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Ships and marine technology — Specification for bunkering of liquefied natural gas fuelled vessels

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 8, *Ships and marine technology*.

Introduction

This document has been produced to meet an industry need identified by the International Maritime Organization (IMO). This document has been designed to support the IMO International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code).

Due to numerous economic and environmental factors, the use of liquefied natural gas (LNG) as a vessel's fuel has increased. While LNG fuelled ships and vessels have been in service for over 10 years, most of these vessels have operated within small defined areas using LNG bunkering operations designed for that particular vessel service. The increase in LNG fuelled vessels corresponds with an increase in the number of the regions that these vessels will service. Therefore, there is a need to standardize LNG bunkering operations internationally to a reasonable degree so that vessel operators will have the tools to select vessel fuel providers that meet set safety and fuel quality standards and LNG bunkering operations will be conducted safely. This document can be used for both vessels involved in international and domestic service regardless of size.

This document does not replace existing laws or regulations. It is flexible so that it can be applied in many situations and under various regulatory regimes as long as the requirements of this document are met. If, however, local regulations preclude its use and do not provide the safety specified in this document, compliance with this document should not be claimed.

Ships and marine technology — Specification for bunkering of liquefied natural gas fuelled vessels

1 Scope

This document sets requirements for LNG bunkering transfer systems and equipment used to bunker LNG fuelled vessels, which are not covered by the IGC Code. This document includes the following five elements:

a) hardware: liquid and vapour transfer systems;

b) operational procedures;

c) requirement for the LNG provider to provide an LNG bunker delivery note;

d) training and qualifications of personnel involved;

e) requirements for LNG facilities to meet applicable ISO standards and local codes.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16904, *Petroleum and natural gas industries — Design and testing of LNG marine transfer arms for conventional onshore terminals*

ASME B16.5, *Pipe flanges and flanged fittings: NPS 1/2 through NPS 24 metric/inch standard*

BS 4089, *Specification for metallic hose assemblies for liquid petroleum gases and liquefied natural gases*

EN 1474-2, *Installation and equipment for liquefied natural gas — Design and testing of marine transfer systems — Design and testing of transfer hose*

EN 1474-3, *Installation and equipment for liquefied natural gas — Design and testing of marine transfer systems — Offshore transfer systems*

EN 12434, *Cryogenic vessels — Cryogenic flexible hoses*

IEC 60079-10-1, *Explosive atmospheres — Part 10-1: Classification of areas — Explosive gas atmospheres*

IMO International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code)

IMO International Code of the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)

Oil Companies International Marine Forum. *Design and Construction Specification for Marine Loading Arms*. Third edition, 1999. London, England: Oil Companies International Marine Forum

Society of International Gas Tanker and Terminal Operators (SIGTTO). *ESD Arrangements & Linked Ship/Shore Systems for Liquefied Gas Carriers* [online]. First edition, 2009. Scotland, UK: Witherby Seamanship International Ltd

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
bunkering
operation of transferring LNG fuel to a *vessel* (3.22)

Note 1 to entry: For the purposes of this document, it refers to the delivery of LNG only. This document does not address the transfer of CNG, propane or fuels other than LNG that may be covered by the IGF Code (see 3.2).

3.2
bunkering terminal
fixed operation on or near shore that is not regulated as a *vessel* (3.22) that can be used to provide LNG bunkers to a receiving vessel

3.3
classed
classification
process in which the design and condition of a *vessel* (3.22) is evaluated to determine its compliance with rules and standards developed by the *Classification Society* (3.5) issuing the classification

3.4
controlled zones
areas extending from the bunkering manifolds on the LNG receiving vessel and the LNG supply source during LNG bunkering operations that have restrictions in place

Note 1 to entry: These restrictions include limitation on personnel access, sources of ignition and unauthorized activities. The controlled zones are subdivided into hazardous zones, safety zones and the monitoring and security areas as defined in Annex B.

