaporization of water.

12 *Methane Number* is a measure of resistance of a gas fuel to knock, which is assigned to a test fuel based upon operation in knock testing unit at the same standard knock intensity. (Pure methane

is used as the knock resistant reference fuel, that is, methane number of pure methane is 100, and pure hydrogen is used as the knock sensitive reference fuel, methane number of pure hydrogen is 0.)

13 *Pilot fuel* means the fuel oil that is injected into the cylinder to ignite the main gas-air mixture on Gas-fuelled engines.

14 *Pre-mixed engine* means an engine where gas is supplied in a mixture with air before the turbocharger.

15 *Safety Concept* is a document describing the safety philosophy with regard to gas as fuel. It describes how risks associated with this type of fuel are controlled under reasonably foreseeable abnormal conditions as well as possible failure scenarios and their control measures. A detailed evaluation regarding the hazard potential of injury from a possible explosion is to be carried out and reflected in the safety concept of the engine.

Chapter 2 CONSTRUCTION AND EQUIPMENT OF LOW PRESSURE GAS-FUELLED ENGINES

2.1 General

1 Low pressure gas-fuelled engines are to be dual fuel system types capable of operating on oil fuel and gas fuel, or gas-only system types.

2 Low pressure gas-fuelled engines are to be capable of maintaining stable operation even under any of the following **(1)** to **(3)** conditions:

(1) switching from one fuel to another (in the case of dual fuel engine),

(2) rapid load transient, and

(3) minimum load condition during gas combustion

3 Gas fuel supply pressures for low pressure gas-fuelled engines are to always be kept higher than suction air pressures at the supply points of gas fuel to combustion chambers or the suction pipes before suction valves in order to prevent any back-flow of air into gas fuel lines.

4 The manufacturer is to declare the allowable gas composition limits for the engine and the minimum and (if applicable) maximum methane number.

5 Components containing or likely to contain gas are to be designed in accordance with the following **(1)** to **(5)**.

(1) Minimize the risk of fire and explosion so as to demonstrate an appropriate level of safety commensurate with that of an oil-fuelled engine

(2) Mitigate the consequences of a possible explosion to a level providing a tolerable degree of residual risk, due to the strength of the component(s) or the fitting of suitable pressure relief devices of an approved type

(3) Refer to **10.2** and **10.3, Part GF of the Rules**

(4) Discharge from pressure relief devices is to prevent the passage of flame to the machinery space and be arranged such that the discharge does not endanger personnel or damage other engine components or systems

(5) Relief devices are to be fitted with a flame arrester

2.2 Construction and Strength

2.2.1 Gas Fuel Valves and Actuating Systems

1 Gas fuel valves are to have satisfactory operating characteristics and durability for the assumed service period.

2 Gas fuel valves are to be provided with a sealing system to effectively prevent gas fuel from leaking through spaces around valve spindles.

3 The actuating systems of gas fuel valves are to have satisfactory operating characteristics and reliability.

2.2.2 Cylinder Covers

1 The shape of combustion chambers and the arrangements of gas fuel valves are to be such that reliable ignition and combustion of gas fuel are ensured.

2 The portions of cylinder covers where gas fuel valves and oil fuel injection valves are fitted are to be so constructed as to prevent the leakage of gas fuel and unburnt gases in the cylinders.

2.2.3 Crankcase

1 Crankcase explosion relief valves are to be installed in accordance with **2.4.3, Part D of the Rules**. Refer also to **10.3.1-2, Part GF of the Rules**.

2 For maintenance purposes, a connection, or other means, are to be provided for crankcase inerting and ventilating and gas concentration measuring.

2.2.4 Gas Ignition in Cylinder

For gas ignition in the cylinder, the requirements of **16.7, Part N of the Rules** are to be applied.

2.3 Safety Systems

2.3.1 Protection against Explosions

1 Suction manifolds and exhaust gas pipes are to be fitted with suitable pressure relief systems in accordance with **16.7.1-4, Part N of the Rules**.

2 Each gas fuel injection line is to be provided with a non-return valve or devices which have capabilities equivalent to those of the valves.

3 When gas is supplied in a mixture with air through a common manifold, flame arrestors are to be installed before each cylinder head.

4 Effective gas detecting systems to detect gas fuel leaks are to be fitted at the following locations **(1)** and **(2)**.

(1) Crankcases. In this case, the sensors may be required at more than one location depending on the shape of the crankcase; and

(2) Other locations considered necessary by the Society.

2.3.2 Governors

1 In addition to operations using gas fuel, governors of low pressure gas-fuelled engines are to be functional in either the simultaneous combustion mode of gas and oil fuel (or pilot oil) or the combustion mode of oil fuel.

2 The governors of **-1** above are to comply with the requirements in **2.4.1-1, Part D of the Rules** in each mode of operations.

3 Low pressure gas-fuelled dual fuel engines are to be operated in any one of the modes specified in the following **(1)** to **(3)**:

(1) controllable gas fuel supply and fixed oil fuel (pilot oil) supply,

(2) controllable oil fuel (pilot oil) supply and fixed gas fuel supply, or

(3) controllable gas fuel and oil fuel supplies.

2.4 Accessory Equipment

2.4.1 Charge Air Systems

1 The charge air system on the low pressure gas-fuelled engine is to be designed in accordance with **2.1-5**.

2 In case of a single engine installation, the engine is to be capable of operating at sufficient load to maintain power to essential consumers after opening of the pressure relief devices caused by an explosion event. Sufficient power for propulsion capability is to be maintained.

3 Load reduction is to be considered on a case-by-case basis, depending upon engine configuration (single or multiple) and type of relief mechanism (self-closing valve or bursting disk).

2.4.2 Exhaust Gas Systems

1 The exhaust gas system on the low pressure gas-fuelled engine is to be designed in accordance with **2.1-5**.

2 In case of a single engine installation, the engine is to be capable of operating at sufficient load to maintain power to essential consumers after opening of the pressure relief devices caused by

an explosion event. Sufficient power for propulsion capability is to be maintained.

3 Continuous relief of exhaust gas (through open rupture disc) into the engine room or other enclosed spaces is not acceptable.

2.4.3 Starting Systems

Starting air branch pipes to each cylinder are to be provided with effective flame arresters.

2.4.4 Gas Fuel Injection Pipes

1 Except where specifically approved by the Society, gas fuel injection pipes is to be provided with effective shielding against gas fuel bursting due to failures of pipes.

2 Spaces between the gas fuel injection pipes and the shielding is to be provided with means according to the requirements in **3.2.2-2**.

3 When flexible tubes are used as the shielding, they are to be of an approved type.

4 For piping attached to low pressure gas-fuelled engines, the following **(1)** to **(5)** also apply.

(1) Requirements of **5.1** to **5.9** and **Chapter 16, Part GF of the Rules** are applied.

(2) Arrangement of the gas piping system on the engine

Pipes and equipment containing fuel gas are defined as hazardous area zone 0 (refer to **12.5.1, Part GF of the Rules**). The space between the gas fuel piping and the wall of the outer pipe or duct is defined as hazardous area zone 1 (refer to **12.5.2(6), Part GF of the Rules**).

(3) Normal “double wall” arrangement

(a) The gas piping system on the low pressure gas-fuelled engine are applied the requirements of **16.4.3, Part N of the Rules**.

(b) The design criteria for the double pipe or duct are given in the **9.8** and **7.4.1-4, Part GF of the Rules**.

(c) In case of a ventilated double wall, the ventilation inlet is applied the provisions of **16.4.3(2), Part N of the Rules**.

(d) The pipe or duct is to be pressure tested in accordance with **12.6.1-2** to **-4, Part D of the Rules** to ensure gas tight integrity and to show that it can withstand the expected maximum pressure at gas pipe rupture.

(4) Alternative arrangement

Single walled gas piping is only acceptable in cases where the requirements of **Part N of the Rules** permit (e.g. **16.4.4-1, Part N of the Rules**).

(5) Gas admission valves

Gas admission valves are to be certified safe as follows:

(a) The inside of the valve contains gas and therefore it is to be certified for zone 0.

(b) When the valve is located within a pipe or duct in accordance with **(3)**, the outside of the valve is to be certified for zone 1.

