LPG-FUELLED SHIPS

NR647 - JULY 2025

RULE NOTE

BUREAU VERITAS

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RULES, RULE NOTES AND GUIDANCE NOTES

NR647 DT R01 July 2025 takes precedence over NI647 DT R00 January 2018.

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These rules are provided within the scope of the Bureau Veritas Marine & Offshore General Conditions, enclosed at the end of Part A of NR467, Rules for the Classification of Steel Ships. The latest version of these General Conditions is available on the Bureau Veritas Marine & Offshore website.

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NR647

LPG-FUELLED SHIPS

July 2025

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Section 1 General

1 Application

1.1 Scope

1.1.1 This Rule Note applies to ships, other than liquefied gas carriers, using LPG as fuel.

1.1.2 The purpose of this Rule Note is to provide a set of design and installation requirements for the classification of ships using LPG as a fuel other than vessels covered by the IGC Code.

1.1.3 In accordance with NR467, Pt A, Ch 1, Sec 2, Ships complying with the requirements of this Rule Note may be assigned the additional service feature **LPGfuel**.

1.2 Statutory requirements

1.2.1 This Rule Note incorporates requirements, printed in italic type, from IMO Circular MSC.1/Circ.1666 “Interim Guidelines for the safety of ships using LPG as fuel", which are applicable for Classification purposes.

1.3 Classification

1.3.1 LPG-fuelled ships that are designed and built in accordance with this Rule Note may be assigned the additional service feature **LPGfuel**.

The additional service feature **LPGfuel** is completed by:

- the notation **singlefuel** when the engine uses only LPG as fuel
- the notation **dualfuel** when the engine uses LPG as fuel and fuel oil.

The additional service feature e.g. **LPGfuel dualfuel** or **LPGfuel singlefuel** may be completed by:

- the notation **-prop** when LPG fuel is only used for propulsion systems
- the notation **-aux** when LPG fuel is only used for auxiliary systems.

Section 2 LPG-fuelled Ships

1 General

1.1 Reference

1.1.1 As a general principle, except where otherwise stated in this Rule Note, LPG-fuelled ships are to comply with the provisions of NR529, Gas-fuelled ships.

1.2 Documentation to be submitted

1.2.1 The documents listed in Tab 1 are to be submitted.

The list of documents requested is intended as a guidance for the complete set of information to be submitted, rather than an actual list of titles.

The Society reserves the right to request the submission of additional documents if it is deemed necessary for the evaluation of the system, equipment or components.

Table 1 : Documents to be submitted

No.	I/A **(1)**	Documents to be submitted
1	I	General arrangement drawing of the ship showing the areas and spaces containing the LPG installations and piping including: • the LPG bunkering stations • the LPG tanks • the LPG boil-off management systems • the LPG fuel handling systems • the LPG valve units • the vent mast • the inert gas system
2	I	General specification of the LPG fuel installation including: • type and capacity of the LPG storage tanks, range of pressure and temperature anticipated under operational conditions • bunkering method (from terminal, bunker ship or barge, truck) • boil-off management principle
3	A	Drawing showing the hazardous areas and their classification
4	A	Drawing showing the structural fire protection and cofferdams provided in connection with LPG installations
5	A	Arrangement of accesses to hazardous area spaces
6	A	Arrangement of the ventilation systems serving hazardous areas
7	I	Risk analysis as per Sec 2, [1] and follow-up report of the recommendations
8	I	LPG dispersion analysis
9	A	Drawings and calculation of safety relief valves
10	A	Specification of the control, monitoring and safety systems for the LPG fuel installation
11	A	Diagram of the LPG detection system
12	A	Bilge system of the spaces related to LPG fuel storage and preparation
13	A	Emergency shutdown system
14	A	Details of fire-extinguishing appliances and systems related to LPG fuel installation: Water spray system when required to be fitted, Dry chemical powder, Fire Main
15	I	Safety certificates for electrical equipment located in hazardous areas, where applicable
16	A	Schematic electrical wiring diagram in areas containing LPG piping and utilization units
17	A	Arrangement of electrical installation in hazardous areas, including lighting system
(1) A: To be submitted for approval; I: To be submitted for information.		

No.	I/A **(1)**	Documents to be submitted
FOR THE LPG FUEL TANK:		
18	A	Drawings of the tank(s) and material specification
19	A	Structural analysis for the tank(s) and supports as applicable
20	A	Sloshing calculation covering the full range of intended filling levels (for membrane tanks and type A tanks)
21	A	Testing and inspection procedures for LPG tank manufacturing
22	A	In-service inspection/survey plan for the LPG tanks
23	A	LPG fuel tank pressure control principle
24	A	LPG fuel tank instrumentation (pressure, temperature, level)
25	I	Fuel containment system gas freeing procedure, including emptying, inerting and purging
FOR THE LPG FUEL HANDLING SYSTEM:		
26	A	Drawings and material characteristics of the pumps, compressors and heat exchangers
27	I	Specification and calculations of the pumps, compressors and heat exchangers
FOR THE LPG FUEL PIPING SYSTEM:		
28	A	Schematic diagram and materials of the LPG (liquid and vapour) piping systems, including venting systems
29	A	Details of the piping protective enclosure
30	A	Arrangement of the vent mast
31	I	Documentation related to the LPG bunkering system devices installed on the ship
FOR TANKS OTHER THAN FULLY PRESSURIZED TYPE C TANKS:		
32	I	Specification of the boil-off vapour management system(s)
33	A	Calculations of the boil-off rate of the tank, for the different operating conditions (maximum ambient temperature, filling rates, pressure and temperature in the tank after bunkering)
FOR LPG CONSUMERS:		
34	I	Specification and approval reference of the gas utilization units (engines, gas turbines, boilers)
35	A	Diagram of the gas fuel supply systems, for each gas utilization unit
36	A	Arrangement of the LPG gas valves units
37	A	Diagram of the fuel oil system including pilot fuel supply
38	A	Diagram of the engine lubricating oil system
39	A	Diagram of the engine cooling system
40	A	Diagram of the engine crankcase venting systems
41	A	Drawings of the boilers, including burners
42	A	Drawing of the exhaust gas ducts
43	A	Specification of the control, monitoring and safety systems for each LPG utilization unit
44	A	Instrumentation list
45	I	Procedure for maintenance of the LPG utilization units and other LPG-related equipment, including the steps to be taken prior to servicing the units
(1) A: To be submitted for approval; I: To be submitted for information.		