3.5
Classification Society
non-governmental organization that establishes and maintains technical standards for the construction and operation of ships and offshore structures

Note 1 to entry: They also validate that construction is according to these standards and carry out regular surveys in service to verify compliance with the standards.

3.6
dry-disconnect
method that reduces *LNG* (3.10) or natural gas releases into the atmosphere under normal operation to a negligible amount consistent with safety, either by equipment design or procedural practice

3.7
emergency release (break-away) coupling
ERC
coupling installed on *LNG* (3.10) and vapour lines, as a component of ERS, to ensure the quick physical disconnection of the transfer system from the unit to which it is connected, designed to prevent damage to loading/unloading equipment in the event that the transfer system's operational envelope and/or parameters are exceeded beyond a predetermined point

3.8
emergency release system
ERS
system that provides a safe shut down, transfer system isolation and quick release of hoses or *transfer arms* (3.19) between the facility or *vessel* (3.22) providing the *LNG* (3.10), and the vessel receiving the LNG, preventing product release at disconnection time

Note 1 to entry: The ERS consists of an emergency release coupling (ERC) and interlocked isolating valves which automatically close on both sides, thereby containing the LNG or vapour in the lines (dry disconnect), and, if applicable, associated control system.

3.9
emergency shutdown system
ESD
system that safely and effectively stops the transfer of *LNG* (3.10) and vapour between the facility or *vessel* (3.22) providing the LNG and the vessel receiving the LNG or vice versa

Note 1 to entry: The operation of this system can be referred to as an "ESD I". Vessel ESD systems should not be confused with other emergency shutdown systems within the terminal or on board vessels.

Note 2 to entry: An informative illustration of an ESD I and ESD II is provided in Figure C.2.

3.10
liquefied natural gas
LNG
natural gas that has been cooled and condensed into liquid form

Note 1 to entry: It is characterized as a cryogenic liquid having a temperature typically around −161 °C under normal atmospheric pressure.

3.11
lower flammable limit
LFL
concentration of flammable gas or vapour in air below which there is insufficient amount of substance to support and propagate combustion

3.12
management system
set of procedures an organization needs to follow in order to meet its objectives

3.13
member state authority
legal authority within a member state that has jurisdiction over maritime or port activities within that state

3.14
mobile facility
mobile facilities are trucks, rail car or other mobile device (including portable tanks) used to transfer *LNG* (3.10) to a *vessel* (3.22)

3.15
monitoring and security area
area around the bunkering facility and *vessel* (3.22) where vessel traffic and other activities are monitored to mitigate harmful effects

3.16
recognized organization
competent organization with delegated authority on behalf of an Administration to assist in the uniform and effective implementation of IMO Codes and Conventions

Note 1 to entry: Adapted from IMO A.739(18).

3.17
LNG transfer system
consists of all equipment contained between the bunkering manifold flange on the facility or *vessel* (3.22) providing LNG fuel and the bunkering manifold flange on the receiving LNG fuelled vessel including but not limited to; vessel to vessel transfer arms, LNG transfer arms (articulated rigid piping) or hoses, *emergency release system (ERS)* (3.8), insulation flanges; quick connect/disconnect couplings (QC/DC), and in addition the ESD ship/shore or ship/ship link used to connect the supplying and receiving ESD systems

Note 1 to entry: An illustration of a typical LNG transfer system is provided in Figure C.1.

3.18
technical standards
standards that prescribe requirements for one or more of the following: operations, equipment design/fabrications or testing methodology

Note 1 to entry: Auditors cannot issue a certification or approval to a company that claims compliance with a Technical Standard unless that standard is incorporated into a recognized management system as a management objective.

3.19
transfer arm
articulated metal transfer system used for transferring *LNG* (3.10) to the *vessel* (3.22) being bunkered

Note 1 to entry: It can be referred to as a "loading arm" or "unloading arm".