(c) However, if they are not rated for the zone they are intended for, it is to be documented that they are suitable for that zone. Documentation and analysis is to be based on *IEC* 60079-10-1:2015 or *IEC* 60092-502:1999.

2.4.5 Cylinder Lubrication

Cylinder lubricating systems for low pressure gas-fuelled engines are to be capable of maintaining adequate alkali values and cylinder oil feeding rates according to the mode of operation on oil fuel only and also the modes of operation specified in **2.3.2-3(1)** to **(3)** as standard.

2.5 Design Requirements for Each Kind of Engines

2.5.1 Dual Fuel Engine

1 General

(1) The maximum continuous power that a dual fuel engine can develop in gas mode may be lower than the approved MCR of the engine (i.e. in oil fuel mode), depending in particular on the gas quality. This maximum power available in gas mode and the corresponding conditions are to be stated by the engine manufacturer and demonstrated during the type test.

(2) Low pressure gas-fuelled dual fuel engines are to be capable of supplying oil fuel to each cylinder in amounts sufficient for maintaining stable combustion of gas fuel under any conditions.

(3) Only oil fuel is, in principle, to be used when operation of low pressure gas-fuelled dual fuel engines are unstable.

2 Starting, changeover and stopping

(1) Dual fuel engines are to be arranged to use either oil fuel or gas fuel for the main fuel charge and with pilot oil fuel for ignition. The engines are to be arranged for rapid changeover from gas use to fuel oil use. In the case of changeover to either fuel supply, the engines are to be capable of continuous operation using the alternative fuel supply without interruption to the power supply.

(2) Changeover to gas fuel operation is to be only possible at a power level and under conditions where it can be done with acceptable reliability and safety as demonstrated through testing.

(3) Changeover from gas fuel operation mode to oil fuel operation mode is to be possible at all situations and power levels.

(4) The changeover process itself from and to gas operation is to be automatic but manual interruption is to be possible in all cases.

(5) In case of shut-off of the gas supply, the engines are to be capable of continuous operation by oil fuel only.

3 Gas supply to the combustion chamber is not to be possible without operation of the pilot oil injection. In addition, pilot injection is to be monitored for example by fuel oil pressure and combustion parameters.

2.5.2 Gas only engine

In case of failure of the spark ignition, the engine is to be shut down except when the following **(1)** to **(3)** are satisfied:

(1) the failure is limited to one cylinder;

(2) the gas supply to the failed cylinder is immediately shut off; and

(3) safe operation of the engine is substantiated by risk analysis and tests.

2.5.3 Pre-mixed Engine

Inlet manifolds, turbochargers, charge air coolers, etc. are to be regarded as parts of fuel gas supply systems, and failures of such components likely to result in gas leakages are to be considered in risk analysis by a method deemed appropriate by the Society.

Chapter 3 GAS FUEL SUPPLY SYSTEMS

3.1 Gas Fuel make-up Plants

3.1.1 General

1 Gas fuel make-up plants and oil fuel supply systems for low pressure gas-fuelled engines are to be capable of sustaining main engine operation so that at least normal navigation can be maintained even if one of the fuel systems for gas fuel or oil fuel fails.

2 Low pressure gas compressors and heat exchangers forming gas fuel make-up plants are to comply with requirements specified separately by the Society.

3 Pressure vessels and piping systems composing a gas fuel make-up plant are to comply with the requirements of **Chapter 5, Part N of the Rules**.

4 If the heating medium of gas fuel heat exchangers returns to spaces other than cargo spaces, it is to be so arranged that the heating medium is returned through degassing tanks located in cargo spaces. The degassing tanks are to be provided with a gas detecting system to issue alarms on detecting gas leaks. Vent outlets of the degassing tanks are to be provided with flame screens and the openings are to be located at safe positions.

3.2 Gas Fuel Supply Piping Systems

3.2.1 General

Gas fuel supply piping systems are to comply with the relevant requirements of **16.4.1-2, Part N of the Rules**.

3.2.2 Protection against Gas Fuel Leaks

1 Gas fuel supply piping systems are not to be led through the accommodation spaces, service spaces and control stations.

2 The arrangements are to comply with the requirements in **16.4.3(1)** or **(2), Part N of the Rules** when gas fuel supply piping systems are led through or led into the spaces other than those specified in **-1** above.

Chapter 4 CONTROL, ALARM AND SAFETY SYSTEMS

4.1 General

1 Control systems for operating low pressure gas-fuelled engines using gas fuel are to comply with the requirements in **18.1 to 18.3** and **18.7, Part D of the Rules**.

2 Gas fuel supply compressors in the gas fuel make-up plant are to be provided with the following safety systems :

(1) Remote stopping devices from readily accessible places and the position from which station of the main engine is normally controlled.

(2) Automatic stopping devices actuated when the suction pressure of boil-off gases drops to below the predetermined value according to the cargo tank construction system, before the tank pressure reaches the set pressure of negative pressure relief valves for cargo tanks.

(3) Emergency shut-down specified in **Table N18.1, Part N of the Rules**.

(4) Volumetric compressors are to be fitted with pressure relief valves discharging into the suction line of the compressor. The size of the pressure relief valves is to be determined in such away that, with the delivery valve kept close, the maximum pressure will not exceed the maximum working pressure by more than 10%.

3 The exit temperature and pressure or flow rate of the gas fuel at the gas fuel make-up plant are to be automatically controlled. Visual and audible alarm device are also to be provided such as to be activated when the temperature and pressure exceed the preset ranges.

4 The engine control system is to be independent and separate from the safety system.

5 The gas supply valves are to be controlled by the engine control system or by the engine gas demand.

6 Combustion is to be monitored on an individual cylinder basis.

7 In the event that poor combustion is detected on an individual cylinder, gas operation may be allowed in the conditions specified in **10.3.1-6, Part GF of the Rules**.

8 Regardless of **-6**, if monitoring of combustion for each individual cylinder is not practicable due to engine size and design, common combustion monitoring may be accepted.

9 Unless risk analysis by a method deemed appropriate by the Society proves that risk is within the acceptable range, alarm and safety system functions of dual fuel or gas only engines are to be provided in accordance with **Table 4.1**. (for dual fuel engines, **Table 4.1** applies only to gas mode) However, even if risk analysis proves that risk is within the acceptable range, the alarm and safety system functions specified in **Part N of the Rules** are still to be provided.

Table 4.1 Alarm and Safety System Functions for Dual Fuel Engines

Parameter	Alarm	Automatic activation of the double block and bleed valves	Automatic switching over to oil fuel mode	Engine shutdown
1. Abnormal pressures in the gas fuel supply line	X	X	X	-
2. Gas fuel supply systems - malfunction	X	X	X	-
3. Pilot fuel injection or spark ignition systems - malfunction	X	X	X	-
4. Exhaust gas temperature after each cylinder - high	X	X	X	-
5. Exhaust gas temperature after each cylinder - low[1)]	X	X	X	-
6. Cylinder pressure or ignition - failure, including misfiring, knocking and unstable combustion	X	X [2)]	X [2)]	-
7. Oil mist concentration in crankcase or bearing temperature[3)] - high	X	X	-	X
8. Pressure in the crankcase - high[2)]	X	X	X	-
9 Engine stops - any cause	X	X	-	-
10. Failure of the control-actuating medium of the block and bleed valves	X	X	X	-

Notes:

1) Required only if necessary for the detection of misfiring. In addition, deviation from average is to be used for the operation setting of each function.

2) In the case where the failure can be corrected by an automatic mitigation action, only the alarm may be activated. If the failure persists after a given time, the safety actions are to be activated.

3) Where required by **2.4.5, Part D of the Rules**.

4.2 Low Pressure Gas-fuelled engines of Ships to which the Rules for Automatic Remote Control Systems Apply

Low pressure gas-fuelled engines of ships to which the requirement **1.1.1, of Rules for Automatic and Remote Control Systems** apply are to comply with the requirements of **3.2**, **3.3** and **4.2** of the same **Rules**, in addition to the following requirements **(1)** and **(2)**.

(1) Low pressure gas-fuelled engines are to be provided with safety systems which automatically cut off the gas fuel supply, and in addition, automatically transfer the mode of operation to oil fuel alone or stop the engines when abnormalities **(a)** to **(c)** given below occur. However, automatic cut off of the gas fuel supply with the automatic double block and bleed valves specified in **16.4.5, Part N of the Rules** may be accepted.

