

Requirements for

Liquefied Carbon Dioxide Carriers



January 2024



REQUIREMENTS FOR

LIQUEFIED CARBON DIOXIDE CARRIERS
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American Bureau of Shipping
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ABS Plaza
1701 City Plaza Drive
Spring, TX 77389 USA

Foreword

The International Maritime Organization (IMO) has set a goal on Green House Gas Emissions from Ships to reduce the CO₂ emissions per transport work, at an average across international shipping by at least 40% by 2030 when compared to 2008. When compared to 2008, the total annual GHG emissions from international shipping are expected to decrease by at least 20%, aiming for 30% by 2030 and at least 70%, aiming for 80% by 2040. With an increasing interest in reducing GHG emissions, global industries are looking for ways to reduce their carbon emissions either by using alternate clean fuels or low carbon fuels with carbon capture and storage technologies. As more industries adopt carbon capture and storage strategies, the amount of CO₂ captured will be more than is currently used. This surplus CO₂ must be transported to be stored underground in geological formations or utilized in new consumption pathways. Currently, captured carbon dioxide (CO₂) is primarily transported either by pipelines or ships. This has led to an increased demand for dedicated liquefied CO₂ carriers.

The *ABS Rules for Building and Classing Marine Vessels (Marine Vessel Rules)* Part 5C, Chapter 8 has incorporated the International Code for the Construction and the Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) along with the ABS requirements that apply to Vessels Intended to Carry Liquefied Cargoes in Bulk. This document outlines requirements for building and classing liquefied CO₂ carriers where liquefied CO₂ is carried as a cargo in Type C independent tanks.

For requirements applicable to onboard carbon capture technologies, refer to the requirements in *ABS Requirements for Onboard Carbon Capture and Storage*.

The current edition of the *ABS Rules for Building and Classing Marine Vessels* is to be used in association with this document.

This document 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 the document is the most current.

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



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1 Classification Notations

Vessels that are dedicated to the carriage of liquefied carbon dioxide and built to the requirements of this document are to be classed as either **A1 Liquefied Gas Carrier** or **A1 Liquefied Carbon Dioxide Carrier** or **A1 Liquefied Gas Carrier with Independent Tanks**. Whichever notation is selected is to be considered mandatory. The Certificate of Fitness is to indicate that the vessel may carry liquefied carbon dioxide.

Gas carriers approved to carry multiple cargoes are to be classed **A1 Liquefied Gas Carrier**. These vessels are not eligible for the **A1 Liquefied Carbon Dioxide Carrier** notation.

2 Application

These requirements apply to steel vessels, regardless of their size, including those of less than 500 tons gross tonnage, engaged in carriage of liquefied carbon dioxide when carried in bulk in Type C tanks. This document applies to the cargo containment system and related systems.

The ABS *Marine Vessel Rules* cover the remainder of the vessel (hull and machinery requirements) except as modified in this document.

2.1 Use of Low-flash point fuels

This document applies to liquefied CO₂ carriers covered by the IGC Code (5C-8 of the *Marine Vessel Rules*) with traditional fuels. Where liquefied CO₂ carriers use low flash point fuels, the principles of 5C-8 of the *Marine Vessel Rules* associated with vessels using their cargo as fuel will apply for fuel handling and consumers.

3 Reference

With the exception of Section 1/2.1 above, this document, including section numbers, titles, and Appendices, is in accordance with Part 5C-8 of the *Marine Vessel Rules*, except for the following:

- Section 16 “Use of Cargo as Fuel” of the *Marine Vessel Rules* is not applicable to dedicated Liquefied CO₂ Carriers.
- Section 19 “Summary of Minimum Requirements” of the *Marine Vessel Rules* has been replaced by “Survey Requirements” in this document.
- Appendix 5C-8-A1 “Guidelines for the Uniform Application of the Survival Requirements of the Bulk Chemical Code and the Gas Carrier Code” of the *Marine Vessel Rules* is not applicable to dedicated Liquefied CO₂ Carriers.
- Appendix 5C-8-A5 “Reliquefaction System” of the *Marine Vessel Rules* has been incorporated in Section 16 of this document.

- Appendix 5C-8-A6 “Gas Combustion Units/Thermal Oxidizers” of the *Marine Vessel Rules* is not applicable to dedicated Liquefied CO₂ Carriers.
- Appendix 5C-8-A7 “Dual Fuel Diesel and Single Gas Fuel Engines” of the *Marine Vessel Rules* is not applicable to dedicated Liquefied CO₂ Carriers.
- Appendix 5C-8-A8 “Dual Fuel Gas Turbine Propulsion System” of the *Marine Vessel Rules* is not applicable to dedicated Liquefied CO₂ Carriers.

This document includes text from the following:

- a) The International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code), 2014 that came into force on 1 Jan 2016 by resolution MSC.370(93) adopted on 22 May 2014.
- b) Amendments and references to the Code, which include:

<i>IMO Document Number</i>	<i>Date of Adoption of the Amendment</i>	<i>Title of the Document</i>	<i>Entry into Force</i>
MSC.93/Add.1/Corr.3	05 Nov 2015	Correction to Appendix 2	01 Jan 2016
MSC.93/Add.1/Corr.5	22 May 2014	Correction to Appendix 2	17 Oct 2016
Resolution MSC.411(97)	25 Nov 2016	Amendments To The International Code For The Construction And Equipment Of Ships Carrying Liquefied Gases In Bulk (IGC Code)	1 Jan 2020
Resolution MSC.441(99)	24 May 2018	Amendments To The International Code For The Construction And Equipment Of Ships Carrying Liquefied Gases In Bulk (IGC Code)	1 Jan 2020
MSC.1/Circ 1213	15 December 2006	Interpretation and Application of the IGC Code for ships carrying Liquefied Carbon Dioxide in bulk	

The text contained in this document that comes from the IGC Code is presented in italics.