1.3 Definitions

1.3.1 General

Definitions mentioned in NR529, [2.2] are to be considered by default in the context of this Rule Note.

1.3.2 Liquefied Petroleum Gas (LPG)

LPG means liquefied petroleum gas. It is mainly composed of a mixture of propane (C_3H_8) and butane (C_4H_{10}) and may contain small amounts of other hydrocarbons and impurities. In this Note Rule, petroleum gas either in its liquefied or gaseous state is referred to as LPG. When it is necessary to distinguish between the liquefied state and the gas state, LPG in the liquefied state is referred to as LPG liquid, and LPG in the gaseous state is referred to as LPG gas. LPG may be supplied to fuel consumers in liquid or gaseous state.

1.3.3 LPG fuel system

LPG fuel system includes the LPG bunkering, storage, preparation, supply and consuming systems.

1.3.4 Fuel preparation room

Fuel preparation room means any space containing pumps, compressors, heat exchangers or vaporizers for LPG preparation purposes.

1.3.5 Design vapour pressure

Design vapour pressure is the maximum gauge pressure, at the top of the tank, to be used in the design of the tank.

1.3.6 Ventilation analysis

Ventilation analysis means the analysis of the ventilation efficiency of a space using appropriate modelling techniques such as CFD analysis.

1.3.7 Space containing a potential source of LPG release

Space containing a potential source of LPG release, in the context of this Rule Note, means a space where a single failure in a system or equipment or a consequential failure of it would result in a release of LPG in the space. Such spaces are to be clearly identified by the risk analysis (see [3.2]).

1.3.8 Normal operational condition

Normal operational condition has the same meaning as in SOLAS Convention, regulation II-1 / 3.5. It includes blackout situations.

1.3.9 Failure condition

Failure condition means a condition under which a component in the LPG fuel system is affected by a failure or a malfunction resulting in an LPG leakage or an unsafe or unreliable situation.

2 General design principles

2.1 Risk assessment

2.1.1 An exhaustive risk assessment is to be performed, considering the hazards associated with physical layout, operation, process and maintenance, following any reasonably foreseeable failure. The risk assessment is to include at least an HAZID study and a HAZOP study.

2.1.2 The risks are to be analysed using acceptable and recognized risk analysis techniques, as per IACS Recommendation No.146 “Risk assessment as required by the IGF code”. The risks listed in paragraph 3.2 of IACS Rec.146, as deemed relevant to LPG, are to be considered as well as the following ones:

- loss of function
- component damage
- fire
- explosion
- collision
- grounding
- intoxication through anoxia
- pollution
- variations of bunkered LPG fuel characteristics (temperature)
- rollover.

The analysis is to ensure that risks are ALARP (As Low As Reasonably Practicable). Risks which cannot be eliminated are to be mitigated as necessary. Details of risks, and the means by which they are mitigated, are to be documented to the satisfaction of the Society.

2.1.3 The risk assessment is to cover the possible liquid and gaseous fuel leakages and spills and their consequences during the ship operation including bunkering, in particular with respect to:

- the accumulation of LPG vapours in spaces containing a potential source of LPG release and their spreading over the ship's spaces through non-gastight openings
- the spreading of LPG vapours from the vent mast outlet on open decks and their possible recirculation to accommodation through openings and ventilation inlets
- the draining of the hold space in case of type A or B tank failure.

2.1.4 The risk analysis is to cover at least the following spaces, zones and systems:

- storage tanks
- tank hold spaces
- tank connection spaces (TCS)
- fuel preparation rooms
- bunkering stations
- spaces containing liquid or gaseous LPG piping
- vent masts.

The LPG spreading scenarios in case of leakage are to be analyzed.

2.1.5 Limitation of explosion consequences

An explosion in any space containing any potential sources of release and potential ignition sources is not to:

- *cause damage to or disrupt the proper functioning of equipment/systems located in any space other than that in which the incident occurs;*
- *damage the ship in such a way that flooding of water below the main deck or any progressive flooding occur;*
- *damage work areas or accommodation in such a way that persons who stay in such areas under normal operating conditions are injured;*
- *disrupt the proper functioning of control stations and switchboard rooms necessary for power distribution;*
- *damage life-saving equipment or associated launching arrangements;*
- *disrupt the proper functioning of fire-fighting equipment located outside the explosion-damaged space;*
- *affect other areas of the ship in such a way that chain reactions involving, inter alia, cargo, gas and bunker oil may arise; or*
- *prevent persons access to life-saving appliances or impede escape routes.*

Note 1: Double wall fuel pipes are not considered as potential sources of release.

3 Ship design and arrangements

3.1 General provisions

3.1.1 *Unless expressly provided otherwise, the requirements of NR529, Chapter 5 apply.*

3.2 Protection of LPG fuel storage tanks against external damages

3.2.1 LPG fuel storage tanks are to be protected against mechanical damage likely to occur during the ship operation.

3.2.2 LPG fuel storage tanks are to be protected from external damage caused by collision or grounding, in accordance with the requirements for protective location given in NR529, [5.3].

3.3 Location of the LPG fuel storage tanks and equipment on open decks

3.3.1 Fuel storage tanks or equipment located on open deck are to be located to ensure sufficient natural ventilation, so as to prevent accumulation of escaped gas.

3.4 Location and protection of LPG fuel piping

3.4.1 LPG fuel piping is not to be located less than 800 mm from the ship's side.

3.4.2 All LPG fuel pipes are to be protected from mechanical damages likely to occur during the ship operation.

3.4.3 All LPG piping is to be enclosed in a protective gastight enclosure complying with [7.2].

3.4.4 LPG pipes may be accepted in open spaces or on open deck without protective enclosure against leakage provided that there is no risk of LPG accumulation in case of pipe failure.

