International Standard

ISO 11982

Refrigerated hydrocarbon and non-petroleum based liquefied gaseous fuels — Liquefied Natural Gas (LNG) as marine fuel — Measurement on board LNG bunkering ship

Hydrocarbures réfrigérés et combustibles gazeux liquéfiés à base non pétrolière — Utilisation du Gaz Naturel Liquéfié (GNL) comme combustible marin — Mesurage à bord des navires avitailleurs de GNL

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Foreword

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This document was prepared by Technical Committee ISO/TC 28, *Petroleum and related products, fuels and lubricants from natural or synthetic sources*, Subcommittee SC 5, *Measurement of refrigerated hydrocarbon and non-petroleum based liquefied gaseous fuels*.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Efforts such as the restriction of sulfur content in marine fuel oil introduced by IMO MARPOL ANNEX IV[23] and growing trends towards decarbonisation have promoted cleaner marine fuel.

Liquefied natural gas (LNG) is one of the most practical marine fuel choices. It is considered cleaner than conventional fuel oils. The conventional trade volume of LNG transported by one shipment is large, with a total capacity of 170 000 m^3 at the time of publication of this document. The trade quantity is calculated according to the method defined by the sales and purchase agreement between the cargo supplier and receiver.

On the other hand, the trade quantity of LNG as a marine fuel by one shipment can be smaller than the conventional trade volume of 170 000 m^3. Furthermore, the LNG containment system of the LNG bunkering ship is unlike the systems of conventional LNG carriers, especially the pressure in the tanks, which is relatively higher than that of the conventional carrier type. Tank types, including IMO type C, membrane, and SPB type, are available.

In addition to the difference in trade quantity and the cargo containment system between LNG bunkering shipments and conventional shipments, the energy transferred during the operations also differs. Determining the amount of energy transfer involves calculating not only the quantity but also the quality of transferred liquid and vapour, as well as the gas used during the transfer operation. This document provides the data treatment, calculation methods and calculation examples.

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Refrigerated hydrocarbon and non-petroleum based liquefied gaseous fuels — Liquefied Natural Gas (LNG) as marine fuel — Measurement on board LNG bunkering ship

1 Scope

This document provides requirements and guidance for quantifying liquefied natural gas (LNG) as a marine fuel on board LNG bunkering ships.

It is applicable to the measurement of LNG from any source, e.g. gas from conventional reservoirs, shale gas, coalbed methane, at the time of:

— ship to ship (STS) transfer to LNG-fuelled ships,

— STS transfer between LNG bunkering ships, and

— transfer to or from shore tanks or other facilities, irrespective of the type of tanks.

This document is also applicable to the quantification of biomethane and synthetic methane from fossil fuels or renewable sources.

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 6976:2016, *Natural gas — Calculation of calorific values, density, relative density and Wobbe indices from composition*

ISO 23306:2020, *Specification of liquefied natural gas as a fuel for marine applications*

3 Terms and definitions

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

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

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

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

3.1
liquefied natural gas
LNG
liquid composed predominantly of methane

[SOURCE: ISO 6578: 2025, 3.1.3]

3.2
LNG bunkering ship
ship that supplies *liquefied natural gas (LNG)* (3.1) as marine fuel to LNG-fuelled ships

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3.3
LNG-fuelled ship
ship that utilises *liquefied natural gas (LNG)* (3.1) for the purpose of propulsion

3.4
LNG carrier
cargo ship specifically constructed and used for the carriage of *liquefied natural gas (LNG)* (3.1) in bulk

[SOURCE: ISO 10976:2023, 3.1.21]

3.5
custody transfer measurement
measurement of liquid level, liquid and *vapour* (3.11) temperature, *vapour pressure* (3.12) and analysis of the composition of *liquefied natural gas (LNG)* (3.1) to be delivered to/from a tank, by which volumetric and other data are determined to be a basis of payment of cost or assessment of duty

[SOURCE: ISO 19970:2025, 3.3, modified — "measurement" has replaced "measuring" in the definition.]

3.6
custody transfer measurement system
CTMS
system that processes inputs from an *automatic tank gauge* (*ATG)* (3.7) system, thermometers, pressure gauges, etc., and provides *custody transfer measurement* (3.5) information on board, generating documents with regard to custody transfer of *liquefied natural gas (LNG)* (3.1)

Note 1 to entry: The ATG system can be incorporated as part of a CTMS.