4 General

Section 5C-8-1 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

<i>Marine Vessel Rules Cite</i>	<i>Topic</i>	<i>Applicability</i>
5C-8-1/2.1.1	Classification Notations	See Section 1/1 above.
5C-8-1/2.1.2	Classification Notations	See Section 1/2 above.
5C-8-1/2.1.3	Classification Notations	Not applicable
5C-8-1/2.1.4	Classification Notations	Not applicable
5C-8-1/2.3.1	Classification Notations	The equipment notation referenced in this subsection may be assigned to LCO ₂ carriers. This subsection is applicable by interpreting the term “LNG” as “LCO ₂ ”.

<i>Marine Vessel Rules Cite</i>	<i>Topic</i>	<i>Applicability</i>
5C-8-1/2.3.2	Classification Notations	Not applicable
5C-8-1/3	Format	See Section 1/3 above.
5C-8-1/5(i)	Submission of Data	For LCO ₂ cargo, the following complete cargo specification and data are to be submitted: Full particulars of the intended LCO ₂ cargo and its properties, including LCO ₂ specification and composition, purity, critical point, triple point, maximum vapor pressure, minimum and maximum pressure and temperature during loading, unloading and transit, as applicable, along with loading and carriage procedures.
5C-8-1/5(xv), (xxvi), (xxix), (xxx), (xxxi) and (xxxii)	Submission of Data	Hazardous area drawings and plans relative to the use of cargo as fuel may not be applicable.
5C-8-1/5	Submission of Data	In addition to the list provided in 5C-8-1/5 of the <i>Marine Vessel Rules</i> , the following are to be submitted: <ul style="list-style-type: none"> • Cargo Operations manual, • Inspection/survey plan for the liquefied cargo containment system • Details of reinforcement for cargo tank lifting and strength calculation
5C-8-1/27	Initial Testing	This subsection was replaced by 19/2.5 of this document.
5C-8-1/1.4.1 to 1.4.4	Application and Implementation	Not applicable
5C-8-1/1.5	Application and Implementation	Not applicable
5C-8-1/1.6.1 to 1.6.4	Application and Implementation	Not applicable
5C-8-1/1.7.1.2 and 1.7.2	Application and Implementation	Not applicable
5C-8-1/1.10	Application and Implementation	Not applicable
5C-8-1/2	Definitions	In addition to the definitions listed in 5C-8-1/2, see below definition: Gas dangerous space is a space in which an asphyxiation gas is or may be expected to be present.

SECTION 2

Ship Survival Capability and Location of Cargo Tanks

1 General

Section 5C-8-2 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-2/1.2.1 to 5C-8-2/1.2.3	Not applicable
5C-8-2/1.2.4	Liquefied CO ₂ carriers are to be designed to meet the requirements of Type 3G gas carriers.
5C-8-2/1.4	Not applicable
5C-8-2/4.1.1	Not applicable
5C-8-2/4.1.2	Not applicable
5C-8-2/6.1.1 to 5C-8-2/6.1.4	Not applicable

1 General

Section 5C-8-3 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-3/1.2	A gastight “A-0” class division is acceptable for the segregation of the cargo hold spaces.
5C-8-3/1.3 to 5C-8-3/1.6	Not applicable
5C-8-3/2.2	The requirement is applicable by interpreting the term “hazardous vapours” as “CO ₂ gas”.
5C-8-3/2.3	Not applicable
5C-8-3/2.4.4	Not applicable
5C-8-3/2.5	A-60 class may not be required subject to acceptance by the Administration.
5C-8-3/2.6	The requirement is applicable by interpreting the term “toxic” as “asphyxiant”.
5C-8-3/2.7	Not applicable
5C-8-3/3.1	For the purpose of fire protection, cargo machinery spaces are to meet the requirements of cargo spaces specified in SOLAS Regulation II-2/9.2.3.
5C-8-3/3.4	Not applicable
5C-8-3/3.7	Not applicable
5C-8-3/4.1	For cargo control rooms with entrance not in compliance with 5C-8-3/2.4.1 of the <i>Marine Vesel Rules</i> , A-0 insulation may be considered for compliance with 5C-8-3/4.1.2.2 of the <i>Marine Vessel Rules</i> subject to acceptance by the Administration.
5C-8-3/4.2	Not applicable
5C-8-3/4.3	Not applicable
5C-8-3/5.4 to 5C-8-3/5.6	Not applicable
5C-8-3/6	Not applicable
5C-8-3/7	Not applicable
5C-8-3/8.2	Not applicable

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-3/8.6	Not applicable
5C-8-3/9	Not applicable

SECTION 4 Cargo Containment

1 General

Where applicable to independent Type C tanks, the requirements of 5C-8-4 of the *Marine Vessel Rules* are to be considered for the design, construction, testing, materials and thermal insulation of the cargo containment system for liquefied CO₂, except as shown in the below table.

For further guidance on the Type C tank design including detailed procedures for design loads and load cases, finite element (FE) analysis, and the strength assessment of tank and supporting structures, refer to the *ABS Guidance Notes on Strength Assessment of Independent Type C Tanks*.

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-4/4.1 to 5C-8-4/4.3	Not applicable
5C-8-4/4.5	Not applicable
5C-8-4/5 to 5C-8-4/7	Not applicable
5C-8-4/10.2	For determining insulation performance, only the amount of acceptable boil-off in association with the re-liquefaction plant or other pressure/temperature control system on board is to be considered. The boil-off related to main propulsion machinery is not applicable.
5C-8-4/19.1.1.2	Not applicable
5C-8-4/19.1.4	Not applicable
5C-8-4/19.2	Material requirements of secondary barriers are not applicable
5C-8-4/21	Not applicable
5C-8-4/22	Not applicable
5C-8-4/24 to 5C-8-4/26	Not applicable

