



GUIDE FOR

LNG CARGO READY VESSELS

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**American Bureau of Shipping
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Foreword

The U.S. shale oil and gas revolution has initiated a shift in global liquefied natural gas (LNG) trade and stimulated growth in associated production of Natural Gas Liquids, including liquefied petroleum gas (LPG) and ethane (LEG). Whilst LPG products can be transported in traditional LPG carriers, ethane has traditionally been consumed by domestic markets rather than being shipped overseas. With domestic markets unable to absorb the large volumes of ethane an opportunity is arising to ship liquefied ethane gas overseas. Historically only a limited number of small ethylene carriers were suitable to carry ethane. The recent growth in ethane export has stimulated the construction of dedicated ethane carriers.

The current LEG market is still relatively small but there are undeniable signs that trading volumes will grow significantly and there will be demand for significantly larger ethane carriers. The first Very Large Ethane Carriers (VLEC) entered into service in 2016. Industry stakeholders realize ethane remains a niche market in its infancy and vessel owners and financiers are demanding flexible designs, allowing the carriage of alternative cargoes. For VLECs up to about 100,000 m³ flexibility can relatively easily be provided by enabling the vessels to carry LPG cargoes. Significantly larger vessels would however not be suitable to trade to conventional LPG terminals due to terminal restrictions. Enabling the vessel to carry LNG cargo provides greater opportunities and flexibility to owners/operators. Designing a vessel that can carry both LEG and LNG is possible but increases the cost of the vessel. Designing a vessel to be “LNG Cargo Ready” limits the initial investment while maintaining a viable option to select LNG as a future cargo.

The scope of such modifications can significantly differ from ship to ship and needs to be agreed between the buyer and the shipbuilder. In order to facilitate future modifications, the ship buyers and shipbuilders must make a significant effort to document what features should be incorporated in the vessel design and in the shipbuilding contract.

This Guide applies to liquefied gas carriers, such as Ethane or Ethylene carriers, that have also been designed and constructed for possible future carriage of LNG cargo. ABS recognizes the need for defining the “LNG Cargo Ready” scheme, which documents LNG cargo compliance and thereby assists owners, designers, and operators in taking advantage of the alternative LNG cargo carriage option. This Guide specifies the ABS requirements for obtaining the class notation **LNG Cargo Ready**.

This Guide becomes effective on the first day of the month of publication.

Users are advised to check periodically on the ABS website www.eagle.org to verify that this version of this Guide is the most current.

We welcome your feedback. Comments or suggestions can be sent electronically by email to rsd@eagle.org.



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SECTION 1 General

1 Scope and Application

This Guide is applicable to liquefied gas carriers falling under the scope of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) and the ABS requirements under Part 5C, Chapter 8 of the *ABS Rules for Building and Classing Marine Vessels (Marine Vessel Rules)* and having design features suitable for the carriage of LNG at a future date.

The submitted design is to be in accordance with the requirements of this Guide and the current edition of the specified codes and rules, as referenced herein.

This Guide generally applies to hull structures, systems and equipment that have been installed on a vessel in compliance with the *Marine Vessel Rules* at the time of vessel new construction.

The guide offers the option to review the overall future conversion design concept for the carriage of LNG cargo (See Section 3).

The requirements for the design and construction of all features of systems proposed are established in the *Marine Vessel Rules*.

Details of all hull structures, systems and equipment covered by this guide are to be submitted for review to ABS for the design and construction for the carriage of Primary Cargo (e.g., LPG, LEG, Ethylene, etc.) and LNG.

For the purposes of this guide, the term "Primary Cargoes" are those cargoes the vessel is originally certified to carry as described in the vessel's Certificate of Fitness (COF).

Upon completion of the installation to the Surveyor's satisfaction, the vessel will be eligible for the class notation **LNG Cargo Ready**, including descriptive letters as a record comment (See Subsection 2/1) for the component or systems that have been installed in accordance with approved documents. The record comment descriptive letters are to supplement the **LNG Cargo Ready** class notation when the component or system indicated has been ABS approved/surveyed as per the applicable rule requirements and installed/tested on board to the attending Surveyor's satisfaction (with the exception of final LNG gas trials).

The **LNG Cargo Ready** notation is to be applied in combination with either the **Liquefied Gas Carrier** or **Liquefied Gas Carrier with Independent Tanks** notations. Examples:

- Class Notation:
 - ✘ A1, Liquefied Gas Carrier, **LNG Cargo Ready**, ⓔ, ✘ AMS...
 - ✘ A1, Liquefied Gas Carrier with Independent Tanks, **LNG Cargo Ready**, ⓔ, ✘ AMS...
- Record Comment:

LNG Cargo Ready (CC, CP, ...)

Note: Once the vessel has been converted to carry LNG as a cargo in compliance with the *Marine Vessel Rules*, in accordance with approved plans and to the satisfaction of the Surveyor, the above "**LNG Cargo Ready**" notation will be dropped. The IGC Code Certificate of Fitness (COF) will be updated to include the carriage of LNG as cargo.