[SOURCE: ISO 18132-1:2011, 2.1.4]

3.7
automatic tank gauge
ATG
instrument that automatically measures and displays liquid levels or ullages in one or more tanks, either continuously, periodically or on demand

[SOURCE: ISO 10976:2023, 3.1.4]

3.8
tank capacity table
capacity table
calibration table
tank table
table showing the capacities of, or volumes in, a tank corresponding to various liquid levels measured from a reference point

[SOURCE: ISO 8311:2013, 3.18]

3.9
trim
difference between the fore and aft draught of the vessel

Note 1 to entry: When the aft draught is greater than the forward draught, the vessel is said to be trimmed by the stern. When the aft draught is less than the forward draught, the vessel is said to be trimmed by the head.

[SOURCE: ISO 8311:2013, 3.19]

3.10
list
transverse inclination of a ship

Note 1 to entry: It is expressed in degrees.

[SOURCE: ISO 8311:2013, 3.7]

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3.11
vapour
fluid in the gaseous state that is transferred to/from or contained within the cargo tank

[SOURCE: ISO 10976:2023, 3.1.30]

3.12
vapour pressure
pressure at which a liquid and its *vapour* (3.11) are in equilibrium at a given temperature

[SOURCE: ISO 10976:2023, 3.1.31]

3.13
absolute pressure
total of the gauge pressure plus the pressure of the surrounding atmosphere

[SOURCE: ISO 10976:2023, 3.1.1]

3.14
bunker delivery note
BDN
proprietary document of the bunker supplier providing details of the quality and quantity of the bunker(s) delivered by the *liquid natural gas (LNG) bunkering ship* (3.2) to the *LNG-fuelled ship* (3.3)

[SOURCE: ISO 22192:2021, 3.6, modified — replaced “the bunker tanker to the vessel” with “the LNG bunkering ship to the LNG-fuelled ship”.]

3.15
gross calorific value
amount of heat that would be released by the complete combustion with oxygen of a specified quantity of gas, in such a way that the pressure, p_1, at which the reaction takes place remains constant, and all the products of combustion are returned to the same specified temperature, t_1, as that of the reactants, all of these products being in the gaseous state except for water, which is condensed to the liquid state at t_1

Note 1 to entry: t_1 and p_1 are the combustion reference temperature and the combustion reference pressure, respectively.

[SOURCE: ISO 6976:2016, 3.1, modified — Note 1 to entry has been replaced.]

3.16
net calorific value
amount of heat that would be released by the complete combustion with oxygen of a specified quantity of gas, in such a way that the pressure, p_1, at which the reaction takes place remains constant, and all the products of combustion are returned to the same specified temperature, t_1, as that of the reactants, all of these products being in the gaseous state

[SOURCE: ISO 6976:2016, 3.2, modified — Note 1 to entry has been removed.]

3.17
methane number
rating indicating the knocking characteristics of a fuel gas

Note 1 to entry: It is comparable to the octane number for petrol. One expression of the methane number is the volume percentage of methane in a methane-hydrogen mixture, that in a test engine under standard conditions has the same tendency to knock as the fuel gas to be examined.

[SOURCE: ISO 14532:2014, 2.6.6.1]

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3.18
Wobbe index
calorific value on a volumetric basis at specified reference conditions, divided by the square root of the relative density at the same specified metering reference conditions

Note 1 to entry: The Wobbe index is specified as superior (denoted by the subscript “S”) or inferior (denoted by the subscript “I”), depending on the calorific value.

[SOURCE: ISO 14532:2014, 2.6.4.3]

3.19
calibration
operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication

[SOURCE: ISO/IEC Guide 99:2007, 2.39, modified — Notes 1, 2 and 3 to entry have been removed.]

3.20
verification
process of confirming the accuracy of an instrument by comparing to a source with known *uncertainty* (3.24)

[SOURCE: ISO 10976:2023, 3.1.32]

3.21
biomethane
methane rich gas derived from biogas or from gasification of biomass by upgrading with the properties similar to natural gas

[SOURCE: ISO 14532:2014, 2.1.1.15]

3.22
working range
range of an instrument in normal operation

[SOURCE: ISO 10976:2023, 3.1.36]

3.23
flowmeter
flow measuring device which indicates the measured flowrate

[SOURCE: ISO 19970:2025, 3.6]

3.24
uncertainty
non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used

[SOURCE: ISO 19970:2025, 3.13]

4 On-board measurement

4.1 Outline

Proper on-board measurement is necessary to ensure reliable energy determination. Energy transferred is calculated via volume/mass and composition of the product transferred. There are two kinds of measurement principles: one is static, and the other is dynamic. The measurement equipment for the cargo measurement shall be calibrated and verified with reasonable uncertainty.

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