SECTION 5

Process Pressure Vessels and Liquid, Vapour, and Pressure Piping Systems

1 General

Section 5C-8-5 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-5/2.1.3 to 5C-8-5/2.1.5	Not applicable
5C-8-5/3.3	Not applicable
5C-8-5/3.4	Not applicable
5C-8-5/4.4	Not applicable
5C-8-5/6.5.1	The requirement is applicable by interpreting the term “toxic” as “asphyxiant”. The cargo sampling systems are to be of a closed loop design.
5C-8-5/6.5.3	Not applicable
5C-8-5/7.3	Not applicable
5C-8-5/7.4	Not applicable
5C-8-5/10.2	Not applicable
5C-8-5/10.3	Not applicable
5C-8-5/11.4	Not applicable
5C-8-5/13.1.1(b)	See Section 19/2.2.1 of this document
5C-8-5/13.1.2 Expansion bellows (ABS)	See Section 19/2.2.2 of this document
5C-8-5/13.1.3(b)	See Section 19/2.2.3 of this document
5C-8-5/13.1.4(d), (e), (f)	See Section 19/2.2.4 of this document
5C-8-5/13.2.4	Not applicable

Material of Construction and Quality Control

1 General

1.1 Applicability

The requirements for metallic and non-metallic materials used in the construction of the cargo containment and associated systems applicable to independent Type C tanks are to be in accordance with Section 5C-8-6 of the *Marine Vessel Rules*. Requirements for secondary barriers and other types of tanks are not applicable to Type C tanks.

1.2 Material Thickness, Testing and Heat Treatment

For requirements related to material thicknesses from 40 mm to 50 mm, service temperatures, Charpy V-notch (CVN) testing and post weld heat treatment (PWHT) or alternatives to post weld heat treatment, refer to *Commentary* under 5C-8-6/Table 1 of the *Marine Vessel Rules*.

Where it is impractical to carry out whole post weld heat treatment for cargo tank due to its large size, local post weld heat treatment is acceptable and is to be performed in accordance with recognized standards. For the local PWHT:

- i) The process needs to be well controlled to prevent the development of high residual stress in other areas.
- ii) Use of full encirclement bands are suggested where possible.
- iii) Encirclement bands are required for nozzles.
- iv) Properly sized soak bands (local heating devices such as heating mats, blankets, panels) are to be used with appropriate gradient control.
- v) Welding Procedure Specifications (WPS) are to be qualified with PWHT, including local or entire full-scale heat treatment.

1.3 Yield Stress Limitation

The application and approval of materials with specified minimum yield stress exceeding 410 N/mm² is dependent upon consultation with and approval by the ABS Materials Department. Refer to 5C-8-6/Table 2 Note #5 of the *Marine Vessel Rules*. Extra High Strength Steels, steels with yield 410 N/mm² and above, may be subject to additional fracture toughness in consideration of the base metal and welds.

1.4 Corrosion Considerations

This subsection is applicable to LCO₂ cargo of reclaimed quality as listed in Section 5C-8-19 of the *Marine Vessel Rules*. The design LCO₂ cargo specifications and the respective corrosive properties of the cargo considered for the design of the cargo handling system are to be submitted (see Section 1/4 – item

5C-8-1/5(i) of this document). Impurities in LCO₂ cargo under different pressures and temperatures in the presence of water can lead to the formation of acids which can influence corrosion and pitting rates of the steel.

The selected materials and corrosion allowances are to be suitable for the corrosive properties of the cargo and are to be submitted for the evaluation of the ABS Materials Department.

The complete cargo specifications, including the corrosive properties of the cargo, are to be included in the Cargo Operations Manual and be available on board for the safe carriage of the cargo. See also 5C-8-18/3 of the *Marine Vessel Rules*.

If alternate LCO₂ cargo specifications are proposed that have impurities exceeding the limits indicated in the design LCO₂ cargo specification reevaluation will be required and details are to be submitted to ABS.

Commentary:

The following guidelines are important factors to address in the application of materials and corrosion rates for LCO₂ cargo:

- i** LCO₂ specification relative to material corrosion: Refer to industry codes or standards for determining suitable materials to withstand corrosion for the storage of LCO₂.
- ii** Establish LCO₂ specification related to the project: In establishing the LCO₂ specification, potential supply sources are to be considered such as steel making, fossil fuel power plants, refineries, cement manufacturing, waste incinerators, exhaust from ship engines, and others. Each industry may produce LCO₂ with different impurities which can affect the corrosion rates.
- iii** The design pressure of the system can influence corrosion rates:

Different considerations need to be given to low pressure (about 7 bar / -50°C) (LP), medium pressure (about 20 bar / -25°C) (MP) and high pressure (about 75 bar / 10°C) (HP) systems. For example, in LP and MP systems, liquefaction and refrigeration will reduce light elements such as H₂, N₂, AR, CO, CH₄ and C₂H₆ to match the solubility in LCO₂ which results in a purer LCO₂ specification. Accordingly, the pre-liquefaction specification and post-liquefaction specification will be different. In HP systems light elements are not removed and the resultant post-liquefaction LCO₂ specification is similar to the pre-liquefaction specification.

- iv** Impurity levels in LCO₂ specifications:

Various studies have developed tables indicating anticipated and allowable impurity levels for pre-liquefaction and post liquefaction of CO₂. In developing limits, various factors are considered such as international standards, corrosion risk, chemical reaction between components (for example NO_x+SO_x+H₂S potentially form free water byproduct, also potential for sulfuric and nitric acid formation), influence on refrigeration, solid particle influence (dust, ash, etc.), toxicity and build-up of toxicity, and thermophysical influence of component constituents.

- v** Critical impurities are as follows:

- a)** Water can lead to operational and technical challenges and its content needs to be low for both pre-liquefaction and post-liquefaction. A lower water content reduces the likelihood of corrosion. LCO₂ specifications generally indicate water ranges between 30 ppm-mol and 70 ppm-mol for LP, MP and HP systems. Higher water values may be tolerated, however there is increased risk of interaction with other impurities, and an increased possibility of corrosion, and therefore control of the other impurities becomes more critical.
- b)** Oxidizing agents O₂, NO₂, SO₂: NO₂ is a principle oxidizing agent and plays a key role in acid-forming reactions. The lowering or complete removal of NO₂ permits the relaxation of limits of other impurities such as SO₂, H₂S and O₂.
- c)** Agents that can damage materials such as hydrogen.
- d)** Toxic components such as H₂S.