2 Objectives

The primary objectives of the **LNG Cargo Ready** notation are:

- i) To provide confirmation to the buyer and the shipbuilder that a specific vessel feature has been designed, installed and approved by ABS based on their Rules as applicable if the vessel had been built as an LNG carrier.
- ii) To provide clear framework to the buyer and the shipbuilder in terms of Class guidance and requirements.
- iii) To provide independent and public recognition that a vessel has been designed intentionally with LNG cargo conversion in mind and that it has physical features that make it suitable for such conversion.

3 Certification

Design review, survey, testing, and the issuance of reports or certificates constitute the certification of machinery, equipment and systems; see also 4-1-1/3 of the *Marine Vessel Rules*. Where the **LNG Cargo Ready** notation is requested for a specific system, the associated machinery, equipment and systems are to be certified for service with both the Primary Cargoes as well as LNG.

The final certification for LNG service will be pending until gas trials on the vessel are carried out with LNG as cargo and all primary containers, the insulation, and the cargo-handling equipment have been tested under service conditions to the satisfaction of ABS. The scope of the gas trials will depend on the scope of the conversion and will be agreed on a case by case basis with ABS followed by First Loading/Unloading survey/testing criteria, 5C-8-1/27.5 & 5C-8-1/27.7 of the *Marine Vessel Rules* as applicable and agreed with ABS.



SECTION 2 LNG Cargo Ready

1 General

“LNG Cargo Ready” incorporates both the Class Approval of the detailed drawings and the installation of the specified hull structure, system or equipment onboard the ship. The approval is categorized in separate groups, identifying the different parts of the complete design. A list of drawings is required for approval of each part before installation. Drawings are to be in compliance with the relevant sections of Part 5C, Chapter 8 of the *Marine Vessel Rules*. Upon completion of the installation and testing to the Surveyor’s satisfaction, the vessel will be eligible for the class notation **LNG Cargo Ready**, including descriptive letters as a record comment as per Table 1 for the systems that have been installed in accordance with approved plans for LNG cargo in addition to the Primary Cargoes.

The LNG Cargo Ready system groups and associated description letters are as follows:

TABLE 1
LNG Cargo Ready System Groups

<i>System</i>	<i>Descriptive Letters</i>
Cargo Containment	CC
Cargo Piping	CP
Cargo Pump	PP
Cargo Gas Compressor	CO
Reliquefaction System	RS
Gas Combustion Unit	GC
Fuel Gas Supply	FG
Dual Fuel Engine	DF

The above descriptive letters are to supplement the **LNG Cargo Ready** class notation as a record comment when the component or system indicated has been ABS approved/surveyed as per the applicable Rule requirements and installed and tested on board to the attending Surveyor’s satisfaction (e.g., **LNG Cargo Ready (CC, CP, FG)**).

To receive the class notation **LNG Cargo Ready**, the cargo containment (CC) system record comment is mandatory. (See 2/2.2).

Prior to the delivery of the liquefied gas carrier, ABS will issue a Statement of Compliance (SoC) letter outlining the scope of LNG Cargo Ready compliance with this guide. The letter will be retained in the vessel records for future reference if the carriage of LNG cargo is requested.

2 Plans and Data to be Submitted

The general submission of data is to be provided in accordance with Section 5C-8-1 of the *Marine Vessel Rules* for both the Primary Cargoes and LNG.

The plans and documents to be submitted for each system group outlined in Section 2, Table 1 are to be evaluated as follows:

2.1 LNG Ready Scope

A single document is to be provided outlining the scope of the vessel that will be designed and constructed for LNG cargo at the time of new construction vessel delivery. This document is to be submitted prior to any LNG Ready portions of the vessel are submitted for design review.

The document is to detail the cargo containment system plus any additional systems groups (See Section 2, Table 1) and specific components that will be designed and fitted onboard the vessel for future use with LNG cargo. This document will assist with clarifying the scope of the engineering evaluation that is requested and to appropriately document the same.

Where parts of some systems or equipment do not fully comply with the requirements for carriage of LNG but can easily be retrofitted at the time of conversion shall be detailed and such deviation will be reviewed. The Statement of Compliance (SoC) letter, as referred to in Subsection 2/1, will outline such deviations if deemed acceptable.

Necessary vessel conversions for the carriage of LNG cargo after delivery of the vessel may be evaluated in the Concept Design Review (See Section 3).

2.2 Cargo Containment (CC) – Mandatory Record Comment

To obtain the **LNG Cargo Ready (CC)** record comment, the cargo containment system, material forming vessel hull structure, and associated systems are to be in compliance with the requirements as specified in 5C-8-1/11 and Section 5C-8-4 of the *Marine Vessel Rules* for the carriage of both the Primary Cargoes and LNG.