(a) When operating on gas fuel, abnormalities are detected in the following:

i) gas fuel valve function

ii) pilot oil fuel injection valve function

iii) suction valve and exhaust valve function

iv) exhaust gas temperatures at cylinder outlets

v) pressure in cylinder

vi) blow-by through suction valves or exhaust valves

(b) When gas leaks to double wall pipes or void spaces of ducts specified in **3.2.2-2** are detected.

(c) Others as deemed necessary by the Society.

(2) Low pressure gas-fuelled engines are to be provided with a system which automatically reduces speed or transfers the mode of operation to oil fuel alone and issues an alarm in the event of the following **(a)** through **(f)**:

(a) Abnormal gas fuel temperature.

(b) Abnormal gas fuel supply pressure.

(c) Activation of an alarm issued before the pressure of the space between concentric pipes specified in **3.2.2-2** drops to below the atmospheric pressure.

(d) Low inert gas supply pressure for purging gas fuel pipe lines.

(e) Low pressures of hydraulic and pneumatic sources or loss of electric power supply for gas fuel combustion control.

(f) Others as deemed necessary by the Society.

4.3 Gas Fuel Supply Compressors for Ships to which the Rules for Automatic and Remote Control Systems Apply

Gas fuel supply compressors of ships to which the requirements of **1.1.1 of the Rules for Automatic and Remote Control Systems** apply are to be provided with safety systems and alarm systems specified in the following **(1)** through **(8)**:

(1) Monitoring systems and protective devices specified separately by the Society.

(2) Emergency shut-down devices specified separately by the Society.

(3) Automatic stopping device at overspeeds.

(4) Automatic stopping device at low lubricating oil pressures.

(5) Automatic stopping device at abnormal high discharge pressures.

(6) Automatic stopping device at abnormal low temperatures at boil-off gas heater outlets.

(7) Devices to avoid continuous operations in the barred speed ranges.

(8) Safety systems and alarm systems specified in **3.9 of the Rules for Automatic and Remote Control Systems** when gas compressors are driven by steam turbines.

Chapter 5 TESTS

5.1 Approval of Use

For each type of low pressure gas-fuelled engine, approval of use is to be obtained by the engine designer (licensor) in accordance with requirements specified separately by the Society.

5.2 Shop Test

5.2.1 Hydrostatic Tests

The parts and accessory equipments of low pressure gas-fuelled engines, which are exposed to pressures, are to be subjected to hydrostatic tests in accordance with the requirements of **2.6.1, Part D of the Rules**.

5.2.2 Shop Trials

Low pressure gas-fuelled engines are to be tested as specified in **2.6.1-3, Part D of the Rules**. To implement surveys of tests, in lieu of traditional ordinary surveys where the Surveyor is in attendance, the Society may approve survey methods which it considers to be able to obtain information equivalent to that obtained through traditional ordinary surveys.

5.3 Tests after Installation On Board

The control systems of low pressure gas-fuelled engines and related equipment are to be subjected to tests in accordance with the requirements of **18.7.3, Part D of the Rules** or the requirements of **2.2.4 of the Rules for Automatic and Remote Control Systems** according to the kind of Installations Character.

5.4 Sea Trials

1 Performance of control systems of high pressure gas-fuelled engines and related equipment is to be verified during operations using gas fuel depending upon their installation characters in accordance with the requirements of **2.2.5 of the Rules for Automatic and Remote Control Systems**: relevant requirements are to be applied mutatis mutandis.

2 Sea trials specified in **2.3.1, Part B** are to be carried out for operations using the oil fuel only. (In case of dual fuel engine) In addition, however, either the testing items as considered to be necessary by the Society are to be carried out to verify the control performance of engine operations using the gas fuel.

EFFECTIVE DATE AND APPLICATION (Amendment 1-1)

1. The effective date of the amendments is 30 June 2023.
2. Notwithstanding the amendments to the Rules, the current requirements apply to the surveys for which the application is submitted to the Society before the effective date.

Amendment 1-2

Chapter 3 SHIP ARRANGEMENTS

3.6 Airlocks (IGC Code 3.6)

Paragraph 3.6.7 has been amended as follows.

3.6.7 Door Sill

Subject to the requirements of the ~~**Chapters 18 to 20 of**~~**11.3, 14.6 and 14.7, Part 1, Part C** or **Chapters 18 and 19, Part CS**, the door sill is not to be less than 300 mm in height.

EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 1 July 2023.

2. Notwithstanding the amendments to the Rules, the current requirements apply to the following ships:

(1) ships for which the date of contract for construction is before the effective date; or

(2) sister ships of ships subject to the current requirements for which the date of contract for construction is before 1 January 2025.

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

GUIDANCE

Part N Ships Carrying Liquefied Gases in Bulk

2023 AMENDMENT NO.1

Notice No.28 30 June 2023
Resolved by Technical Committee on 25 January 2023

Notice No.28 30 June 2023
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 N SHIPS CARRYING LIQUEFIED GASES IN BULK

Amendment 1-1

N6 MATERIALS OF CONSTRUCTION AND QUALITY CONTROL

N6.5 Welding of Metallic Materials and Non-destructive Testing

Paragraph N6.5.5 has been amended as follows.

N6.5.5 Production Weld Tests

1 Production weld tests are to ~~be in accordance with the requirements specified in **6.5.5, Part N** and **Chapter 11, Part D of the Rules** and are also to~~ comply with the following ~~requirements~~:

(1) Application
When welding is made for independent tanks of ships carrying liquefied gases in bulk, the production weld tests are to be carried out for each position of welding in accordance with the following requirements, in addition to the welding procedure qualification tests specified in **Part M of the Rules**.

(a) Type *A* independent tanks
The production weld test is to be carried out on at least one test sample for every 50 *m* of welding length of butt joints of principal structural members. However, consideration may be given for reduction of the number of test sample or omission of the production weld test taking into account the past records and the actual state of quality control system of the manufacturer.

(b) Type *B* independent tanks
The production weld tests are to be carried out on at least one test sample for every 50 *m* of welding length of butt joints of principal structural members. However, the number of test sample may be reduced to one test sample for every 100 *m* of welding length taking into account the past records and the actual state of quality control system of the manufacturer. In this case, however, at least one or more test specimens are to be selected for one tank.

(c) Type *C* independent tanks
The production weld tests are to be carried out on at least one test sample for every 30 *m* of welding length of butt joints of principal structural members. However, the number of test sample may be reduced to one test sample for every 50 *m* of welding length taking into account the past records and the actual state of quality control system of the manufacturer.

(2) Test procedures
(a) The production weld tests are to be carried out for every welding length specified in the above **(1)** for welded joints made under the same welding procedure, welding position and welding conditions.

(b) Test ~~sample~~ assemblies are, in principle, to be located on the same line as the welded joints of the body and to be welded at the same time of welding of the body.

(3) Kind of test

The ~~K~~kind~~s~~ of the test ~~are~~ is to be as given in **Table N6.5.5-1**. In the case of Type *A* and Type *B* independent tanks, tensile tests need not be carried out.

(4) Test assemblies

The shape and size of test assemblies are to be as shown in **Fig. N6.5.5-1**. ~~In cases of Type *A* and Type *B* independent tanks, tensile test may not be required.~~

(5) Test specimens

(a) The shape and size of tensile test specimens are to be of the *U*2*A* or *U*2*B* test specimen specified in **Table M3.1**, **Part M of the Rules**.

(b) The shape and size of bend test specimens are to be of the *UB*-1, *UB*-2 and *B*-~~3~~ 10 test specimens specified in **Table M3.2**, **Part M of the Rules**. For test specimens with a thickness not less than 12 *mm*, side bend test specimens may be substituted for face bend and root bend test specimens.

(c) Impact test specimens are to be the *U*4 test specimen specified in **Table K2.5**, **Part K of the Rules**. In the impact test, one set of test specimens comprising three pieces are to be taken from every test assembly.