3.4.5 LPG piping is not to be led directly through accommodation spaces, service spaces, electrical equipment rooms or control stations

3.4.6 *Double barrier around fuel piping systems is to be continuous and not have openings in machinery spaces*

3.4.7 Any valve necessary for isolating a storage tank or other components of the LPG fuel system in case of leakage is to be provided with a remote closing device, which is to be accessible from a protected location.

3.5 Leakage containment

3.5.1 Possible LPG leakages, as identified by the HAZID, are to be contained by a suitable enclosure, wherever practicable.

3.6 Arrangement of machinery spaces

3.6.1 *A single failure of fuel systems is not to lead to a gas release in the machinery space, i.e. only gas-safe machinery space concept in accordance with NR529 is to be accepted.*

3.6.2 *The requirements of NR529, [5.6] do not apply to ships using LPG as fuel. ESD-protected machinery spaces may be permitted, provided that the requirements of alternative design (SOLAS II-1/55) are met to the satisfaction of the Administration*

3.7 Fuel preparation room

3.7.1 Fuel preparation rooms are to be located on an open deck, unless a specific analysis is submitted demonstrating that, for the worst leakage scenario, they can withstand the maximum pressure build up in the space, taking into account the pressure relief devices, where fitted.

3.7.2 The pumping, vaporisation and heating capacity is to be sufficient to provide the required pressure and temperature of the LPG supply at the gas consumers inlet in all LPG conditions in the storage tank, operating conditions of the LPG consumers, including transient conditions, irrespective of the ambient conditions.

3.8 Bilge systems and drainage arrangements

3.8.1 *In addition to the requirements in NR529, [5.9], the bilge systems in the hazardous area are to be arranged separately for each space and discharged overboard or to an enclosed tank fitted with a gas detector. Where bilge piping of two or more hazardous areas is connected, means are to be provided to prevent the gas in one area from entering into other areas through the connected bilge pipes.*

3.8.2 Bilge lines serving hazardous areas are not to be connected to pumps in safe spaces.

3.9 Drip trays

3.9.1 *In addition to the requirements in NR529, [5.10.1], drip trays identified by the risk assessment in accordance with [2.3] are to be equipped with means to detect leakage and shut off the fuel if required. However, NR529, [5.10.3] does not apply to ships using LPG as fuel.*

3.10 Control of LPG vapours and drains

3.10.1 *In addition to the requirements of NR 529, Chapter 5, the following provisions on pipe vents and pressure relief devices apply:*

- *LPG gas line from the following are to be led to a vent mast:*
  - *the pressure relief valve of the tank; and*
  - *vent lines and bleed lines for gas fuel systems (including gas valve units, safety valves and piping enclosures); and*
- *LPG liquid line from the following is to be led to a fuel tank. Where it is not practicable, the line may be led to a vent mast but liquid release from the outlet of vent is not acceptable:*
  - *the pressure relief valve of the liquid fuel supply pipe*
  - *vent line and bleed line of liquid fuel supply piping*
  - *pressure relief valve in bunkering line.*

3.10.2 The arrangement of the vent mast is to be based on the gas dispersion analysis required in Table 1. It is to preclude the risk of accumulation of gas on open decks and of escape of gas into the ship spaces through openings. The provisions of NR529, [7.2.7], are to be complied with, considering following additional provisions:

- *escaped LPG gas does not escape to non-hazardous areas through the opening around the vent exit,*
- *escaped LPG gas is not trapped by any structure on an open deck; and*
- *escaped LPG gas does not form a flammable atmosphere in the way of exhaust gas outlets and other ignition sources.*

3.10.3 *In addition to NR529, [6.7.2], the vent piping system is to be fitted with an inert gas purging interface.*

4 Fuel containment system

4.1 General

4.1.1 *LPG tanks are to be designed in accordance with the relevant provisions of the NR529, Chapter 6, except where otherwise specified in the present Article.*

4.1.2 *The provision of NR529, [6.3.1] does not apply to ships using LPG as fuel.*

4.1.3 *In addition to NR529, [6.3.4], the following applies: For the fuel tank located in enclosed space, a tank connection space is to be provided separately from fuel storage hold space. For the fuel tank located on an open deck, a tank connection space is*

also to be provided where escaped gas may accumulate on the open deck or enter in non-hazardous space such as accommodation space and machinery space based on the risk assessment.

4.1.4 *In addition to NR529, [6.4.2.1], no secondary barrier is to be required where the fuel temperature at atmospheric pressure is at or above –10°C. Where the fuel temperature at atmospheric pressure is not below –55°C, the hull structure may act as a secondary barrier.*

4.1.5 *The provision of NR529, [6.6] does not apply to ships using LPG as fuel.*

4.2 Operating conditions of the storage tank

4.2.1 The operating conditions of the tank are to be detailed:

- expected pressure and temperature range of LPG in the tank in both harbour and seagoing situations if different.
- operating principle (vapour bleeding and liquid extraction) and relevant control principles.

4.2.2 The Maximum Allowable Working Pressure (MAWP) of the LPG tank is not to exceed 90% of the Maximum Allowable Relief Valve Setting (MARVS).

4.2.3 Loading and filling limits of the tank are to be in accordance with the provisions of NR529, [6.8].

4.2.4 Particular consideration is to be paid to a possible vacuum in the liquefied LPG tank.

4.3 Tank pressure relief systems

4.3.1 The tank pressure relief system is to be in compliance with the provisions of NR529, [6.7.2] and NR529, [6.7.3].

5 Material and general pipe design

5.1 General

5.1.1 *The provisions of NR529, Chapter 7, for materials and piping systems also apply to LPG, except where otherwise specified in the present Article.*

5.1.2 LPG systems are to be designed to prevent unexpected phase changes in the supply system up to the consumers.

5.1.3 Arrangements are to be made to deal with icing of LPG piping components due to low temperatures in the LPG storage tank or vaporization of pressurized LPG fuel.

5.2 Materials

5.2.1 LPG supply lines are to be made of drawn copper or drawn stainless steel. Carbon steel and aluminium are not permitted.