- vi** Effects of impurities that alter the bubble point such as N₂, CH₄, and H₂ will influence the LCO₂ phase envelope.

- vii Operational aspects during cargo loading and unloading (including pressure and temperature variations and ingress of moisture) can also affect the thermophysical properties and corrosivity of the LCO₂.

End of Commentary

Cargo Pressure/Temperature Control

1 General

Section 5C-8-7 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-7/1.1.2	Not applicable
5C-8-7/Table 1	Not applicable
5C-8-7/3.1.4	Not applicable
5C-8-7/3 (Cargo-Refrigeration System (ABS))	In addition to the requirements of 5C-8-7/3 of the <i>Marine Vessel Rules</i> (Cargo-Refrigeration System (ABS)), reliquefaction systems where fitted are to be identified as an essential service (refer to 4-8-1/7.3.3 of the <i>Marine Vessel Rules</i>), and the cargo operations manual (5C-8-18/2 of the <i>Marine Vessel Rules</i>) is to consider cargo operations with the use of the reliquefaction system. As an alternative, if the reliquefaction system is fitted but not identified as an essential service, the cargo containment insulation and associated design pressure are to comply with the requirements of “Pressure Accumulation System” specified in 5C-8-7/5 of the <i>Marine Vessel Rules</i> . (refer also Section 16 of this document).
5C-8-7/4	Not applicable
5C-8-7/7	Not applicable

SECTION 8

Vent System for Cargo Containment

1 General

Section 5C-8-8 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-8/2.2	Not applicable
5C-8-8/2.4.2	In addition to the requirements of 5C-8-8/2.4.2 of the <i>Marine Vessel Rules</i> , each PRV piping is to be independent so it can be operable in case there is ice formation in one of the PRVs.
5C-8-8/2.9.2	Not applicable, as per 5C-8-17/21.2 of the <i>Marine Vessel Rules</i> .
5C-8-8/2.10	Not applicable, as per 5C-8-17/21.3 of the <i>Marine Vessel Rules</i> .
5C-8-8/2.11.1	For ships less than 90 m in length, smaller distances may be permitted based on the gas dispersion analysis report which is to be submitted for evaluation.
5C-8-8/2.13	Not applicable
5C-8-8/2.15	Not applicable, as per 5C-8-17/21.3 of the <i>Marine Vessel Rules</i> .
5C-8-8/4 Interpretation (IACS UI GC28)	Not applicable

Cargo Containment System Atmosphere Control**1 General**

Section 5C-8-9 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-9/1.2	Not applicable
5C-8-9/1.3	Not applicable
5C-8-9/1 SOLAS Amendments (ABS)	Not applicable
5C-8-9/2	Not applicable
5C-8-9/4	Not applicable

SECTION 10 Electrical Installations

1 General

Section 5C-8-10 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-10/2.1	Not applicable
5C-8-10/2.2	Hazardous areas are not applicable to liquid CO ₂ .
5C-8-10/2.3 to 5C-8-10/2.5	Not applicable
5C-8-10/2.7 to 5C-8-10/2.11	Not applicable
5C-8-10/2.13	Not applicable
5C-8-10/3.1	Not applicable
5C-8-10/3.2	Where portable cargo pumps are carried onboard the vessel, in addition to the pumps required by 5C-8-5/6.1 of the <i>Marine Vessel Rules</i> , for use in cargo discharge in an emergency, they are to comply with the requirements in 5C-8-10/2.12 of the <i>Marine Vessel Rules</i> . Flexible unarmored cables of the heavy-duty type shown to be suitable for use in a low temperature environment may be specially considered by ABS upon submission of complete cable construction standards.
5C-8-10/3.3	Not applicable

SECTION 11
Fire Protection and Extinction

1 General

Section 5C-8-11 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-11/1.1	The requirements for general cargo ships in SOLAS chapter II-2 are to apply to CO ₂ carriers, irrespective of tonnage including ships of less than 500 tons gross tonnage.
5C-8-11/1.2	Not applicable
5C-8-11/2.1	Irrespective of size, CO ₂ carriers are to comply with the requirements of regulation II-2/10.2 of the SOLAS Convention, as applicable to cargo ships.
5C-8-11/3 to 5C-8-11/6	Not applicable

SECTION 12

Artificial Ventilation in the Cargo Area

1 General

Section 5C-8-12 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-12/1.1	References to toxic and/or flammable vapours are not applicable. The system is to be designed to prevent accumulation of asphyxiant vapours.
5C-8-12/1.3	In addition to the requirements in 5C-8-12/1.3 of the <i>Marine Vessel Rules</i> , the ventilation system is to be designed to take exhaust air from the bottom of the space.
5C-8-12/1.4 to 5C-8-12/1.7	Not applicable
5C-8-12/1.10	Not applicable
5C-8-12/2.3	This subsection is applicable, but fans or blowers are not required to comply with the requirements of 5C-8-12/1.7 of the <i>Marine Vessel Rules</i> .

SECTION 13

Instrumentation and Automation System

1 General

Section 5C-8-13 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-13/2.3	Cargo tank liquid level gauges are to be of a closed type.
5C-8-13/2.3.4	Not applicable
5C-8-13/6	The gas detection system referred in this section is to be interpreted as CO ₂ gas, unless specifically stated for oxygen monitoring
5C-8-13/6.2.2	CO ₂ gas detection is required for hold spaces with Type C tanks, as per 5C-8-17/21.6 of the <i>Marine Vessel Rules</i> .
5C-8-13/6.2.3 to 5C-8-13/6.2.5	Not applicable
5C-8-13/6.2.7	Not applicable
5C-8-13/6.3	The gas detection system is to be designed, installed, and tested in accordance with a recognized standard. Reference to “IEC 60079-29-1 – Explosive atmospheres – Gas detectors” is not applicable.
5C-8-13/6.5	Not applicable
5C-8-13/6.6	Not applicable
5C-8-13/6.7	The CO ₂ gas detection system is to be of continuous detection type. The automatic activation of safety shutdown functions in 5C-8-13/6.9 and 5C-8-16 of the <i>Marine Vessel Rules</i> is not required.
5C-8-13/6.8 to 5C-8-13/6.11	Not applicable
5C-8-13/6.14 to 5C-8-13/6.16	Not applicable
5C-8-13/6.17	Alarms are to be activated when the CO ₂ concentration reaches the set point defined by the Administration. In the absence of a set point defined by the Administration, the alarms are to be set to 5,000 ppm.
5C-8-13/7	Not applicable