The test specimens are to be taken alternately from the position *A* and from a position among *B* through *E* where the lowest value is recorded in the welding procedure qualification test, shows in **Fig. M4.4**, **Part M of the Rules**. This means that one set of three test specimens are taken from a test assembly at the position *A*, thence other set of three test specimens are taken in the subsequent test assembly from the position among *B* through *E* where the lowest value is recorded, and this procedure is repeated.

(6) Tensile tests

The tensile strength of weld metal is to be more than the specified value of the base metal. However, the tensile strength of weld metal which has lower tensile strength than that of the parent metal is to be complied with ~~the requirements in~~ **4.2.5**, **Part M of the Rules**.

(7) Bend tests

(a) The bend test specimen is to be bent up to an angle of 180 degrees by a test jig with an inner radius of double the thickness of the test specimen.

(b) The results of the bend test are to be as free from cracks exceeding 3 *mm* in length in any direction on the outer bent surface and from other significant defects.

(8) Impact tests

(a) ~~The specified value for the impact test~~ Minimum average energy values are to be the value prescribed for the base material being joined. However, test temperature may be determined in accordance with the requirements in **N4.19.2**.

(b) Minimum single energy values are to be in accordance with **6.5.3-5(3)**, **Part N of the Rules**.

(c) For type *C* independent tanks and process pressure vessels, notwithstanding the preceding **(b)**, minimum single energy values are to be in accordance with **11.5.4-1(3)(b)**, **Part D of the Rules**.

2 For the purpose of ~~the requirements in~~ **6.5.5-1**, **Part N of the Rules**, the number of test specimens for production weld tests of secondary barriers may be reduced to the extent as deemed appropriate by the Society considering the experience of same welding procedures in past, workmanship and quality control. In general, intervals of production tests for secondary barriers may be approximately 200 *m* of butt weld joints and the tests are to be representative of each welding position.

3 For the purpose of ~~the requirements in~~ **6.5.5-5**, **Part N of the Rules**, number of test specimens for the production weld tests for integral tanks may be reduced to the same level as in the case of secondary barrier given in the preceding **-2**. Production weld tests for membrane tanks

are left to the discretion of the Society depending on the construction system of the tank.

4 Procedures for additional tests before rejection are to comply with the following:

(1) Tensile tests

The requirements in **11.5.4-3**, **Part D of the Rules** are to be complied with.

(2) Bend tests

(a) The requirements in **4.2.12-2**, **Part M of the Rules** are to be complied with.

(b) For type *C* independent tanks and process pressure vessels, notwithstanding the preceding **(a)**, bend tests are to be in accordance with **11.5.4-3**, **Part D of the Rules**.

(3) Impact tests

(a) The requirements in **6.3.2-4**, **Part N of the Rules** are to be complied with.

(b) For type *C* independent tanks and process pressure vessels, notwithstanding the preceding **(a)**, impact tests are to be in accordance with **11.5.4-3**, **Part D of the Rules**.

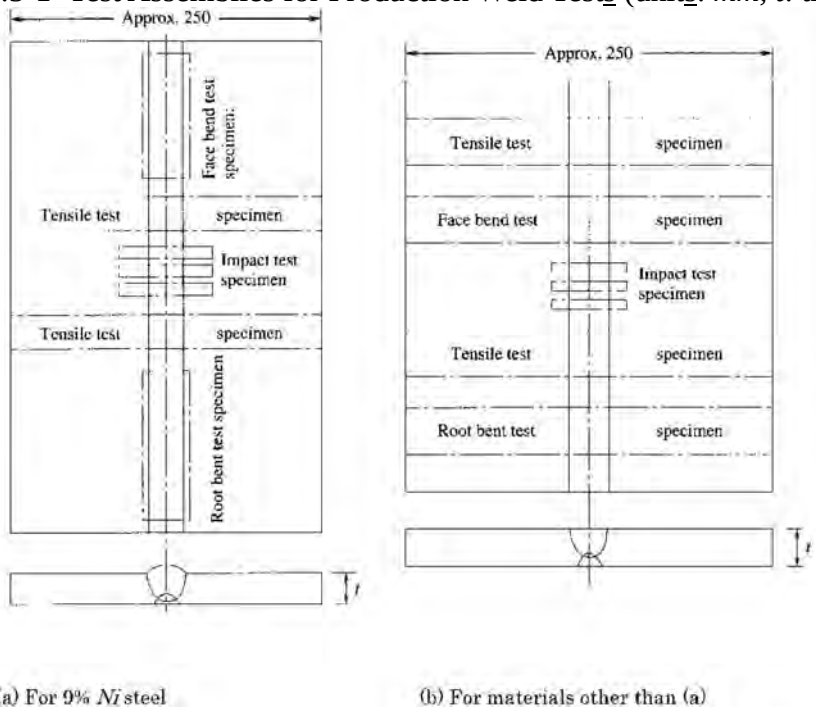
Table N6.5.5-1 Kinds of Tests

Material	Kind of test
9% *Ni* steel	Tensile test, bend test and impact test
Austenitic stainless steel	Tensile test, and bend test
Aluminium alloy (1)	Tensile test, and bend test
~~Steel for low temperature service (excluding 9% *Ni* steel)~~ Others	Tensile test, bend test and impact test

Note:

(1) For aluminium alloys other than type 5083, additional tests may be required to verify the toughness of the material.

Fig. N6.5.5-1 Test Assemblies for Production Weld Tests (units: *mm*, *t*: thickness)



(a) For 9% *Ni* steel (b) For materials other than (a)

Note:

(1) In the case of Type *A* and Type *B* independent tanks, tensile tests need not be carried out.

EFFECTIVE DATE AND APPLICATION (Amendment 1-1)

1. The effective date of the amendments is 30 June 2023.

Amendment 1-2

N6 MATERIALS OF CONSTRUCTION AND QUALITY CONTROL

N6.5 Welding of Metallic Materials and Non-destructive Testing

N6.5.5 Production Weld Tests

Sub-paragraph -1 has been amended as follows.

1 Production weld tests are to be in accordance with the requirements specified in **6.5.5**, **Part N** and **Chapter 11**, **Part D of the Rules** and are also to comply with the following requirements:

~~(1) Application~~

~~When welding is made for independent tanks of ships carrying liquefied gases in bulk, the production weld tests are to be carried out for each position of welding in accordance with the following requirements, in addition to the welding procedure qualification tests specified in **Part M of the Rules**.~~

~~(a) Type *A* independent tanks~~

~~The production weld test is to be carried out on at least one test sample for every 50 *m* of welding length of butt joints of principal structural members. However, consideration may be given for reduction of the number of test sample or omission of the production weld test taking into account the past records and the actual state of quality control system of the manufacturer.~~

~~(b) Type *B* independent tanks~~

~~The production weld tests are to be carried out on at least one test sample for every 50 *m* of welding length of butt joints of principal structural members. However, the number of test sample may be reduced to one test sample for every 100 *m* of welding length taking into account the past records and the actual state of quality control system of the manufacturer. In this case, however, at least one or more test specimens are to be selected for one tank.~~

~~(c) Type *C* independent tanks~~

~~The production weld tests are to be carried out on at least one test sample for every 30 *m* of welding length of butt joints of principal structural members. However, the number of test sample may be reduced to one test sample for every 50 *m* of welding length taking into account the past records and the actual state of quality control system of the manufacturer.~~

(~~2~~1) Test procedure

(a) The production weld tests are to be carried out ~~for every welding length specified in the above **(1)**~~ for welded joints made under the same welding procedure, welding position and welding conditions.

(b) Test sample are, in principle, to be located on the same line as the welded joints of the body and to be welded at the same time of welding of the body.

(~~3~~2) Kind of test

Kinds of the test are to be as given in **Table N6.5.5-1**.

(~~4~~3) Test assemblies

The shape and size of test assemblies are to be as shown in **Fig. N6.5.5-1**. In cases of Type *A* and Type *B* independent tanks, tensile test may not be required.

(~~5~~4) Test specimens

(a) The shape and size of tensile test specimens are to be of the *U*2*A* or *U*2*B* test specimen

specified in **Table M3.1**, **Part M of the Rules**.

(b) The shape and size of bend test specimens are to be of the *UB*-1, *UB*-2 and *B*-3 test specimens specified in **Table M3.2**, **Part M of the Rules**. For test specimens with a thickness not less than 12 *mm*, side bend test specimens may be substituted for face bend and root bend test specimens.