5.3 Prevention of phase changes in LPG supply lines

5.3.1 Where LPG fuel is intended to be used in the gaseous state at pressures close to the vapor pressure at expected ambient temperature, the fuel is to be sufficiently heated and the fuel lines are to be properly heat traced or insulated.

5.3.2 Where LPG fuel is intended to be used in the liquid state, the pressure in the fuel manifold is to be sufficient to maintain the fuel in the liquid state.

6 Bunkering

6.1 General

6.1.1 *The provisions of NR529, Chapter 8, for LNG bunkering also apply LPG, except where otherwise specified in the present Article.*

6.1.2 *For ships using LPG as fuel, NR529, [8.3.1.6] is not applicable*

6.2 Arrangement of the bunkering station

6.2.1 The bunkering station is to be arranged without low points or obstacles that could lead to LPG vapour accumulation.

6.3 Vapour management

6.3.1 *Means are to be provided to manage vapour generated in the tank during bunker transfer. Where means of vapour management are not provided on ship, vapour return connection is to be fitted at bunkering manifold.*

7 Fuel supply to consumers

7.1 General

7.1.1 *The provisions of NR529, Chapter 9, for LNG fuel supply to consumers also apply to LPG, except where otherwise specified in the present Article.*

7.1.2 *Notwithstanding of NR529, [9.4.4], where fuel supply systems supply LPG in the liquid state, relevant bleed lines are to be led to the fuel tank or gas-liquid separator or similar device to prevent LPG liquid from being released to the atmosphere.*

7.1.3 *In addition to NR529, [9.4.7], where fuel supply systems supply LPG in the liquid state, vent lines are to be led to the fuel tank or gas-liquid separator or similar device*

7.1.4 *The provision of NR529, [9.4.10] does not apply to ships using LPG as fuel.* However, for each LPG supply line to high pressure installations, means are to be provided for rapid detection of a rupture in the gas line in the engine-room. When rupture is detected a valve is to be automatically shut off (the shutdown is to be time delayed to prevent shutdown according to transient load variation). This valve is to be located in the gas supply line before it enters the engine room or as close as possible to the point of entry inside the engine-room. It can be a separate valve or combined with other functions, e.g. the master valve.

7.1.5 *The provision of NR529, [9.7] does not apply to ships using LPG as fuel.*

7.1.6 *In addition to NR529, [9.8.2], the most conservative value of k is to be selected for considering expected composition of fuel (propane: 1,13 ; butane: 1,096).* Here 1,096 is to be used.

7.1.7 Efficient means of detection of clogging of filters mounted on the fuel supply lines are to be fitted.

7.1.8 Replacement or recovery of the clogged filters are to be possible without exposing the crew to a potential projection of fluids at a pressure more than 0,5MPa.

7.2 Secondary enclosure for LPG fuel piping

7.2.1 Where required by [3.4], [3.5] and [3.6], the secondary enclosure against leakage is to fulfill one of the following conditions:

a) Ventilated arrangement

- the enclosure consists of a pipe or duct maintained at a pressure lower than the atmospheric pressure by an extraction ventilation system having a capacity of at least 30 air changes per hour.
- the air inlet is to be from the open deck and is to be connected to the upper part of the enclosure
- the extraction fan is to be connected to the lowest point of the enclosure and is to discharge to a position on the open deck
- a LPG detector is to be provided at the fan discharge and at the liquid leaks drain, which needs to be connected at the lowest point of the enclosure.

b) Inert gas-pressurized arrangement

- the enclosure consists of a pipe or duct pressurized with inert gas at a pressure greater than the LPG fuel pressure. *Other solutions providing an equivalent safety level may also be accepted by the Administration.*
- a pressure monitoring is to be provided for the space between the LPG fuel pipe and the enclosure. Loss of inert gas pressure between the pipes is to be indicated by suitable alarms
- the pressure monitoring is to activate in case the inner pipe is a high pressure line as defined in NR529, [7.3] the automatic closing of the master LPG fuel valve or LPG tank valve, as appropriate.

7.3 Master LPG fuel valve

7.3.1 A master LPG fuel valve is to be provided in accordance with the provisions of NR529, [9.4.3].

8 Power generation including propulsion and other LPG consumers

8.1 General

8.1.1 *The provisions of NR529, Chapter 10, for LNG consumers also apply to LPG, except where otherwise specified in the present Article.*

8.1.2 *The exhaust systems are to be configured to prevent any accumulation of unburnt gaseous fuel.*

8.1.3 *Unless designed with the strength to withstand the worst case over pressure due to ignited gas leaks, engine components or systems containing or likely to contain an ignitable gas and air mixture are to be fitted with suitable pressure relief systems. Dependent on the particular engine design, this may include the air inlet manifolds and scavenge spaces.*

8.1.4 *The explosion venting is to be led away from where personnel may normally be present.*

8.1.5 *All gas consumers are to have a separate exhaust system*

8.1.6 *Notwithstanding NR529, [10.5.2], the gas turbine is to be fitted in a gastight enclosure arranged in accordance with NR529, [10.5.3]. Gas leakage in the gastight enclosure and the consequence is to be evaluated based on the risk assessment in accordance with [2.1] and to the satisfaction of the Administration.*

8.1.7 *Notwithstanding NR529, [10.3.1.7], if combustion has not been detected by the engine monitoring system within an engine-specific time after the opening of the fuel supply valve, the fuel supply valve is to be automatically shut off. Means to ensure that any unburnt fuel mixture is purged away from the exhaust system is to be provided.*

8.2 Internal combustion Engines using LPG

8.2.1 LPG engines are to be of a type approved by the Society on the basis of the risk assessment (see [8.2.3]) and type testing (see [8.2.4]).

8.2.2 LPG engines are to be designed to operate satisfactorily with all expected compositions of the LPG fuel.

8.2.3 The risk assessment of the engine is to be carried out using an HAZID analysis or other acceptable methods. It is to cover in particular the following hazards:

- presence and possible accumulation of gaseous LPG in the charge air system and in the crankcase (Otto cycle engines)
- condensation of LPG vapours in the fuel supply system (Otto cycle engines)
- leakage of high pressure liquid LPG (Diesel cycle engines)
- presence of unburnt LPG vapours in the exhaust system
- failure of an LPG admission valve or injection valve
- failure of the ignition system (sparking plug or pilot injection).