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-13/8.1	In addition to the requirements in 5C-8-13/8.1 of the <i>Marine Vessel Rules</i> , the automation systems are also to comply with the applicable requirements of Part 4, Chapter 9 of the <i>Marine Vessel Rules</i> , including specific requirements for Cyber Resilience for vessels and onboard systems and equipment as indicated in 4-9-13 and 4-9-14 of the <i>Marine Vessel Rules</i> .
5C-8-13/9.1	In addition to the requirements in 5C-8-13/9.1 of the <i>Marine Vessel Rules</i> , Integrated Automation systems are also to comply with the applicable requirements of Part 4, Chapter 9 of the <i>Marine Vessel Rules</i> , including specific requirements for Cyber Resilience for vessels and onboard systems and equipment as indicated in 4-9-13 and 4-9-14 of the <i>Marine Vessel Rules</i> .

SECTION 14 Personnel Protection

1 General

Section 5C-8-14 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-14/3.2.1	Each set of safety equipment is to be compatible with that required by Regulation II-2/10.10 of the SOLAS Convention.
5C-8-14/4	Not applicable



SECTION 15 Filling Limits for Cargo Tanks

1 General

Section 5C-8-15 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks.

SECTION 16 Reliquefaction System

1 General

Appendix 5C-8-A5 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

For the application of Appendix 5C-8-A5 of the *Marine Vessel Rules*, the optional **RELIQ** notation may be granted to liquefied CO₂ carriers, provided all applicable requirements in 5C-8-A5 of the *Marine Vessel Rules* are met by interpreting the term "LNG" as "LCO₂".

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-A5/1.5	Electrical bonding (earthing) is not applicable
5C-8-A5/1.5	The FMECA is to include additional risks as listed below: <ul style="list-style-type: none"> • impurities in the CO₂ cargo and its effect on cargo triple point; • asphyxiation; • risk of liquid CO₂ solidification due to loss of pressure; • failure of cargo pumps or cargo vapor handling equipment.
5C-8-A5/5.3	The requirements in this document are applicable for the use of non-flammable refrigerants. Alternately, the use of flammable refrigerants may be considered on a case-by-case basis.
5C-8-A5/7.1	In addition to the requirements of 5C-8-A5/7.1 of the <i>Marine Vessel Rules</i> , automation systems are to meet the applicable requirements of Part 4, Chapter 9 of the <i>Marine Vessel Rules</i>
5C-8-A5/23	Survey During Construction – not applicable. Refer to Section 19 of this Document.

SECTION 17 Special Requirements

1 General

Section 5C-8-17 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-17/1 to 5C-8-17/20	Not applicable
5C-8-17/21.1	Requirements of 5C-8-17/21.1 of the <i>Marine Vessel Rules</i> are applicable, except that the triple point for pure carbon dioxide occurs at 0.417 MPa gauge and -56.6°C.
5C-8-17/21.6	In addition to the requirements of 5C-8-17/21.6 of the <i>Marine Vessel Rules</i> , the required CO ₂ alarms are to be set to the Administration's requirement. In the absence of a set point defined by the Administration, the alarms are to be set to 5,000 ppm.

SECTION 18 Operating Requirements

1 General

Section 5C-8-18 of the *Marine Vessel Rules* is applicable to Liquefied CO₂ Carriers with independent Type C tanks except as follows:

<i>Marine Vessel Rules Cite</i>	<i>Applicability</i>
5C-8-18/2	In addition to the requirements of 5C-8-18/2 of the <i>Marine Vessel Rules</i> , the complete cargo specifications, including the composition and corrosive properties of the cargo and corrosion allowances as listed in 5C-8-18/3 of the <i>Marine Vessel Rules</i> , are to be included in the Cargo Operations Manual.
5C-8-18/3.1.2	Not applicable
5C-8-18/4.2	Not applicable
5C-8-18/4.3	Not applicable
5C-8-18/8.2	Not applicable
5C-8-18/8.3	Not applicable
5C-8-18/9.4	Not applicable
5C-8-18/10.3.2	In addition to the requirements in 5C-8-18/10.3.2 of the <i>Marine Vessel Rules</i> , the use of fusible elements in the emergency shutdown system is not required.
5C-8-18/10.3 Table 1	5C-8-18/10.3 Table 1 of <i>Marine Vessel Rules</i> modified as indicated below.
5C-8-18/11.1	Reference to insulation systems contaminated with hydrocarbons is not applicable.
5C-8-18/12	Applicable operating requirements of the <i>Marine Vessel Rules</i> : 5C-8-2/2.2, 5C-8-2/2.5, 5C-8-2/2.8, 5C-8-3/8.3, 5C-8-3/8.5, 5C-8-5/3.2, 5C-8-7/1, 5C-8-8/2.7, 5C-8-8/2.8, 5C-8-8/2.9, 5C-8-9/3, 5C-8-12/1.1, 5C-8-13/1.3, 5C-8-13/3.6, 5C-8-13/6.18, 5C-8-14/3.3, 5C-8-15/3, 5C-8-15/6, 5C-8-17/21, 5C-8-17/22.

