
**Refrigerated light hydrocarbon
fluids — Measurement of cargoes on
board LNG carriers**

*Hydrocarbures légers réfrigérés — Mesurage des cargaisons à bord
des navires méthaniers*



This document is a preview generated by EBS



COPYRIGHT PROTECTED DOCUMENT

© ISO 2015, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms, definitions and abbreviated terms	1
3.1 Terms and definitions	1
3.2 Abbreviated terms	5
4 General operating safety precautions and regulatory requirements	6
4.1 General	6
4.2 Electrical equipment classification	7
4.3 Electromagnetic disturbance	7
4.4 Maintenance	7
4.5 Service conditions	7
4.6 Compatibility	7
4.7 Personnel protection	7
4.8 Procedures	7
5 Measurement systems and equipment	8
5.1 General	8
5.2 Measurement equipment performance	8
5.3 Calibration and certification of measurement equipment	9
5.4 Verification of measurement equipment between dry dockings	9
5.5 Inspection of measurement equipment during transfer operations	9
5.6 Static measurement systems and equipment	10
5.6.1 General	10
5.6.2 Tank capacity tables	10
5.6.3 Trim and list measurement	12
5.6.4 Tank gassing-up tables or means of determination	12
5.6.5 Tank cool-down tables or means of determination	13
5.6.6 Liquid level measurement equipment	13
5.6.7 Temperature measurement equipment	17
5.6.8 Pressure measurement equipment	18
5.6.9 Custody transfer measurement system	18
5.7 Dynamic measurement systems and equipment	19
6 Measurement procedures	19
6.1 General	19
6.2 Static measurement	20
6.2.1 General	20
6.2.2 Measuring liquid level	21
6.2.3 Loading	21
6.2.4 Discharge	21
6.2.5 Shipboard measurements	21
6.2.6 Liquid level	22
6.2.7 Temperature	23
6.2.8 Pressure	24
6.2.9 CTMS	24
6.2.10 Sampling	24
6.2.11 Vapour return	25
6.3 Gas-up and cool-down quantification	25
6.3.1 General	25
6.3.2 Inerting	25
6.3.3 Gas up and cool down	25
6.4 Dynamic measurement	26

7	Cargo calculations	26
7.1	General	26
7.2	LNG volume determination	26
7.2.1	General	26
7.2.2	Liquid levels below lower measurable limit	27
7.3	LNG density determination	27
Annex A	(informative) LNGC design and marine operations	28
Annex B	(informative) Additional considerations for measurement on board an LNGC	36
Annex C	(informative) Examples of tank capacity tables for a spherical tank	40
Annex D	(informative) Calculation examples	46
Annex E	(informative) Sampling	55
Annex F	(informative) Marine measurement witnessing checklists	59
Bibliography		62

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 28, *Petroleum products and lubricants*, Subcommittee SC 5, *Measurement of refrigerated hydrocarbon and non-petroleum based liquefied gaseous fuels*.

This second edition cancels and replaces the first edition (ISO 10976:2012), of which it constitutes a minor revision.

Introduction

This International Standard provides accepted methods for measuring quantities on liquefied natural gas (LNG) carriers for those involved in the LNG trade on ships and onshore. It includes recommended methods for measuring, reporting and documenting quantities on board these vessels.

This International Standard is intended to establish uniform practices for the measurement of the quantity of cargo on board LNG carriers from which the energy is computed. It details the commonly used current methods of cargo measurement, but is not intended to preclude the use or development of any other technologies or methods or the revision of the methods presented. It is intended that the reader review, in detail, the latest editions of the publications, standards and documents referenced in this International Standard in order to gain a better understanding of the methods described.

This International Standard is not intended to supersede any safety or operating practices recommended by organizations, such as the International Maritime Organization (IMO), the International Chamber of Shipping (ICS), the Oil Companies International Marine Forum (OCIMF), the International Group of LNG Importers (GIIGNL) and the Society of International Gas Tanker and Terminal Operators (SIGTTO), or individual operating companies. This International Standard is not intended to supersede any other safety or environmental considerations, local regulations or the specific provisions of any contract.

The International System of units (SI) is used throughout this International Standard as the primary units of measure since this system is commonly used in the industry for these types of cargoes. However, as some LNG carrier tanks are calibrated in US customary units and some sales and purchase agreements (SPA) are made in US customary units, both SI and US customary equivalents are shown. Proper unit conversion is intended to be applied, documented and agreed upon among all parties involved in the LNG custody transfer.

Refrigerated light hydrocarbon fluids — Measurement of cargoes on board LNG carriers

1 Scope

This International Standard establishes all of the steps needed to properly measure and account for the quantities of cargoes on liquefied natural gas (LNG) carriers. This includes, but is not limited to, the measurement of liquid volume, vapour volume, temperature and pressure, and accounting for the total quantity of the cargo on board. This International Standard describes the use of common measurement systems used on board LNG carriers, the aim of which is to improve the general knowledge and processes in the measurement of LNG for all parties concerned. This International Standard provides general requirements for those involved in the LNG trade on ships and onshore.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8310, *Refrigerated hydrocarbon and non-petroleum based liquefied gaseous fuels — General requirements for automatic tank thermometers on board marine carriers and floating storage*

ISO 8943, *Refrigerated light hydrocarbon fluids — Sampling of liquefied natural gas — Continuous and intermittent methods*

ISO 18132-1, *Refrigerated hydrocarbon and non-petroleum based liquefied gaseous fuels — General requirements for automatic tank gauges — Part 1: Automatic tank gauges for liquefied natural gas on board marine carriers and floating storage*

IEC 60533, *Electrical and electronic installations in ships — Electromagnetic compatibility*

EN 1160, *Installations and equipment for liquefied natural gas — General characteristics of liquefied natural gas*

IACS, *Unified Requirements E10*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

3.1.1

absolute pressure

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

3.1.2

aerating

<context of preparing a tank for entry> introduction of fresh air with an acceptable dew point into the tank to purge inert gases and to increase the oxygen content to approximately 21 % of volume so as to ensure a breathable atmosphere