The possible variations of the LPG characteristics associated with its composition (density, flashpoint, heat value, flammability range) are to be considered.

8.2.4 The engine is to undergo at least the following type tests, in addition to those required in NR467, Pt C, Ch 1, Sec 2 and NR467, Pt C, Ch 1, App 2, for standard diesel engines:

- for dual fuel engines, the lowest specified speed is to be verified in diesel mode and LPG mode
- for dual-fuel engines, switch over between LPG and diesel modes are to be tested at different loads
- the efficiency of the ventilation arrangement of the double walled LPG piping system is to be verified
- the capability of engines driving generators to take sudden load and loss of load is to be verified.

8.3 Gas Turbine

8.3.1 Gas turbines are to be of a type approved by the Society in accordance with the requirements of NR467, Pt C, Ch 1, Sec 5.

8.3.2 Gas turbines are to be tested according to a program approved by the Society. This program is to include the following tests:

- capability of the turbine to operate with the different expected LPG fuel compositions
- capability of the turbine to switch over from LPG fuel to oil fuel operation at low load
- load variation test.

9 Fire safety

9.1 General

9.1.1 *The provisions of NR529, Chapter 11 also apply to LPG, except where otherwise specified in the present Article.*

9.1.2 *In addition to NR529, [11.3.1], the fuel preparation room is to be separated from a machinery space of category A and rooms with high fire risks. The separation is to be done by a cofferdam of at least 900 mm with insulation of A-60 class.*

9.1.3 *In addition to the requirements of NR529, Chapter 11, a fuel preparation room is to be provided with a fixed fire-extinguishing system complying with the provisions of NR467, Pt C, Ch 4, Sec 15 and taking into account the necessary concentrations/application rate required for extinguishing LPG gas fires.*

10 Explosion prevention

10.1 General

10.1.1 *Unless expressly provided otherwise, the requirements of NR529, Chapter 12 apply.*

10.1.2 *The classification of a hazardous area is to be subject to special consideration to characteristics of LPG (e.g. density, LEL). IEC 60079-10-1 may be referred, if necessary, to determine hazardous areas.*

10.1.3 *Hazardous area classification according to IEC 60079-10-1:2020 may be considered as an alternative to hazardous area classification defined in NR529, Chapter 12.*

10.2 Inerting

10.2.1 An inert gas system complying with the provisions of NR529, [6.13.2]; NR529, [6.10]; NR529, [6.13] and NR529, [6.14] is to be provided.

11 Ventilation

11.1 General

11.1.1 *The provisions of NR529, Chapter 13, for ventilation also apply to LPG, except where otherwise specified in the present Article.*

11.1.2 *In addition to NR529, [13.3.5], air outlets and air inlets for hazardous enclosed spaces are to be arranged to prevent exhausted gas from re-entering the space through air inlets, based on the risk assessment in accordance with [2.1] and to the satisfaction of the Society.*

11.1.3 *In addition to the NR529, [13.3.8], when determining the required ventilation capacity, special consideration is to be given to the density and lower explosion limit (LEL) of LPG gas, which is to be supported by numerical calculations such as CFD analysis.*

11.1.4 *In addition to the NR529, [13.4.2], approved automatic fail-safe fire dampers are to be fitted in the ventilation trunk for the tank connection space, fuel preparation room or any other space as deemed necessary by a risk assessment in accordance with [2.1] and to the satisfaction of the Society.*

11.1.5 *The number and location of the extraction points of the ventilation in each space are to be considered taking into account the size and layout of the space. Where bottom arrangements are complicated, it is to be demonstrated based on ventilation analysis that capacity and duct arrangements of ventilation are adequate for the space.*

11.1.6 *The provisions in NR529, [13.5.2], NR529, [13.5.3] and NR529, [13.5.4] do not apply to ships using LPG as fuel.*

11.1.7 *Notwithstanding NR529, [13.8.3], the ventilation inlet for the double wall piping or duct is always to be located in an open area away from ignition sources. The inlet opening is to be fitted with a suitable wire mesh guard and protected from ingress of water.*

11.2 Arrangement of the ventilation systems serving hazardous spaces

11.2.1 Ventilation systems serving hazardous spaces are to be designed to avoid accumulation of LPG vapours at the bottom of the space in case of leakage. The ventilation capacity is to be at least 30 air changes per hour.

11.2.2 Ventilation outlets are to be provided in the lowest parts of the space and suitably protected.

11.2.3 Bunkering stations that are not located on open deck are to be suitably ventilated to ensure that any vapour being released during bunkering operations will not accumulate inside the bunkering station. If the natural ventilation is not sufficient for this purpose, mechanical extraction ventilation is to be provided.

12 Electrical installations

12.1 General

12.1.1 *The provisions of NR529, Chapter 14, for electrical installations also apply to LPG, except where otherwise specified in the present Article.*

12.2 Electrical equipment for hazardous areas

12.2.1 *In addition to NR529, [14.3.3], equipment for hazardous areas is to be of a certified safe type appropriate for compositions of LPG in accordance with IEC 60079-20. IEC 60079-20 classifies the temperature class and equipment groups for propane and butane as per Tab 2:*

Equipment is to be certified to IEC temperature class T2 and equipment group IIA.