3.20
safety zone
area around the bunkering station where only dedicated and essential personnel and activities are allowed during *bunkering* (3.1)

3.21
security zone
area established by the national or local authorities around a bunkering facility or area through which *vessel* (3.22) and personnel movement is subject to regulatory restrictions

3.22
vessel
includes ships, barges (self-propelled or no propulsion) or boats of any size in domestic or international service

Note 1 to entry: A bunkering vessel is a vessel used to transport LNG to a vessel using LNG as a fuel.

Note 2 to entry: A receiving vessel is a vessel that uses LNG as a fuel and does not transport LNG as a cargo.

4 Abbreviated terms

Term	Description	Explanation
IGC Code	International Maritime Organization's International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk	The IGC Code applies to ships involved in the carriage of bulk liquefied gases and prescribes the design and construction standards of ships involved in such carriage and the equipment they should carry.
IGF Code	International Maritime Organization's International Code of Safety for Ships using Gases or other Low-flashpoint Fuels, 2017	The IGF Code applies to ships fuelled by gases or other low-flashpoint fuels. The Code contains mandatory provisions for the arrangement, installation, control and monitoring of machinery, equipment and systems using low-flashpoint fuels.
IACS	International Association of Classification Societies	An organization that establishes, reviews, promotes and develops minimum technical requirements in relation to the design, construction, maintenance and survey of ships and other marine related facilities; and assists international regulatory bodies and standards organizations to develop, implement and interpret statutory regulations and industry standards in ship design, construction and maintenance, with a view to improving safety at sea and the prevention of marine pollution.
IMO	International Maritime Organization	A specialized agency of the United Nations whose purpose is "to provide machinery for cooperation among governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade; to encourage and facilitate the general adoption of the highest practicable standards in matters concerning efficiency of navigation, and prevention and control of marine pollution from ships."
ISM	International Safety Management Code	An IMO code that provides an international standard for the safe management and operation of ships and for pollution prevention.
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers	This convention promotes the safety of life and property at sea and the protection of the marine environment by establishing in common agreement international standards of training, certification and watchkeeping for seafarer.
SGMF	Society for Gas as a Marine Fuel	A non-governmental organization established to promote safety and industry best practice in the use of gas as a marine fuel.

5 Transfer system design requirements

5.1 Vessel requirements

5.1.1 In order to be compliant with this document, vessels involved shall meet the following requirements (this applies to vessels of all sizes, in domestic or international service):

5.1.2 Bunkering vessels shall conform with this document and be approved by its Flag State, Recognized Organization or Classification Society that complies with the applicable uniform interpretations and requirements posted by IACS, indicating that it meets, at a minimum, the applicable requirements of the IGC Code, this document and applicable Flag State requirements.

5.1.3 Receiving vessels shall conform with this document and be approved by its Flag State, Recognized Organization or Classification Society that complies with the applicable uniform interpretations and requirements posted by IACS, indicating that it meets, at a minimum, the applicable requirements of the IGF Code, this document and applicable Flag State requirements.

5.2 Facility requirements

5.2.1 Mobile facilities (e.g. tank trucks, rail cars and portable tanks) including their tanks, piping, hoses, pumps and valves shall be fabricated and conform to meet ISO or other standards recognized by national standards bodies that are ISO members for handling cryogenic liquids.

5.2.2 The bunkering terminal shall conform to local codes. If local codes do not address LNG bunkering terminals, the terminal operator shall obtain a document issued by a competent organization or individual such as a qualified engineer confirming the terminal conforms to the applicable sections of standards published by ISO and ISO member organizations as well as guidance published by SGMF.

5.3 Transfer equipment requirements

5.3.1 All equipment used in the transfer system shall meet the requirements defined for that specific piece of equipment as prescribed in 5.3 to 5.5. The use of liquid nitrogen as a substitute for LNG during testing of the equipment by the equipment manufacturers is acceptable.