(c) Impact test specimens are to be the *U*4 test specimen specified in **Table K2.5**, **Part K of the Rules**. In the impact test, one set of test specimens comprising three pieces are to be taken from every test assembly.

The test specimens are to be taken alternately from the position *A* and from a position among *B* through *E* where the lowest value is recorded in the welding procedure qualification test, shows in **Fig. M4.4**, **Part M of the Rules**. This means that one set of three test specimens are taken from a test assembly at the position *A*, thence other set of three test specimens are taken in the subsequent test assembly from the position among *B* through *E* where the lowest value is recorded, and this procedure is repeated.

(~~6~~5) Tensile test

The tensile strength of weld metal is to be more than the specified value of the base metal. However, the tensile strength of weld metal which has lower tensile strength than that of the parent metal is to be complied with the requirements in **4.2.5**, **Part M of the Rules**.

(~~7~~6) Bend test

(a) The bend test specimen is to be bent up to an angle of 180 degrees by a test jig with an inner radius of double the thickness of the test specimen.

(b) The results of the bend test are to be as free from cracks exceeding 3 *mm* in length in any direction on the outer bent surface and from other significant defects.

(~~8~~7) Impact test

The specified value for the impact test are to be the value prescribed for the base material being joined. However, test temperature may be determined in accordance with the requirements in **N4.19.2**.

EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 30 June 2023.

2. Notwithstanding the amendments to the Guidance, the current requirements may apply to ships for which the date of contract for construction is before the effective date.

Amendment 1-3

N16 USE OF CARGO AS FUEL

N16.1 General

Paragraph N16.1.1 has been amended as follows.

N16.1.1 General

1 The requirements for gas fuel engines, gas fuel boilers and gas combustion units are to be in accordance with **Annex ~~3 "GUIDANCE FOR HIGH PRESSURE DUAL FUEL ENGINES"~~16.1.1-2, Part N of the Rules** or **Annex ~~4 "GUIDANCE FOR LOW PRESSURE DUAL FUEL ENGINES"~~16.1.1-3, Part N of the Rules**, **Annex 2 "G~~UIDANCE~~uidance ~~FOR~~for D~~UAL~~ual F~~UEL~~uel B~~OILERS~~oilers**" and **Annex 2A "G~~UIDANCE~~uidance ~~FOR~~for G~~AS~~as C~~OMBUSTION~~ombustion U~~NITS~~nits**" respectively. In addition, gas fuel turbines are to be as deemed appropriate by the Society.

2 Notwithstanding the requirements **-1** above, if other cargo gases are used as fuel in accordance with **16.9.1, Part N of the Rules**, gas fuel boilers, gas combustion units, gas fuel reciprocating internal combustion engines and gas turbines are to be approved by the Administration.

3 In applying **16.1.1, Part N of the Rules**, **Annex 16.1.1-2, Part N of the Rules** is to be dealt with as follows:

(1) The wording "specified separately by the Society" specified in **3.1.1-2, Annex 16.1.1-2, Part N of the Rules** refers to **Chapter 2** to **Chapter 4 of Annex 1**.

(2) The wording "requirements specified separately by the Society" and "tests specified separately by the Society" specified in **3.2.2-3, Annex 16.1.1-2, Part N of the Rules** mean to be in accordance with the following **(a)** and **(b)** respectively:

(a) The wording "requirements specified separately by the Society" refers to **Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.

(b) The wording "tests specified separately by the Society" refers to **Chapter 5** and **Chapter 7 of Annex 1**.

(3) The wording "specified separately by the Society" specified in **4.3(1)(a), Annex 16.1.1-2, Part N of the Rules** refers to **2.4.3 of Annex 1**.

(4) The wording "specified separately by the Society" specified in **4.3(2), Annex 16.1.1-2, Part N of the Rules** refers to **2.4.3 of Annex 1**.

(5) The wording "specified separately by the Society" specified in **5.1, Annex 16.1.1-2, Part N of the Rules** refers to **Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.

4 In applying **16.1.1, Part N of the Rules**, **Annex 16.1.1-3, Part N of the Rules** is to be dealt with as follows:

(1) The wording "specified separately by the Society" specified in **1.1-3, Annex 16.1.1-3, Part N of the Rules** refers to **8.3(4)(i), Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.

(2) The wording "deemed appropriate by the Society" specified in **2.5.3, Annex 16.1.1-3, Part N of the Rules** refers to **8.3, Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.

(3) The wording "specified separately by the Society" specified in **3.1.1-2, Annex 16.1.1-3, Part N of the Rules** refers to **Chapter 2** to **Chapter 4 of Annex 1**.

(4) The wording "deemed appropriate by the Society" specified in **4.1-9, Annex 16.1.1-3, Part N**

of the Rules refers to **8.3, Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.

(5) The wording "specified separately by the Society" specified in **4.3(1), Annex 16.1.1-3, Part N of the Rules** refers to **2.4.2 of Annex 1**.

(6) The wording "specified separately by the Society" specified in **4.3(2), Annex 16.1.1-3, Part N of the Rules** refers to **2.4.3 of Annex 1**.

Annex 3 has been deleted.

~~**Annex 3 GUIDANCE FOR HIGH PRESSURE DUAL FUEL ENGINES**~~

~~**(Omitted)**~~

Annex 4 has been deleted.

~~**Annex 4 GUIDANCE FOR LOW PRESSURE DUAL FUEL ENGINES**~~

~~**(Omitted)**~~

EFFECTIVE DATE AND APPLICATION (Amendment 1-3)

1. The effective date of the amendments is 30 June 2023.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to the surveys for which the application is submitted to the Society before the effective date.

Amendment 1-4

N2 SHIP SURVIVAL CAPABILITY AND LOCATION OF CARGO TANKS

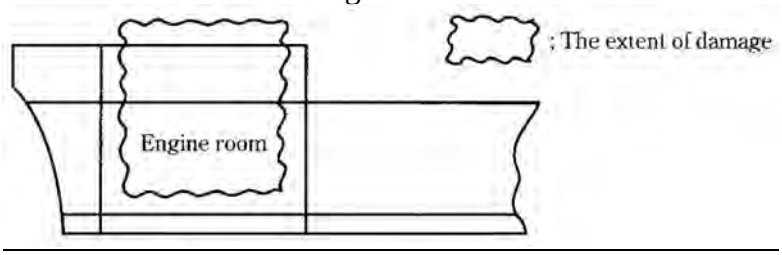
N2.5 Flooding Assumptions

N2.5.8 Buoyancy of Superstructures

Sub-paragraph -2 has been amended as follows.

2 The sliding watertight doors specified in **2.5.8(2), Part N of the Rules** are to satisfy the requirements of ~~**13.13.3,**~~ **2.2.2, Part 1, Part C of the Rules**, unless otherwise specified in this chapter and to be remotely operable from a readily accessible place in case of damage. Further, the openings of weathertight accepted within the minimum range of residual stability are to be capable of being securely closed at final equilibrium.

Fig. N2.5.8



N2.7 Survival Requirements

N2.7.1 Survival Requirements

Sub-paragraph -2 has been amended as follows.

2 The "remotely operated watertight sliding doors" referred to in **2.7.1-2(1), Part N of the Rules** are such doors satisfying the requirements of ~~**13.13.3,**~~**2.2.2, Part 1, Part C of the Rules**, unless otherwise specified in this chapter.

Sub-paragraph -4 has been amended as follows.

4 In applying the requirements of **2.7.1-3(1), Part N of the Rules**, "other openings capable of being closed weathertight" do not include ventilators provided with weathertight closing appliances in accordance with the requirements of ~~**23.6.5-2,**~~**14.12.3.1-3, Part 1, Part C of the Rules** or **21.6.5-2, Part CS of the Rules** that for operational reasons have to remain open to supply air to the engine room or emergency generator room (if the same is considered buoyant in the stability calculation or protecting openings leading below) for the effective operation of the ship.

N3 SHIP ARRANGEMENTS

N3.1 Segregation of the Cargo Area

Paragraph N3.1.7 has been amended as follows.