Table 2 :

	Temperature class	Equipment group
Propane	T2	IIA
Butane	T2	IIA

13 Control, monitoring and safety systems

13.1 General

13.1.1 *The provisions of NR529, Chapter 15, for control, monitoring and safety systems also apply to LPG, except where otherwise specified in the present Article.*

13.1.2 *In addition to the NR529, [5.8.1], permanently installed gas detectors are to be fitted at ventilation inlets of accommodation and machinery spaces and other rooms with high fire risk, unless the Society deems it unnecessary based on a risk assessment in accordance with [2.1], as well as at the bunkering station as required in Article [6].*

13.1.3 *In addition to the NR529, [8.3.1], a monitoring position is to be provided in a safe area with direct line of sight or CCTV on the manifold, wherefrom the bunkering manifolds may be continuously monitored by the ship's crew during bunker transfer.*

14 Manufacture, workmanship and testing

14.1 General

14.1.1 The provisions of NR529, [16], for manufacture, workmanship and testing also apply to LPG.

14.2 Certification

14.2.1 Equipment are to be certified as listed in Tab 3. Symbols used in Tab 3 have the following meaning:

C : A BV product certificate is required with invitation of the Surveyor to attend the tests unless otherwise agreed, in addition to the manufacturer's document stating the results of the tests performed and/or compliance with the approved type as applicable

DA : Design assessment / Appraisal of the product is required; this one may be carried out as applicable either for a specific unit or using the Type Approval procedure

TA : Type Approval is required

TA (HBV): Type Approval is required with work's recognition (HBV scheme as per NR320)

W : A manufacturer's document is required, stating the results of the tests performed and/or stating compliance with the approved type (as applicable)

X : Examinations and tests are required

Where fitted, each additional index (h, ndt) indicates a specific type of test:

h : Hydraulic pressure test (or equivalent)

ndt : Non-destructive tests as per Rules.

Table 3 : Certification requirements

LPG FUEL HANDLING AND CONTAINMENT SYSTEMS OF LPG FUELLED SHIPS						
No.	Item	Product certification				Remarks
		Design assessment /approval	Raw material certificate	Examination and testing	Product certificate	
1	Steel plates and profiles for independent LPG fuel tanks (1)	(2)	C (2)	X	C	(1) Alternative metallic materials are subject to specific approval programme (2) As per provisions of NR529, Chapter 7 and NR529, Chapter 16
2	Aluminium alloy plates and profiles for independent LPG fuel tanks	(1)	C(1)	X	C(1)	(1) As per provisions of NR529, Chapter 7 and NR529, Chapter 16
3	Stainless or high alloy steel for membrane liquefied gas fuelled ships (1)	TA(2) (3)	C(2)	X	C	(1) Alternative metallic materials are subject to specific approval programme (2) As per provisions of NR529, Chapter 7 and NR529, Chapter 16 (3) Provisions of NR529, Appendix 2 are to be applied and relevant provisions of NR216 and NR480 Note: Contacts of LPG fuel tanks to supporting blocks to be checked on board
4	Insulation materials (1)					(1) Refer to NR529, C.6.4.13.3 and NR529, C.6.4.13.3 (a) (2) Test to be witnessed by attending surveyors unless otherwise agreed (3) DA for glue not used in secondary barrier (SB) or insulation panels (IP) bonding (4) Tensile tests for TA (5) C for polyurethane foam, W for polystyrene 6) Review of bonders operators qualifications Review of bonding and other fabrication or testing qualifications including Flat, Corner and Tri-way panels (7) In the case of shipbuilder's own manufacturing, no certificate would be issued after inspection unless explicitly required
	1 - Paint for inner hull protection	TA			W	
	2 - Studs, nuts, washers, coupler sockets, staples and screws		W		W	
	3 - Load bearing mastic	TA (2)		X	W	
	4 - Adhesives and glue	TA (3) (4)			W	
	5 - Foam panel	TA			C/W (5)	
	6 - Plywood	TA			W	
	7 - Stainless steel sheet	TA		X	C	
	8 - Stainless steel sheet studs, nuts and washers	DA			C	
	9 - Glass wool and Glass cloth	TA			W	
	10 - Thermal protection				W	
	11 - Aluminium for reinforced elements	TA		X	C	
	12 - Aluminium wedges	TA	C		W	
	13 - Secondary Barrier (composite material)	TA		X	C	
	14 - Insulating Panels	TA	C	X(6)	C	
	15 - Expansion Rivets (15 mm)	TA	W		W	
	16 - Stainless Steel corners and Anchor Strips	TA	C	X	C	
	17- Primary barrier component	DA	C	X	C	

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LPG FUEL HANDLING AND CONTAINMENT SYSTEMS OF LPG FUELLED SHIPS						
No.	Item	Product certification				Remarks
		Design assessment /approval	Raw material certificate	Examination and testing	Product certificate	
4	18 - Single Legs	DA	W	X	C	
	19 - Primary Block Assembly	DA	W		C	
	20 - Perlite	TA			W	
	21–- Insulating Material Flexible / Rigid	TA			W	
	22 - Fe-Ni alloy (36% Nickel) strips	TA		X	C	
	23 - Anti-sticking film				W	
	24 - Insulating Boxes	DA	W		W	
	25 - Fe-Ni (36% Nickel) welding filler metal	TA		X	C	
	26 - Densified wood laminated for pipe guide tower	DA	C		C(7)	
5	LPG gas fuel compressors and their prime movers					(1) As per provisions of NR529 (3) According to an agreed program (4) For electrical motors, refer to NR467, Pt C
	1- LPG gas fuel compressors TA or DA (1) C (1) X h (3) C	TA or DA (1)	C/W (1)	Xh(3)	C	
	2 - Prime movers (4)	(4)		X (4)	C	
6	LPG fuel pumps and their prime movers					(1) As per provisions of NR529 (3) According to an agreed program (4) For electrical motors, refer to NR467, Pt C
	1- LPG fuel pumps	TA or DA (1)	C (1)	X h (3)	C	
	2 - Prime movers (4)	(4)	(4)	(4)	C	
7	Bulkhead seal and gastight shaft bulkhead penetration devices	DA or TA (1)		X h	C (2)	(1) As per NR529, C9(a) (2) As per conditions set in the TA
8	Fans for hazardous enclosed spaces, and their prime movers					(1) Concerns the anti-sparking fans (2) As per conditions set in the TA (3) For electrical motors, refer to NR467, Pt C
	1 - Fans	TA (1)		X	C/W (2)	
	2 - Prime movers	(3)		X(3)	C	
9	Condensers, gasifiers or vaporizers, separators, heat exchangers,receivers, process pressure vessels, or other similarapparatus of LPG fuel supply system	DA (1)	C (1)	X h ndt	C	(1) As per provisions of NR529, Chapter 7. process pressure vessels handling LPG fuel are to be considered as Class I pressure vessels, in accordance with NR467, Pt C, Ch 1, Sec 3, [1.4.1] Note: Running tests - during gas trials of the ship