TABLE 1
ESD Functional Arrangements (1 July 2021)

	<i>Pumps</i>		<i>Compressor Systems</i>		<i>Valves</i>	<i>Link</i>
	<i>Cargo pumps/cargo booster pumps</i>	<i>Spray/stripping pumps</i>	<i>Vapour return compressors</i>	<i>Reliquefaction plant*** including condensate return pumps, if fitted</i>	<i>ESD valves</i>	<i>Signal to ship-shore link****</i>
<i>Shutdown action</i> → <i>Initiation</i> ↓						
<i>Emergency push buttons</i> (See 18/10.3.1 of MVR)	✓	✓	✓	✓	✓	✓
<i>Fire detection on deck or in compressor house*</i> (See 18/10.3.2 of MVR)	✓	✓	✓	✓	✓	✓
<i>High level in cargo tank</i> (See 13/3.3 of MVR)	✓	✓	✓	<i>Note 1</i> <i>Note 2</i>	<i>Note 4</i>	✓
<i>Signal from ship/shore link</i> (See 18/10.1.4 of MVR)	✓	✓	✓	<i>Note 2</i>	✓	N/A
<i>Loss of motive power to ESD valves**</i>	✓	✓	✓	<i>Note 2</i>	✓	✓
<i>Main electric power failure ("blackout")</i>	<i>Note 5</i>	<i>Note 5</i>	<i>Note 5</i>	<i>Note 5</i>	✓	✓
<i>Level alarm override</i> (See 13/3.7 of MVR)	<i>Note 3</i>	<i>Note 3</i>	✓	<i>Note 1</i>	✓	✓

Note 1: These items of equipment can be omitted from these specific automatic shutdown initiators, provided the equipment inlets are protected against cargo liquid ingress.

Note 2: If the reliquefaction plant compressors are used for vapour return/shore line clearing, they are to be included in the ESD system when operating in that mode.

Note 3: The override system permitted by 5C-8-13/3.7 of the Marine Vessel Rules may be used at sea to prevent false alarms or shutdowns. When level alarms are overridden, operation of cargo pumps and the opening of manifold ESD valves are to be inhibited except when high-level alarm testing is carried out in accordance with 5C-8-13/3.5 of the Marine Vessel Rules (see 5C-8-18/10.3.4 of the Marine Vessel Rules).

Interpretation of Table 1

In applying the second sentence of Note 3, 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.

Note 4: The sensors referred to in 5C-8-13/3.2 of the Marine Vessel Rules may be used to automatically close the tank filling valve for the individual tank where the sensors are installed, as an alternative to closing the ESD valve referred to in 5C-8-18/10.2.2 of the Marine Vessel Rules. If this option is adopted, activation of the full ESD system are to be initiated when the high-level sensors in all the tanks to be loaded have been activated.

- Note 5: These items of equipment are to be designed not to restart upon recovery of main electric power and without confirmation of safe conditions.*
- * Electronic point temperature monitoring or area fire detection may be used for this purpose on deck.*
 - ** Failure of hydraulic, electric or pneumatic power for remotely operated ESD valve actuators.*
 - *** Indirect refrigeration systems which form part of the reliquefaction plant do not need to be included in the ESD function if they employ an inert medium such as nitrogen in the refrigeration cycle.*
 - **** Signal need not indicate the event initiating ESD.*
 - ✓ Functional requirement.*
 - N/A Not applicable.*

1 General

This Subsection applies to surveys during fabrication at the manufacturer's facility, and installation and testing of machinery and electrical systems onboard the Liquefied CO₂ carrier. For surveys at the manufacturer's facility, the scope of the survey will be confined to only those items that are supplied by the manufacturer.

2 Survey During Construction

2.1 Surveys at Manufacturer's Facility

Certification of the complete cargo tanks and handling system cannot be accepted based only on the ABS Type Approval Program, and therefore ABS Surveyor's attendance is required during fabrication for unit certification. However, component parts of the unit can be certified in accordance with the ABS Product Quality Assurance (PQA) Certification system outlined in Appendix 1-1-A3 of the *ABS Rules for Conditions of Classification (Part 1)*.

When Surveyor's attendance at the shop of the manufacturer and at the assembly site is required by the applicable Rules, the manufactured/assembled system components will be verified for compliance with the aforementioned Rules. Surveyor's attendance is typically required to:

- i)* Confirm that the facility manufacturing, fabricating or repairing reliquefaction systems or their components possess and maintain a quality-control program effectively covering design, procurement, manufacturing and testing, as applicable, and which meets the requirements of a recognized standard applicable to their product.
- ii)* Qualify or verify welder's qualifications, welding procedure specifications and corresponding weld procedure qualification records to the satisfaction of the attending Surveyor.
- iii)* Verify material certificates/documentations, particularly for materials of piping, main pressure retaining parts of valves, including safety valves that have flanged or threaded ends or other specialty fittings. Witness of material testing where required by the Marine Vessel Rules.
- iv)* Survey final weldments.
- v)* Witness, as far as deemed necessary, weld nondestructive examination tests and to review records of nondestructive examinations.
- vi)* Witness pressure and/or proof-load testing of equipment components and as a unit, as applicable and as called for in the fabrication procedures.
- vii)* Witness testing of subassemblies and completed units as called for in the fabrication procedures.
- viii)* Verify all certified safe systems, motor controllers, consoles and instrumentation and control panels are in compliance with approved drawings.

- ix) Carry out other inspections and to witness the final Factory Acceptance Test (FAT) as agreed upon during prefabrication meeting.

2.2 Equipment Survey

For survey during construction of various equipment and systems, the survey is to include the applicable requirements of 5C-8-1/4, 5C-8-1/21, 5C-8-4/3.6, 5C-8-5/13, 4-1-1 and 5C-8 of the *Marine Vessel Rules*.

2.2.1 Valves Unit Production Testing

In addition to 5C-8-5/13.1.1 of the *Marine Vessel Rules*, all valves intended to be used at a working temperature below -55°C are to be tested at the manufacturer's plant in the presence of the Surveyor. Testing is to include a hydrostatic test of the valve body at a pressure equal to 1.5 times the design pressure for all valves, and seat and stem leakage test at a pressure equal to 1.1 times the design pressure for valves other than safety valves. In addition, cryogenic testing consisting of valve operation and leakage verification for a minimum of 10% of each type and size of valve for valves other than safety valves intended to be used at a working temperature below -55°C . The set pressure of safety valves is to be tested at ambient temperature.