N3.1.7 Openings for Cargo Containment System

"Arrangements for sealing the weather decks in way of openings for cargo containments systems" referred to in **3.1.7, Part N of the Rules** means the arrangements complying with the requirements in ~~**20.2.1, 20.2.2, 20.2.3**~~**14.6.1, 14.6.2,** and ~~**20.2.5-4(3),**~~**14.6.3, Part 1, Part C of the Rules**.

N4 CARGO CONTAINMENT

N4.8 Supporting Arrangements

N4.8.1 General

Sub-paragraph -2(2) has been amended as follows.

2 The analysis of supporting structures against the load conditions specified in the requirements in **4.13.9** and **4.14.1**, **Part N of the Rules** is to be done while giving considerations to the following conditions **(1)** and **(2)**:

(1) A condition where static load by the weight of cargo tank containing the cargo at a static heel angle of 30° and the static sea water pressure without dynamic pressure due to waves is imposed.

(2) A condition where load by the weight of cargo tank containing the cargo with the acceleration caused by ship motions specified in the requirements in **4.14.1**, **Part N of the Rules** and the dynamic sea water pressure due to waves are imposed. Such dynamic sea water pressure due to waves may be determined by the requirements in ~~**C31.1.3**~~**4.6, Part 1 and 4.3, Part 2-9, Part C of the Rules**.

N4.21 Type *A* Independent Tanks

Paragraph N4.21.3 has been amended as follows.

N4.21.3 Ultimate Design Condition

~~**1** The definitions of the symbols specified in **N4.21.3** are given in **Table N4.21.3-1**.~~

Table N4.21.3-1 Definitions

Symbol		Definitions
L	m	Length of ship specified in **2.1.2, Part A of the Rules**
S	m	Spacing of stiffeners
l	m	Spacing of girders
ρ_c	kg/m^3	Maximum cargo density in design temperature among all cargoes fully loaded in cargo tanks
ρ_s	kg/m^3	Sea water density
R_e	N/mm^2	As specified in **4.18.1(3), Part N of the Rules**
R_m	N/mm^2	As specified in **4.18.1(3), Part N of the Rules**
P_0	MPa	Design vapour pressure
P_R	MPa	As specified in **4.13.2-3, Part N of the Rules**
P_{0f}	MPa	P_0 multiplied by 1.2.
P_{Rf}	MPa	P_R multiplied by 1.2.
P_S	MPa	Static pressure of cargo liquid obtained from the following formula $P_S = \rho_c z_f g \times 10^{-6}$
P_D	MPa	Dynamic pressure of cargo liquid obtained from the following formula $P_D = \rho_c \sqrt{(x_f a_x)^2 + (y_f a_y)^2 + (z_f a_z)^2} \cdot g \times 10^{-6}$
P_{DH}	MPa	Dynamic pressure of cargo liquid in harbor condition obtained from the following formula: $P_{DH} = 0.4 P_D$
a_x, a_y, a_z	m/s^2	As specified in **4.28.2, Part N of the Rules**
x_f, y_f, z_f	m	As specified in **N4.28.1-1(1)**
C		Coefficient according to the type of end connections is given as follows: — Both ends of stiffeners are connected by bracket, lug connection or supported by girders: 1.0 — One end of stiffeners is connected by bracket, lug connection or supported by girders and the other end of stiffeners is unattached: 1.5 — Both ends of stiffeners are unattached: 1.5
σ_{allow}	N/mm^2	The lower of $R_m/2.66$ or $R_e/1.33$
g	m/s^2	Acceleration due to gravity to be taken as 9.81
α		Opening ratio of swash bulkhead in cargo tanks
l_t	m	Length of cargo tank

21 The "classical analysis procedures" referred to in the requirements in **4.21.3-1, Part N of the Rules** means to meet the following **(1) to (7)** requirements in **Chapter 6, Part 2-9, Part C of the Rules**. Where openings which cannot be close, excluding vapour spaces at centreline bulkhead, are installed, requirements **(3)** and **(4)** need not be applied.

(1) The thicknesses of tank boundary plates are not to be less than the greater of the values obtained from the following **(a)** and **(b)**:

(a) $3.46S\sqrt{\frac{235}{R_e}}h \ (mm)$

h: pressure head as given in the following formula;

$$h = \frac{P}{\rho_s g} \times 10^6 \ (m)$$

~~P is to be the greatest value of the following P_1, P_2 or P_3. However, P_2 is used only where P_h is set.~~

~~P_1: Internal pressure of tank in sea-going condition, obtained from the following formula:~~

$$P_1 = P_0 + P_s + P_d \ (MPa)$$

~~P_2: Internal pressure of tank in harbour condition, obtained from the following formula:~~

$$P_2 = P_h + P_s + P_{dh} \ (MPa)$$

~~P_3: Maximum static pressure under a 30-degree static heel condition~~

~~(b) $3.2S\sqrt{\frac{235}{R_e}}h_f \ (mm)$~~

~~h_f: Pressure head taking into account a fire scenario, obtained from the following formula:~~

$$h_f = \frac{P_f}{\rho_s g} \times 10^6 \ (m)$$

~~P_f is to be greater value of the following P_{f1} and P_{f2}. However, P_{f2} is used only where P_h is set.~~

~~P_{f1}: Internal pressure of tank in sea going condition, obtained from the following formula:~~

$$P_{f1} = P_{0f} + P_s + P_d \ (MPa)$$

~~P_{f2}:Internal pressure of tank in harbour condition, obtained from the following formula:~~

$$P_{f2} = P_{hf} + P_s + P_{dh} \ (MPa)$$

~~(2) The section moduli of the stiffeners on tank boundary plates are not to be less than those obtained from the following formula:~~

$$\frac{CSPl^2}{12\sigma_{allow}} \times 10^6 \ (cm^3)$$

$$2.33 \cdot \frac{235}{R_e} \cdot CSh_f l^2 \ (cm^3)$$

~~P and h_f: As specified in **(1)**~~

~~(3) The thickness of the centreline bulkhead is not to be less than the greater value of the following **(a)** and **(b)**:~~

~~(a) $3.46S\sqrt{\frac{235}{R_e}}h_{CL} \ (mm)$~~

~~h_{CL}: Pressure head, obtained from the following formula:~~

$$h_{CL} = \frac{P_{CL}}{\rho_s g} \times 10^6 \ (m)$$

~~P_{CL} is to be the greatest value of the following P_{CL1}, P_{CL2} and P_{CL3}.~~

~~P_{CL1}: Tank pressure in sea-going condition obtained from the following formula:~~

$$P_{CL1} = \rho_s y_f a_{yf} g \times 10^{-6} \ (MPa)$$

~~P_{CL2}: Static pressure(MPa) from maximum difference between liquid levels of both side of cargo tank under 30-degree static heel condition~~

~~P_{CL3}: Internal pressure of cargo tank according to operational limitation as specified in the following. Where operations are limited, operational~~

~~limitations are to be specified in the loading manual.~~

- ~~where asymmetric loading of both side of cargo tanks is not allowed in the harbour condition:$P_{CL2} = 0.4P_{CL1}$ (MPa)~~
- ~~where asymmetric loading of both side of cargo tanks is allowed in the harbour condition:$P_{CL2} = P_s + P_{SH}$ (MPa)~~
- ~~where asymmetric loading of both side of cargo tanks is allowed in the sea going condition:$P_{CL2} = P_s + P_{SI}$ (MPa)~~

~~(b) $3.2S\sqrt{\frac{235}{R_e}h_{CL\_A}}$ (mm)~~

~~h_{CL_A}: Pressure head taking into account the static pressure of liquid cargo, obtained from the following formula:~~

$$h_{CL\_A} = \frac{P_s}{\rho_s g} \times 10^6 \ (m)$$

~~(4) The section moduli of stiffeners of centreline bulkhead are not to be less than those obtained from the following formula:~~

~~$\frac{CP_{CL}Sl^2}{12\sigma_{allow}} \times 10^6 \ (cm^3)$~~

~~$2.33 \cdot \frac{235}{R_e} \cdot CSh_{CL\_A}l^2 \ (cm^3)$~~

~~P_{CL} and h_{CL_A}: As specified in **(3)**~~

~~(5) The thicknesses of transverse swash bulkheads are not to be less than those obtained from the following formula:~~