LPG FUEL HANDLING AND CONTAINMENT SYSTEMS OF LPG FUELLED SHIPS						
No.	Item	Product certification				Remarks
		Design assessment /approval	Raw material certificate	Examination and testing	Product certificate	
10	Fuel pipes for liquefied LPG fuel					(1) As per provisions of NR529 and NR467, Pt C, Ch 1, Sec 10 (2) Non-destructive testing: in addition to normal controls before and during the welding, and to the visual inspection of the finished welds, as necessary for proving that the welding has been carried out correctly and according to the regulations in this paragraph, radiographic or ultrasonic inspection or other non-destructive tests shall be carried out as required by NR529, Chapter 16, [16.6.3] (3) W for Seamless steel or stainless steel, C for longitudinally welded stainless steel pipes
	1 - Nominal diameter ND ≥ 50mm		C	X h ndt (1) (2)	C	
	2 - Nominal diameter ND < 50mm		W	X h ndt (1) (2)	W/C (3)	
11	Fuel pipes for gaseous LPG fuel with design pressure equal or lower than 10 bar (Class I or Class II)					(1) As per provisions of NR529 and NR467, Pt C, Ch 1, Sec 10 (2) Non-destructive testing: in addition to normal controls before and during the welding, and to the visual inspection of the finished welds, as necessary for proving that the welding has been carried out correctly and according to the regulations in this paragraph, radiographic or ultrasonic inspection or other non-destructive tests shall be carried out as required by NR529, Chapter 16, [16.6.3] (3) W for Seamless steel or stainless steel, C for longitudinally welded stainless steel pipes
	1 - Class I: pipes in single wall configuration, and nominal diameter ND ≥ 50mm 2 - Class II: pipes in double wall configuration, and nominal diameter ND ≥ 100mm		C	X h ndt (1) (2)	C	
	3 - Class I: pipes in single wall configuration, and nominal diameter ND < 50mm 4 - Class II: pipes in double wall configuration, and nominal diameter ND < 100mm		W	X h ndt (1) (2)	W / C (3)	
12	Fuel pipes for gaseous LPG fuel with design pressure higher than 10 bar (Class I) (1)					(1) For both single and double wall configuration (2) As per provisions of NR529 and NR467, Pt C, Ch 1, Sec 10 (3) Non-destructive testing: in addition to normal controls before and during the welding, and to the visual inspection of the finished welds, as necessary for proving that the welding has been carried out correctly and according to the regulations in this paragraph, radiographic or ultrasonic inspection or other non-destructive tests shall be carried out as required by NR529, Chapter 16, [16.6.3] (4) W for Seamless steel or stainless steel, C for longitudinally welded stainless steel pipes
	1 - Nominal diameter ND ≥ 50mm		C	X h ndt (2) (3)	C	
	2 - Nominal diameter ND < 50mm		W	X h ndt (2) (3)	W/C (4)	
13	Outer pipe of double wall fuel pipes (Class II) (1) (2)					(1) As per provisions of NR529 and NR467, Pt C, Ch 1, Sec 10 (2) Includes the gas valve enclosure (3) Pressure test is at the maximum working pressure of the inner pipe (4) W for Seamless steel or stainless steel, C for longitudinally welded stainless steel pipes
	1 - Nominal diameter ND ≥ 100mm		C	X h ndt (3)	C	
	2 - Nominal diameter ND < 100mm		W	X h ndt (3)	W / C (4)	

LPG FUEL HANDLING AND CONTAINMENT SYSTEMS OF LPG FUELLED SHIPS						
No.	Item	Product certification				Remarks
		Design assessment /approval	Raw material certificate	Examination and testing	Product certificate	
14	LPG fuel pipe fittings (1)	DA (2)	C / W (3)	X h ndt (4)	C	(1) Such as elbows, reducers, flanges: same remarks as for items 10,11, 12 or 13, as appropriate (2) If not already addressed within the scope of the system approval (3) Material certificate as for items 10, 11, 12 or 13 depending on the pipe type (4) When the fittings are of welded type, the welding procedures are to be examined
15	Expansion joints (1)	TA	C (2)	X h ndt	C	(1) Specific requirements as per NR529 (2) Refer to Items 10, 11, 12 or 13 as appropriate
16	Expansion bellows (1)	TA (2)	C (3)	X h ndt	C	(1) Specific requirements as per NR529, Chapter 16, [16.7.2] (2) Prototype tests to be performed on each type of expansion bellows intended or use on LPG fuel piping, primarily on those used outside the LPG fuel tank (3) Refer to Items 10, 11, 12 or 13 as appropriate
17	LPG fuel valves (1)					(1) Class of piping as per provisions of NR529, Chapter 7 (3) Prototype testing as per NR529, Chapter 16 (4) As per NR216, Ch 5, Sec 7, [1.8]. Non-destructive examination by both MPI and UT methods are to be carried out on all Class I drumforgings having thickness > 10 mm, intended for Class I piping systems, typically: all valves of large size (having nominal diameter ≥ 24") (5) In case of welded construction. When the valves have welded elements, the welding procedures are to be examined (6) Unit production testing: all valves are to be tested as per NR529, Ch16
	1 - Nominal diameter ND ≥ 50mm	TA or DA(2) (3)	C (4)	X h ndt (5) (6)	C	
	2 - Nominal diameter ND < 50mm	DA (3)	W (4)	X h ndt (5) (6)	C	
18	Safety relief valves for LPG fuel piping system	TA or DA (1)	C	X h ndt (2) (3)	C	(1) TA, or case-by-case DA (2) Checking of the setting (3) When the valves have welded elements, the welding procedures are to be examined
19	Safety relief valves for LPG fuel tanks	TA (1)	C	X h ndt (2) (3)	C	(1) The approval includes capacity testing (2) Checking of the setting including tightness test (3) When the valves have welded elements, the welding procedures are to be examined