For valves used for isolation of instrumentation in piping not greater than 25 mm (nominal diameter), unit production testing need not be witnessed by the Surveyor. Records of testing are to be made available for review.

As an alternative to the above, the manufacturer may request ABS to certify a valve subject to the following:

- i) The valve has been prototype tested as required by 5C-8-5/13.1.1(a) of the *Marine Vessel Rules* for valves intended to be used at a working temperature below -55°C , and
- ii) The manufacturer has a recognized quality system that has been assessed and certified by ABS subject to periodic audits, and
- iii) The quality control plan contains a provision to subject each valve to a hydrostatic test of the valve body at a pressure equal to 1.5 times the design pressure for all valves and seat and stem leakage test at a pressure equal to 1.1 times the design pressure for valves other than safety valves. The set pressure of safety valves is to be tested at ambient temperature. The manufacturer is to maintain records of such tests, and
- iv) Cryogenic testing consisting of valve operation and leakage verification for a minimum of 10% of each type and size of valve for valves other than safety valves intended to be used at a working temperature below -55°C in the presence of the Surveyor.

2.2.2 Expansion Bellows Unit Production Testing

In addition to 5C-8-5/13.1.2 of the *Marine Vessel Rules*, expansion bellows prototype tests are to be witnessed in the presence of the Surveyor.

2.2.3 Cargo Pumps - Unit Production Testing

In addition to 5C-8-5/13.1.3 of the *Marine Vessel Rules*, all pumps are to be tested at the manufacturer's plant in the presence of the Surveyor. Testing is to include a hydrostatic test of the pump body equal to 1.5 times the design pressure and a capacity test. For submerged electric motor driven pumps, the capacity test is to be carried out with the design medium or with a medium below the minimum working temperature. For shaft driven deep well pumps, the capacity test may be carried out with water.

As an alternative to the above, if so requested by the manufacturer, the certification of a pump may be issued subject to the following:

- i) The pump has been approved as required by 5C-8-5/13.1.3(a) of the *Marine Vessel Rules*, and

- ii) The manufacturer has implemented a recognized quality system that has been assessed and certified by ABS subject to periodic audits, and
- iii) The quality control plan contains a provision to subject each pump to a hydrostatic test of the pump body equal to 1.5 times the design pressure and a capacity test. The manufacturer is to maintain records of such tests.

2.2.4 Gas Compressors - Unit Production Testing

In addition to 5C-8-5/13.1.4 of the *Marine Vessel Rules*, each compressor is to be tested at the plant of manufacture in the presence of the Surveyor. Testing is to include hydrostatic test of the compressor pressure boundary components.

The hydrostatic test is to be carried out at a pressure equal to 1.5 times the design pressure for a period of no less than 30 minutes.

2.2.4(a) Alternative Certification

As an alternative to certification of mass-produced compressors as specified above, the manufacturer may request that ABS carry out design assessment and list the compressor under the Type Approval Program. To be design assessed under this program:

- i) The manufacturer is to submit drawings and apply for a Product Design Assessment based on compliance with recognized standards as specified in 1-1-A3/5.1 of the *ABS Rules for Conditions of Classification (Part 1)*,
- ii) A sample of the compressor type is to be subjected to hydrostatic and capacity tests, and relief valve capacity test specified in 5C-8-5/13.1.4(a) and 5C-8-5/13.1.4(b) of the *Marine Vessel Rules*. Compressors so assessed may be accepted by ABS for listing on the ABS website in the Type Approved Products Index (TA),
- iii) The manufacturer is to operate a quality assurance system which is to be certified for compliance with a quality standard in accordance with 1-1-A3/5.5 Tier 4 (PQA) of the *ABS Rules for Conditions of Classification (Part 1)*. The quality control plan is to include provisions to subject each production unit to tests specified in 19/2.2.4 above. The manufacturer is to submit the record of such tests to the local ABS office, who will then finalize the Unit Certification. Compressors that meet these requirements will be denoted in the ABS Type Approval Product Listing.

2.2.4(b) Compressor Installation

Upon installation on board, the complete compressor assembly connected to the vessel systems is to be subjected to a leak test using air or other suitable medium, to a pressure depending on the leak detection method applied. The test is to be performed in the presence of the Surveyor and considered satisfactory if no leaks are observed.

2.2.5 BOG Compressors

- i) The compressors are to be designed and tested in accordance with 5C-8-5/13.1.4, 5C-8-17/21 and 5C-8-17/22 of the *Marine Vessel Rules*.
- ii) For pressure and temperature measurement and control, see 5C-8-A5/23.7 Table 1 of the *Marine Vessel Rules*.

2.2.6 CO₂ Pumps

- i) The pumps are to be designed and tested in accordance with 5C-8-10/2.12 of the *Marine Vessel Rules* and 19/2.2.3 above.

2.2.7 Compressors/Expanders

- i) Certification of compressors is to be in accordance with 5C-8-A5/13.1.4 of the *Marine Vessel Rules*.

- ii) Air-cooled compressors are to be designed for an air temperature of 45°C (113°F) or cooler. Water-cooled compressors are to be designed for a sea water temperature 32°C (90°F) or cooler. Where a water chilling system is required for the operation of the reliquefaction system, the water chilling system is also to comply with 5C-8-A5/5 of the *Marine Vessel Rules*.
- iii) For instrumentation, monitoring and control system for the compressors, see 5C-8-A5/23.7 Table 1 of the *Marine Vessel Rules*.

2.2.8 Cryogenic Heat Exchange and Cold Box

The heat exchangers are to be certified in accordance with 5C-8-5/1.2 and Section 4-4-1 of the *Marine Vessel Rules*.

2.2.9 Electrical Equipment for Cargo or Vapor Handling Services

The rotating machines of 100 kW and over and their control units for the cargo or vapor handling services are to be shop tested in the presence of the Surveyor in accordance with 4-1-1/Table 3 of the *Marine Vessel Rules*. See also 4-8-3/3 and 4-8-3/5 of the *Marine Vessel Rules*.