~~$3.46S\sqrt{\frac{235}{R_e}h_{SW}}$ (mm)~~

~~h_{SW}: Pressure head taking into consideration sloshing obtained from the following formula:~~

$$h_{SW} = \frac{\rho_e h_{st}}{\rho_s} \ (m)$$

~~h_{st}: As given by the following formula, not to be taken less than 5.6 m~~

$$h_{st} = \left(0.176 - \frac{0.025}{100}L\right)(1.0 - \alpha)l_c \ (m)$$

~~(6) The section moduli of the stiffeners on transverse swash bulkheads are not to be less than those obtained from the following formula:~~

~~$\frac{CP_{SW}Sl^2}{12\sigma_{allow}} \times 10^6 \ (cm^3)$~~

~~P_{SW}: Sloshing pressure as given by the following formula:~~

$$P_{SW} = \rho_e h_{st} g \times 10^{-6} \ (MPa)$$

~~h_{st}: As specified in **(5)**~~

~~(7) The scantling of girders are to be in accordance with the requirements in **Chapter 29, Part C of the Rules** except where the scantlings of members are determined by direct calculations.~~

~~**3** Where high density cargoes are partially loaded into cargo tanks, strength assessments are to be carried out taking into account the cargo density and loading height of the cargo in addition to **2.**~~

~~4~~2 For the purpose of the requirements in **4.21.3-1, Part N of the Rules**, the allowable stress for the equivalent stress σ_c when detailed stress calculations are made on primary members is to be as given in **Table N4.21.3-~~2~~1**.

~~**5** The corrosion allowance used in **-2** is to be in accordance with the requirements in **4.3.5, Part N of the Rules**. In structures where the membrane or axial force due to internal pressure can not be neglected, the calculation equation specified in **-2** may be used after suitable modification.~~
~~**6** Scantling of stiffeners specified in **-2** may be decided based on the requirements specified in **1.1.13-7, Part C of the Rules**.~~

Table N4.21.3-~~2~~1 Allowable Stresses for the Primary Equivalent Stress

Ferrite steels	Austenitic steels	Aluminium alloys
$0.79R_e$	$0.84R_e$	$0.79R_e$
$0.53R_m$	$0.42R_m$	$0.42R_m$

Note:
For each member, the smaller of the above values is to be used with R_e and R_m as specified in **4.18.1(3), Part N of the Rules**.

N4.23 Type *C* Independent Tanks

N4.23.3 Ultimate Design Condition

Sub-paragraph -2 has been amended as follows.

2 The "calculations using accepted pressure vessel buckling theory" referred to in the requirements in **4.23.3-2, Part N of the Rules** means calculations based on standards such as *JIS*, *ASME*, etc. P_4 among design external pressure P_e is to be the value computed by applying the requirements in ~~**10.2, 18.2**~~**4.4.2.7, 4.4.2.8** and ~~**19.2,**~~**4.9.2.2, Part 1, Part C of the Rules** corresponding to the location of the tanks.

N4.24 Membrane Tanks

Paragraph N4.24.4 has been amended as follows.

N4.24.4 Structural Analyses

For the purpose of the requirements in **4.24.4-2, Part N of the Rules,** the hull structure adjacent to membrane tanks is to comply with the requirements in ~~**Chapter 14,**~~ **Chapter 6, Part 1, Part C of the Rules** and, in addition, the stress in the hull structure is to be restricted in consideration of the structural strength of membrane tanks, if necessary. The allowable stresses of the membrane, membrane supporting structures and insulation materials are to be determined in each case according to the mechanical properties of materials, records of construction, product specifications and levels of product quality control practice.

N4.25 Integral Tanks

Paragraph N4.25.3 has been amended as follows.

N4.25.3 Ultimate Design Condition

The allowable stresses specified in **4.25.3-2, Part N of the Rules** are to be those specified in ~~**C31.1.3**~~**8.6.1.2, Part 1, Part C of the Rules.**

N14 PERSONNEL PROTECTION

N14.4 Personnel Protection Requirements for Individual Products (*IGC Code* 14.4)

Paragraph N14.4.3 has been amended as follows.

N14.4.3 Decontamination Shower and Eyewash Stations

Decontamination showers and eyewash stations are to be located in the vicinity of cargo manifolds, cargo pump rooms, etc. which are vulnerable to cargo splashes, and shielding walls are to be provided to prevent crew members from being sprayed by any additional cargo splashes during eye washing. The construction of a special locker for the storage of protective equipment provided in the cargo area is to comply with the requirement in **~~Chapter 19,~~11.3.3, Part 1, Part C of the Rules**. The piping for decontamination showers and eyewash is to be permanent metal piping complying with the requirements in **Chapter 12, Part D of the Rules**, and it is also to be provided with thermal insulation or drain connections at suitable locations to prevent freeze damage.

EFFECTIVE DATE AND APPLICATION (Amendment 1-4)

1. The effective date of the amendments is 1 July 2023.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to the following ships:

(1) ships for which the date of contract for construction is before the effective date; or

(2) sister ships of ships subject to the current requirements for which the date of contract for construction is before 1 January 2025.

Amendment 1-5

N5 PROCESS PRESSURE VESSELS AND LIQUID, VAPOUR, AND PRESSURE PIPING SYSTEMS

N5.7 Installation Requirements

N5.7.2 Precautions against Low Temperatures

Sub-paragraph -3 has been added as follows.

3 Where liquid leakages from additional cargo transfer equipment (including transfer loading arms, bunkering booms, transfer hoses, reducers, spool pieces and transfer hose reels) is anticipated, protection for the hull sections located beneath such equipment is to be provided in accordance with **5.7.2, Part N of the Rules**.

Paragraph N5.7.3 has been added as follows.

N5.7.3 Precautions against Low Temperatures

Ships provided with additional cargo transfer equipment (including transfer loading arms, bunkering booms, transfer hoses, reducers, spool pieces and transfer hose reels) are also to be provided with water distribution systems in way of hull sections beneath the equipment provided for shore connections in accordance with **5.7.3, Part N of the Rules**.

N11 FIRE PROTECTION AND EXTINCTION

N11.3 Water Spray System

N11.3.1 Area to be Covered

Sub-paragraphs -3 and -4 have been renumbered to Sub-paragraphs -4 and -5, and Sub-paragraph -3 has been added as follows.

1 For the purpose of the requirements in **11.3.1(1), Part N of the Rules**, the area to be covered at the exposed tank dome is to include the areas where stop valves for cargo tanks and emergency shutdown valves specified in the requirements in **5.5, Part N of the Rules** are fitted.
2 For the purpose of the requirements **11.3.1(4), Part N of the Rules**, the area of the load/unload connections is to include the areas where emergency shutdown valves specified in the requirements in **5.5.3, Part N of the Rules** are fitted. Further, the "control valve" referred to in the requirements in **11.3.1(4), Part N of the Rules** is to include stop valves for the transfer of cargo line to and from vapour line.
3 Ships provided with additional cargo transfer equipment (including transfer loading arms, bunkering booms, transfer hoses, reducers, spool pieces and transfer hose reels) are also to be provided with water spray systems covering cargo liquid and vapour discharge and loading connection areas (including presentation flanges), areas where their control valves are situated, and all exposed emergency shut-down (*ESD*) valves in cargo liquid and vapour pipes (including the master valves) used for supplying gas consumers in accordance with **11.3.1(4) and (5), Part N of the Rules**. The expression "discharge and loading connection" here refers to the parts where such additional equipment connects to the cargo transfer equipment of other ships, except where not deemed appropriate by the Society.
~~**3**~~**4** The "high fire risk items" referred to in the requirements in **11.3.1(6), Part N of the Rules** are not to include the hydraulic machinery and electric motors (*See* **R2.3.1-7**).
~~**4**~~**5** With respect to the requirements of **11.3.1(7), Part N of the Rules**, the survival crafts on board including remote survival crafts (ref. SOLAS III/Reg. 31.1.4) facing the cargo area are to be protected by a water-spray system taking into consideration cargo area extension for fire-fighting purposes as stated in **11.1.4, Part N of the Rules**. Remote liferafts located in areas covered by water-spray protection as required in **11.3.1(6), Part N of the Rules** may be considered as adequately protected.