Where parts of the cargo containment system do not fully comply with the requirements for carriage of LNG but can easily be retrofitted at the time of conversion this shall be detailed in the LNG Cargo Ready Scope document (see 2/2.1) and such deviation will be reviewed on a case by case basis.

Vessels intended to operate on the navigable waters of the United States are to consider additional design and structural requirements as outlined by Appendix 5C-8-A2 of the *Marine Vessel Rules*.

2.3 Cargo Piping (CP) – Optional Record Comment

To obtain the optional **LNG Cargo Ready (CP)** record comment, the process pressure vessels and liquid, vapor, and pressure piping system are to comply with the requirements specified in Section 5C-8-5 of the *Marine Vessel Rules* for the carriage of both the Primary Cargoes and LNG.

2.4 Cargo Pump (PP) – Optional Record Comment

To obtain the optional **LNG Cargo Ready (PP)** record comment, the cargo pump(s) are to comply with the requirements specified in 5C-8-5/13 of the *Marine Vessel Rules* for the carriage of both the Primary Cargoes and LNG.

The record comment may be assigned if any number of pumps fitted on the liquefied gas carrier are designed, constructed, and tested at the manufacture for LNG cargo. A list of the specific pumps suitable for LNG service is to be submitted and the same list is to be included in the LNG Cargo Ready Scope document (2/2.1) with the appropriate identifying information.

2.5 Cargo Gas Compressor (CO) – Optional Record Comment

To obtain the optional **LNG Cargo Ready (GC)** record comment, the cargo compressors(s) are to comply with the requirements specified in 5C-8-5/13 of the *Marine Vessel Rules* for the carriage of both the Primary Cargoes and LNG.

The record comment may be assigned if any number of compressors fitted on the liquefied gas carrier are designed, constructed, and tested at the manufacture for LNG cargo. The specific compressors suitable for LNG service are to be included in the LNG Ready Scope document (2/2.1) with the appropriate identifying information.

2.6 Reliquefaction System (RS) – Optional Record Comment

To obtain the optional **LNG Cargo Ready (RS)** record comment, the system is to be designed, constructed, and tested in accordance with Section 5C-8-7 and Appendix 5C-8-A5 as applicable, of the *Marine Vessel Rules* for the carriage of both the Primary Cargoes and LNG.

2.7 Gas Combustion Unit (GC) – Optional Record Comment

To obtain the optional **LNG Cargo Ready (GC)** record comment, the system is to be designed, constructed, and tested in accordance with Section 5C-8-7 and Appendix 5C-8-A6 as applicable, of the *Marine Vessel Rules* for the carriage of both the Primary Cargoes and LNG.

2.8 Fuel Gas Supply (FG) – Optional Record Comment

To obtain the optional **LNG Cargo Ready (FG)** record comment, the fuel gas supply system is to comply with the requirements specified in Section 5C-8-16 of the *Marine Vessel Rules* for the use as fuel of both the relevant Primary Cargoes and LNG.

2.9 Dual Fuel Engine (DF) – Optional Record Comment

To obtain the optional **LNG Cargo Ready (DF)** record comment, the dual fuel engine system is to comply with the requirements specified in Section 5C-8-16/7 and Appendix 5C-8-A7 of the *Marine Vessel Rules* for the use as fuel of both the relevant Primary Cargoes and LNG.

The specific engines suitable for LNG service are to be included in the LNG Ready Scope document (2/2.1) with the appropriate identifying information.

3 Survey after Construction

ABS survey of the systems and equipment installed on the vessel will be included in the annual and special periodical surveys required by *ABS Rules for Survey After Construction (Part 7)* for vessels in service intended to carry liquefied gases as reflected on the IGC Code Certificate of Fitness (COF).



SECTION 3 LNG Cargo Ready Concept Design

1 General

Concept Design Review is an optional high-level evaluation of necessary vessel conversions for the carriage of LNG cargo after delivery of the vessel. This option may be selected in addition to the **LNG Cargo Ready** notation (see Section 2).

The concept review is an evaluation of the proposed design modifications necessary to convert the vessel to an LNG carrier.

Upon satisfactory completion of the LNG Cargo Ready Concept Design review, ABS may provide an Approval in Principle (AIP) for this concept design and issue a Record Comment of “**LNG Cargo Ready (CC, Concept)**”.

2 Plans and Data to be Submitted

To obtain an LNG Concept Review AIP and associated “LNG Cargo Ready (CC, Concept)” record comment, the following documents are to be submitted:

- Outline Design Specification of the LNG cargo conversion and description of the main systems
- Description of systems or equipment that do not fully comply with the requirements for carriage of LNG outline per Section 2 and how they will be retrofitted at the time of conversion
- Preliminary ship general arrangement, showing location and arrangement of added equipment and systems.
- Boil Off Gas management concept description and preliminary Process Flow Diagram
- Preliminary Electrical Power Balance
- Preliminary trim and stability booklet

Additional plans may be submitted for review to validate addition cargo parameters of the vessel conversion for the carriage of LNG and the associated operations.