2.2.10 Cargo Tanks and Process Pressure Vessels

All cargo tanks and process pressure vessels are to be subjected to hydrostatic or hydropneumatic pressure testing in accordance with 5C-8-4/20.3 of the Marine Vessel Rules, as applicable for Type C independent tanks. See 5C-8-4/23.6 of the Marine Vessel Rules.

2.2.10(a)

All tanks are to be subjected to a tightness test which may be performed in combination with the pressure test referred to in 19/2.2.10 above.

2.2.10(b)

The Administration may require that for ships fitted with tanks designed according to 5C-8-4/27 of the Marine Vessel Rules at least one prototype tank and its supporting structures is to be instrumented with strain gauges or other suitable equipment to confirm stress. Similar instrumentation may be required for Type C independent tanks depending on their configuration and on the arrangement of their supports and attachments.

2.2.10(c)

The overall performance of the cargo containment system is to be verified for compliance with the design parameters during the full loading and discharging of the cargo in accordance with the survey procedure and requirements in 5C-8-1/4 of the Marine Vessel Rules and the requirements of the Administration or recognized organization acting on its behalf. Records of the performance of the components and equipment essential to verify the design parameters are to be maintained and be available to the Administration.

2.2.10(d)

The cargo containment system is to be inspected for cold spots during, or immediately following the first loaded voyage. Inspection of the integrity of thermal insulation surfaces that cannot be visually checked is to be carried out in accordance with recognized standards.

2.2.11 Reliquefaction Systems

The reliquefaction plant is to be certified in accordance with 5C-8-7/3 and 5C-8-5A of the *Marine Vessel Rules*. The optional **RELIQ** notation will be assigned upon request.

2.3 Surveys During Installation

The following surveys are to be carried out to the satisfaction of the attending Surveyor on the machinery and electrical systems during installation and testing:

- i) Piping systems are to be visually examined and pressure-tested, as required by the *Marine Vessel Rules*.
- ii) Electrical wiring and connections are to be in accordance with Part 4, Chapter 8 of the *Marine Vessel Rules* and checked for continuity and proper workmanship.
- iii) Instrumentation is to be tested to confirm proper operation as per its predetermined set points.
- iv) Pressure relief and safety valves are to be tested.
- v) Control system and shutdowns are to be tested for proper operation.
- vi) The machinery and electrical systems are to be checked for proper operation.

2.4 Surveys During Trials

During the initial gas trials, the machinery and electrical systems are to be confirmed for their satisfactory operation, including associated controls, alarms and shutdowns. The tests are to be conducted in accordance with ABS-approved testing procedure during gas trials. The machinery and electrical systems are to be run while the vessel is underway at sea and the propulsion system operating over its full range of power, demonstrating adequacy of the cargo handling system to deal with the boil-off gas.

2.5 Initial Testing of Cargo System

2.5.1 Type C Tanks

A hydrostatic test on Type C pressurized tanks is to be carried out in accordance with 5C-8-4/23.6 of the *Marine Vessel Rules*.

For further guidance on Type C tank testing, reference can be made to the *ABS Guidance Notes on Strength Assessment of Independent Type C Tanks*.

2.5.2 First Loading for Liquefied CO₂ Carriers (considered to be full loading)

- i) Priority to be given to latter stages of loading (approximately last 6 hours).
- ii) Review cargo logs and alarm reports.
- iii) Witness satisfactory operation of the following:
 - a) Gas detection system.
 - b) Cargo control and monitoring systems such as level gauging equipment, temperature sensors, pressure gauges, cargo pumps and compressors, and proper control of cargo heat exchangers, if operating.
 - c) Nitrogen generating plant or inert gas generator, if applicable.
 - d) Nitrogen or inert gas pressure control system for insulation and annular spaces, if applicable.
 - e) Cofferdam heating system, if in operation.
 - f) Means provided to remove any moisture from the cargo tanks to avoid acid formation.
 - g) Reliquefaction plant, if fitted, refer to 5C-8-A5 of the *Marine Vessel Rules* for further details.
- iv) Examination of on-deck cargo piping systems including expansion and supporting arrangements.
- v) Witness topping off process for cargo tanks including high level alarms activated during normal loading.
- vi) Advise Master to carry out cold spot examination of the hull and external insulation during transit voyage to unloading port.

2.5.3 First Unloading for Liquefied CO₂ Carriers

- i)* Priority to be given to the commencement of unloading (approximately first 4 - 6 hours).
- ii)* Witness emergency shutdown system testing prior to commencement of unloading.
- iii)* Review cargo logs and alarm reports.
- iv)* Witness satisfactory operation of the following:
 - a)* Gas detection system.
 - b)* Cargo control and monitoring systems such as level gauging equipment, temperature sensors, pressure gauges, cargo pumps and compressors, and proper control of cargo heat exchangers, if operating.
 - c)* Nitrogen generating plant or inert gas generator, if applicable.
 - d)* Nitrogen or inert gas pressure control system for insulation and annular spaces, if applicable.
 - e)* Cofferdam heating system, if in operation.
 - f)* Means provided to remove any moisture from the cargo tanks to avoid acid formation.
 - g)* Reliquefaction plant and review of records from previous voyage.
- v)* Examination of on-deck cargo piping systems including expansion and supporting arrangements.
- vi)* Obtain written statement from the Master that the cold spot examination was carried out during the transit voyage and found satisfactory. Where possible, the surveyor is to examine selected spaces.

2.5.4 Ballast or Fuel Oil Tanks

Requirements for testing are contained in Section 3-7-1 of the *Marine Vessel Rules*.

3 Survey After Construction

See specific sections 7-3-2/1.13.8, 9 & 10, 7-3-2/3.11.2 & 3, 7-3-2/5.11, 7-6-2/1.5 and 7-6-2/3.3.3 of the *ABS Rules for Survey After Construction (Part 7)*, for survey requirements for vessels in service intended to carry liquefied CO₂ gases.