N11.4 Dry Chemical Powder Fire-extinguishing Systems

Paragraph N11.4.1 has been amended as follows.

N11.4.1 General

1 "Fixed dry chemical powder fire-extinguishing system approved by the Society" referred to in **11.4.1, Part N of the Rules** are to comply with "*Guidelines for the approval of fixed dry chemical powder fire-extinguishing systems for the protection of ships carrying liquefied gases in bulk*" (*MSC*.1/*Circ*.1315).
2 Ships provided with additional cargo transfer equipment (including transfer loading arms, bunkering booms, transfer hoses, reducers, spool pieces and transfer hose reels) are also to be provided with dry chemical powder fire-extinguishing systems for the purpose of firefighting on decks in cargo areas (including any cargo liquid and vapour discharge and loading connection areas) in accordance with **11.4.1, Part N of the Rules**. The expression "discharge and loading connection"

here refers to the parts where such additional equipment connects to the cargo transfer equipment of other ships, except where not deemed appropriate by the Society.

Paragraph N11.4.2 has been added as follows.

N11.4.2 Performance of the Systems

Additional cargo transfer equipment (including transfer loading arms, bunkering booms, transfer hoses, reducers, spool pieces and transfer hose reels) is also to be regarded as exposed cargo liquid and vapour piping as stipulated in **11.4.2, Part N of the Rules**, and dry chemical powder fire-extinguishing systems are to be capable of delivering powder to any part of the piping as well as the loading and unloading connection areas. The expression "loading and unloading connection" here refers to the parts where such additional equipment connects to the cargo transfer equipment of other ships, except where not deemed appropriate by the Society.

Paragraph N11.4.3 has been amended as follows.

N11.4.3 Monitors and Hand Hose Lines, etc.

1 For the purpose of the requirements in **11.4.3, Part N of the Rules**, the load/unload connection areas may be protected by only one monitor provided that it can be so fixed to protect the load/unload connection area used for cargo operation even if there are load/unload connections on both sides of the ship.

2 Ships provided with additional cargo transfer equipment (including transfer loading arms, bunkering booms, transfer hoses, reducers, spool pieces and transfer hose reels) are also to be provided monitors capable of actuation and discharge both locally and remotely to protect any loading and unloading connection areas in accordance with **11.4.3, Part N of the Rules**. The expression "loading and unloading connection" here refers to the parts where such additional equipment connects to the cargo transfer equipment of other ships, except where not deemed appropriate by the Society.

N18 OPERATING REQUIREMENTS

N18.3 Cargo Emergency Shutdown (*ESD*) System

N18.3.1 Cargo Emergency Shutdown (*ESD*) System

Sub-paragraph -7 has been renumbered to Sub-paragraph -8, and Sub-paragraph -7 has been added as follows.

(Sub-paragraph -1 to -5 are omitted)
6 The confirmation of the actual valve position by the position of the handle device for *ESD* valves is not accepted as "positive indication of the actual valve position" referred to in **18.3.1-2(1)(b), Part N of the Rules**.
7 Additional cargo transfettransfer equipment (including transfer loading arms, bunkering booms, transfer hoses, reducers, spool pieces and transfer hose reels) is also to be regarded as cargo manifolds as stipulated in **18.3.1-3(1)(b), Part N of the Rules**, and the method of detection used on weather decks is to cover such cargo manifolds as well as the areas where liquid piping is regularly disassembled.
~~**7**~~**8** In applying **Note 1)d** of **Table N18.1**, a hardware system such as an electric or mechanical interlocking device is to be provided to prevent inadvertent operation of cargo pumps and inadvertent opening of manifold ESD valves.

EFFECTIVE DATE AND APPLICATION (Amendment 1-5)

1. The effective date of the amendments is 1 July 2023.
2. Notwithstanding the amendments to the Guidance, the current requirements may apply to ships for which the date of contract for construction is before the effective date.

Amendment 1-6

N11 FIRE PROTECTION AND EXTINCTION

N11.4 Dry Chemical Powder Fire-extinguishing Systems

Paragraph N11.4.1 has been amended as follows.

N11.4.1 General

"Fixed dry chemical powder fire-extinguishing system approved by the Society" referred to in **11.4.1, Part N of the Rules** are to comply with "*Guidelines for the approval of fixed dry chemical powder fire-extinguishing systems for the protection of ships carrying liquefied gases in bulk*" (*MSC*.1/*Circ*.1315/Rev.1).

EFFECTIVE DATE AND APPLICATION (Amendment 1-6)

1. The effective date of the amendments is 1 July 2023.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to fixed dry chemical powder fire-extinguishing systems for which the contractual delivery date(In the absence of a contractual delivery date, systems for which the actual delivery date) to the ship is before the effective date.

Amendment 1-7

Annex 1 GUIDANCE FOR EQUIPMENT AND FITTINGS OF SHIPS CARRYING LIQUEFIED GASES IN BULK

Chapter 7 EXPANSION JOINTS (For Cargo Piping and Process Piping Systems)

7.3 Tests and Inspection

7.3.2 Product Test

Sub-paragraph -1(2) has been amended as follows.

1 All expansion joints are, at time of manufacture, to be subjected to the following tests and inspection:
((1) is omitted.)
(2) Non-destructive tests for butt welded joints of bellows~~:~~
100% of the welded joints of the bellows with ~~the~~ design temperatures not more than ~~-~~ –10°C~~, or with~~ that have inside diameters exceeding 75 *mm* or wall thicknesses exceeding 10 *mm* are to be subjected to non-destructive tests. However, ~~and~~ for other cases ~~other than above~~, ~~it is left to~~ non-destructive tests are to be carried out at the discretion of the Society, but sampling tests are to be conducted for~~,~~ at least~~,~~ 10 % of the bellows.
((3) and (4) are omitted.)

EFFECTIVE DATE AND APPLICATION (Amendment 1-7)

1. The effective date of the amendments is 1 July 2023.

Amendment 1-8

N18 OPERATING REQUIREMENTS

N18.3 Cargo Emergency Shutdown (*ESD*) System

N18.3.1 Cargo Emergency Shutdown (*ESD*) System

Sub-paragraph -3 has been amended as follows.

3 "Fail-closed type" referred to in **18.3.1-2(1)(b), Part N of the Rules**, is to be in accordance with the following requirements **(1)** ~~and~~or **(2)** and **(3)**.

(1) Oil hydraulics and air pressure are used only for the opening of the valves and the closing of the valves, including the fail-closed operation, is carried out by springs or weights.

(2) In cases where both the opening and closing of the valves are carried out by oil hydraulics or air pressure due to the impracticability of the **(1)** above derived from the large diameter of the valves, oil hydraulics or air pressure for the fail-closed operation is to be supplied from a specially provided pressure accumulation tank. The composition of the system is to be in accordance with the following requirements **(a)** ~~through **(c)**~~and **(b)**.

(a) Cylinders for valve operation may be used both for the normal operation and the fail-closed operation. However, oil hydraulics and air pressure piping from the specially provided pressure accumulation tank for fail-closed operation to the cylinders for valve operation is not usable as that for the normal operation. Further, stop valves are in principle not to be provided for the oil hydraulics or air pressure piping for the fail-closed operation.

(b) The pressure accumulation tank for the fail-closed operation is to have the capacity sufficient to activate all the connected *ESD* valves at least twice. In cases where one accumulation pressure tank is connected to the identical *ESD* valves fitted to the both sides, the tank may have the capacity sufficient to activate the *ESD* valve on only one side at least twice.

(~~c~~3) Visible and audible ~~A~~alarms are to be activated in a normally manned control station (e.g. cargo control room and/or the navigation bridge, etc.) at the loss of oil hydraulics or air pressure for the normal operation ~~and at the fail-closed operation~~, in cases which may cause fail-close.

EFFECTIVE DATE AND APPLICATION (Amendment 1-8)

1. The effective date of the amendments is 1 January 2024.

2. Notwithstanding the amendments to the Guidance, the current requirements may apply to ships the keel of which were laid or which were at a similar stage of construction before the effective date.

(Note) The term "a similar stage of construction" means the stage at which the construction identifiable with a specific ship begins and the assembly of that ship has commenced comprising at least 50 tonnes or 1% of the estimated mass of all structural material, whichever is the less.