LPG FUEL HANDLING AND CONTAINMENT SYSTEMS OF LPG FUELLED SHIPS						
No.	Item	Product certification				Remarks
		Design assessment /approval	Raw material certificate	Examination and testing	Product certificate	
20	LPG fuel process and containment sensors, transmitters, flow meters, PT100 and PLC, Circuit breakers, Electric cables	TA (1)		X	C / W (2)	(1) For some equipment, DA is applicable on a case-by-case basis; see NR467, Pt C, Ch 2 and relevant provisions of NR467, Pt C, Ch 3 and NR529 (2) As per conditions set in the TA
21	Vent lines on LPG fuel tanks and low pressure LPG fuel system (1)		W	X h ndt (2)	C	(1) Open-ended lines (the design pressure should be not less than 5 bar gauge) (2) In case of welded construction. When the vent lines have welded elements, the welding procedures are to be examined
22	Vent lines on high pressure LPG fuel system (1)		C / W (2)	X h ndt (3)	C	(1) The design pressure of the vent pipe is not to be less than the maximum expected pressure, which is to be justified (2) Depending on the class of piping as per NR529, Table C7.3(a) (3) In case of welded construction. When the vent lines have welded elements, the welding procedures are to be examined
23	Inert gas generation systems (1)					(1) See NR467, Pt C, Ch 1
24	Fire prevention materials and arrangements (1)					(1) See NR467, Pt C, Ch1 and NR467, Pt C, Ch 4, relevant provisions of NR529 and this Rule Note
25	Fire fighting systems (1)					(1) See item NR467, Pt C, Ch1 and NR467, Pt C, Ch 4 , relevant provisions of NR529 and this Rule Note
26	Gas detection system	TA (1)		X	C	(1) Automation systems: see relevant provisions of NR467 Pt C Ch2
27	Integrated LPGfuel supply system (1)	DA		X (2)	C	(1) Complete system including fuel containment, tank connection space and gas preparation system (2) As per agreed program, based on this rule note and MSC.1/Circ.1666 and/or standards recognized by the Society
28	Boil-Off Gas (BOG) handling system, as part of refrigeration / reliquefaction systems (1)	TA or DA		X (2)	C	(1) See relevant provisions of NR529, [6.9] (2) As per agreed program, based on the requirements of IGF Code and/ or standards recognized by the Society
29	Gas valve unit (1)	TA or DA		X (2)	C	(1) See relevant provisions of NR529 (2) As per agreed program, based on the requirements of IGF Code and/ or standards recognized by the Society
30	Gas combustion unit (1)	TA or DA		X (2)	C	(1) See relevant provisions of NR529 (2) As per agreed program, based on the requirements of IGF Code and/ or standards recognized by the Society

LPG FUEL HANDLING AND CONTAINMENT SYSTEMS OF LPG FUELLED SHIPS						
No.	Item	Product certification				Remarks
		Design assessment /approval	Raw material certificate	Examination and testing	Product certificate	
31	Independent LPG tank supporting materials	TA (1)	C (1)	X	C	(1) As per provisions of NR467, Part D, Chapter 9 and relevant provisions of NR216 and NR480 Note 1: Contacts of tanks to supporting blocks to be checked on board Note 2: Also see relevant provisions of NR529
32	Pump tower (fuel piping and supporting structure)	DA	W/C (1)	X h (2) ndt (3)	C (2)	(1) C for fuel piping, W for supporting structure (2) For LPG fuel piping, See item 10 to item 14 (3) Review of welders, and NDT operators qualifications Review of welding, NDT and other fabrication or testing qualifications Survey of the fabrication and witnessing of NDT at random
33	Pump tower base support	DA	C	X ndt (1)	C	(1) Review of welders, and NDT operators qualifications Review of welding, NDT and other fabrication or testing qualifications (in particular - gas tracer/leak test) Survey of the fabrication and witnessing of NDT at random
34	Dome cover	DA	C	X ndt (1) (2)	C (2)	(1) Review of welders, and NDT operators qualifications Review of welding, NDT and other fabrication or testing qualifications (in particular - gas tracer/leak test) Survey of the fabrication and witnessing of NDT at random (2) For fuel piping, See item 10 to item 14
35	Dome seat	DA	C	X ndt (1)	C	(1) Review of welders, and NDT operators qualifications Review of welding, NDT and other fabrication or testing qualifications Survey of the fabrication and witnessing of NDT at random
36	Sump well	DA	C	X ndt (1)	C	(1) Review of welders, and NDT operators qualifications Review of welding, NDT and other fabrication or testing qualifications (in particular - gas tracer/leak test) Survey of the fabrication and witnessing of NDT at random
37	Independent LPG fuel tank systems	DA (1)	C / W (1)	X ndt	C	(1) As per provisions of NR529, IGF Code, MSC.1/Circ.1666 and this Rule Note

LPG FUEL HANDLING AND CONTAINMENT SYSTEMS OF LPG FUELLED SHIPS						
No.	Item	Product certification				Remarks
		Design assessment /approval	Raw material certificate	Examination and testing	Product certificate	
38	Double-wall flexible hose assembly (1)	TA(2)	W	X h(3)(4)	C (5)	(1) Short length of metallic hose with end fittings ready for installation (2) Prototype testing: see NR 467, Pt C, Ch 1, Sec 10 [2.6] and NR467, Pt C, Ch 1, Sec 10, [20.2], with a bursting test performed at 5 times the design pressure (3) Inner & Outer pipes are to be tested (4) Hydraulic test for the inner pipe is to be carried out at 1,5 time the maximum service pressure without pressure in the outer pipe. Pressure test for the outer pipe as per NR 529, [9.8] (5) As per conditions set in the TA
39	Emergency release system (1)					(1) Refer to NR620 when applicable (2) Performance test / Pressure and leak test (3) Power system and PERC
	1- ERC (Emergency release coupling)	TA		X h (2)	C	
	2- PERC (Powered emergency release coupling)	TA(3)		X h (2)	C	
40	Bunkering hoses of LPG bunkering (1)	TA	C	X h ndt	C	(1) Specific requirements as per NR620, Chapter 4 and as per NR 529 Chapter 8
41	QCDC (Quick connect disconnect coupler)	TA		X h (2)	C	(2) Performance test / Pressure and leak test

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