5.3.2 All the components of the transfer system through which LNG or natural gas flow shall be rated for the maximum transfer system design pressure but shall have a pressure rating of no less than 1 034 MPa. All flanges shall be at least Class 150 in accordance with ASME B16.5 and of the weld-neck type.

5.3.3 All the components of the transfer system shall be fabricated to meet or exceed the applicable sections of the standards indicated in Table 1 the IGC/IGF Codes, in addition to other requirements listed in this document.

Table 1 — Standards containing requirements applicable to transfer system components

Component	Function	Standard(s)
Hoses	Transfer of LNG and natural gas	EN 1474-2 or EN 12434 or BS 4089
Swivel joints	Product line articulation	ISO 16904
Flanges	Product line connections	ASME B16.5
Bearings	Articulation of support structure	ISO 16904
ERS	Emergency disconnect	ISO 16904
Breakaway coupling	Emergency disconnect	ISO 16904
Transfer arms	LNG bunkering loading solution	ISO 16904
Other transfer system	LNG bunkering loading solution	ISO 16904

5.3.4 Flow rate of LNG through the transfer system shall not exceed 12 m/s, however, higher speeds can be locally acceptable in reduced passages, for example in the ERS, provided cavitation and vibration is acceptable.

5.4 Emergency shutdown and release systems

5.4.1 The LNG transfer system shall be fitted with an emergency release system (ERS) and connected to an emergency shutdown system (ESD). The delivery facility and receiving vessel ESD systems shall be interconnected with a ship/shore or ship/ship ESD link to ensure the coordinated operation of both the delivery and receiving ESD systems and ERS.

5.4.1.1 The ERS shall be designed to protect the transfer system and the connections by disconnecting the transfer system, primarily should the vessel drift out of their operating envelope. The ERS shall consist of an emergency release coupling (ERC) including interlocked isolating valves to minimize loss of LNG or NG when the ERC is activated.

5.4.1.2 The ESD shall be designed to be activated by operator-initiated signals as well as sensor input and when activated, initiate shutting down the LNG transfer pumps and closing of the ESD valves. At a minimum, they will include sensors that will provide input in the event of

— fire or gas detection,

— power failure,

— LNG tanks being overfilled,

— abnormal pressure in the transfer system,

— vessel drifting out of position,

— low temperature in the drip tray, and

— loading arm being overstressed.

NOTE An illustration of the ESD initiators is provided in Figures C.3 and C.4.

5.4.2 The ESD link shall be designed to conform to the requirements specified in Appendix D or H of *ESD Arrangements & Linked Ship/Shore Systems for Liquefied Gas Carriers*.

5.4.3 The emergency release system (ERS) shall be designed to operate as a dry break system and conform to the following requirements.

— Designed to separate before the hose or loading arm is overstressed. This calculated force or bending moment is to be recorded. The system shall be capable of actuation both automatically on vessel drift or manually from a remote location.

— Designed to operate with ESD I and ESD II stage systems.

— Designed to maintain integrity without leakage following ESD II while LNG is being transferred at maximum flow (for example, ESD II, “may” and “should” were replaced with “shall” throughout the document when they were part of a requirement without ESD I).

— The consequences of an emergency breakaway in terms of resultant surge pressures are to be determined and demonstrated to be within the capability of the supply system to not exceed the design pressure.

— Designed so that ice that forms during or after transfer will not impede the function of the coupling or its emergency release collar when used in accordance with the manufacturer’s directions.

5.4.4 The design for the ERS shall take into account drifting scenarios commensurate with the surrounding environment and location. A study shall be undertaken to simulate and determine the acceleration and velocity of drift likely to occur due to a possible failure of the mooring system, taking into consideration the range of vessels that are likely to use the terminal. The study shall take into account, as a minimum, the following:

— wind speeds and direction;

— current and bank effect;

— tidal range;

— waves and swell height, period and direction;

— surge from passing vessels;

— inadvertent operation of vessel’s propulsion or of mooring system;

— ice flows.