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Quantity and Quality

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While the advice given in the "Contractual Guidelines Quantity and Quality" has been developed using the best currently available information, it is intended solely as guidance to be used at the owner's own risk.

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Foreword

In front of you, you find the guidelines for Quality and Quantity measurements of LNG as a marine fuel.

This comprehensive document is the result of cooperation between knowledgeable individuals and companies across the industry and based on multiple years of experience in the field. The guide will be beneficial for everybody involved in quality and quantity measurements of LNG across the whole marine value chain.

My interest and involvement in LNG started around 3 years ago, when I was involved in the Skangass terminal developments from an Emerson Flow perspective. This project combined with my marine business development role and my analytical background, increased my interest in LNG and from that moment I was fortunate enough to be able to grow my knowledge and experience in this interesting and growing industry. My personal opinion is that LNG definately will be the fuel for the future and allthough there are still some hurdles to overcome, I am convinced it will grow. Already now more and more early adopters and eventually the rest of the marine industry will accept LNG as a marine fuel.

I have had the honour of taking part in the SGMF Workgroup for Q & Q and share insights and ideas with a group of true experts in LNG. The workgroup meetings that I have participated in are an excellent example of 1 + 1 equals more than 2; sharing knowledge and experiences, listen open-minded to new ideas and talk about new technologies resulted in a complete picture of Quality and Quantity measurements. The discussions about not only existing and proven technolgies, but also new developments, the link to existing regulations and the ease of use of all these available technologies are the basis for this comprehensive document.

The SGMF guide for Q & Q will not only help new users and existing users find their way in all the available technologies, but will also contribute in making the right decisions for the LNG fuelling business now and in the future.

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I would like to thank SGMF and the members of our workgroup for all the efforts and the pleasant cooperation and I wish everybody involved in LNG all the best on their LNG-journey.

Claudia Beumer
Marine & LNG Business Development Manager,
Emerson Flow Europe

Introduction

This publication provides an overview of the custody transfer process of LNG to marine vessels. Custody transfer involves the physical and commercial transfer of LNG from one owner to another, in this case from the LNG supplier to the fuel consumer. Third party bunkerers, that own the road tankers or the bunker vessel may be used to distribute the LNG to the fuel consumer. These distribution companies will probably not own the LNG but have an obligation to ensure that the LNG remains within specification and that the correct quantity is delivered/measured. Depending on commercial terms, custody transfer may occur at any LNG movement between the supplier, distributor and fuel consumer.

Fuel oil for bunker is sold on a mass or volume basis. LNG, although fulfilling a common purpose, varies in composition depending on where it is produced. LNG is sold on an energy content basis to reflect this variation in composition. This means that both the quantity transferred and the quality (or composition) of the material transferred have to be measured and documented.

This guide describes the variables required to be measured for the main marine engine types. The key variables for billing and guarantee purposes are the energy content (calorific value) and in some instances other combustion/burner parameters (for example Wobbe Number/ Index). Methane Number is often included but its absolute value provides only an indication of performance and not a guarantee.

The later sections of this guide describe the proven techniques available for measuring both LNG quantity and quality.

This guidance note is not a standard method for determining the quantity and quality of LNG. It describes several such methods, all of which provide sufficient accuracy and auditability to support the custody transfer process. Its aim is to educate and inform and not to be prescriptive. Most of the techniques described have associated international standards which describe in detail the measurements required and the accuracies achievable. These are provided in the bibliography for those wishing to explore further.

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Measurement of the quantity of LNG transferred is relatively simple, with both volume and mass measuring systems in use within the wider LNG industry. This document covers the most common and proven methodologies. These techniques are similar to those used in fuel oil bunkering and may involve measurements before and after transfer - for example sounding, with the quantity transferred calculated from the difference. Alternatively, meters are available to measure the flow rate of the LNG continuously.

Determining the quality of LNG - essentially its calorific value - is more difficult and costly. Direct measurement systems are available but they tend to be cumbersome and have limited accuracies outside of the laboratory. So LNG quality is usually calculated from its composition. LNG quality measurement therefore involves the sampling and analysis of LNG to determine which hydrocarbons are present and in what quantities.

Techniques to measure the quality of natural gas are widely used and accepted for billing purposes throughout the gas pipeline industry. The bulk LNG industry has developed techniques to capture a representative sample and vaporise it to allow standard gas industry composition measurement to be performed. Custody transfer techniques for LNG bunkering must be affordable and simple given the high frequency that LNG powered vessels will require bunkering.

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Definitions and Abbreviations

Aging (or ageing) – the changing of LNG composition over time because of the faster evaporation of the more volatile components. Also known as weathering.

Alkane – a member of the family of saturated hydrocarbon compounds consisting solely of carbon and hydrogen atoms with all bonds between them consisting of single bonds. The most common are methane, ethane, propane and butane

bara – pressure stated as (a) absolute pressure or the actual pressure

barg – pressure stated as (g) gauge pressure or the pressure that is measured above actual pressure

BOG – Boil Off Gas, the vapour created by the evaporation of the LNG

BTEX – aromatic components that must be removed from LNG, such as benzene, toluene, ethyl benzene and xylenes

Calorific Value – The amount of heat given off when a compound is burnt (combusted) and then cooled to a defined temperature. Also known as heating value.

CH_4 – Methane, a hydrocarbon that is the main constituent of natural gas and is a very potent greenhouse gas.

CNG – Compressed Natural Gas: natural gas that has been compressed (up to 200 bar) after processing for storage and transportation purposes, mostly for road vehicles.

CO – carbon monoxide, is a combustion product which eventually oxidises to carbon dioxide (CO_2) in the presence of oxygen. Plays a small role in greenhouse emissions. Poisonous to humans in concentrations above 600 ppm

CO_2 – carbon dioxide, a combustion product. Plays a major role in greenhouse emissions

Coal bed methane/Coal seam gas – methane and other gases trapped in coal seams

FSRU – Floating Storage and Regasification Unit, a form of offshore or near to shore LNG import infrastructure which receives LNG, stores it and vaporises it into natural gas

GIIGNL – An industry group composed of nearly all the companies in the world active in the import and regasification

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terminalling of LNG. The abbreviation is taken from its French name: Groupe International des Importateurs de Gaz Naturel Liquéfié

Heating Value – The amount of heat given off when a compound is burnt (combusted) and then cooled to a defined temperature. Also known as calorific value.

IGF Code – International Code of Safety for Ships using Gases or other Low-Flashpoint Fuels.

IMO – International Maritime Organization, the United Nation's maritime regulatory body

Innage or Sounding – The distance between the liquid surface in a tank and the sounding point at the bottom of the tank. Frequently referred to as the sounding.

ISO – International Organization for Standardization an international standard-setting body composed of representatives from various national standards organisations.

LBM – Liquid Bio Methane, the liquid produced by liquefying gases produced by rubbish disposal and sewage

Lean – in gas combustion terms a gas which is mostly methane and without appreciable amounts of heavier hydrocarbons such as ethane, propane and butane

LFL – Lower Flammable Limit, the low end of the concentration range over which a flammable mixture of gas and vapour in air can ignite at a given temperature and pressure.

LNGC – LNG Carrier, a ship designed to carry LNG as a cargo in bulk.

LPG – Liquid Petroleum Gas, a mixture of propane and butane used as fuel and chemical feedstock

MARPOL Sample – The sample provided by a fuel supplier as evidence of the basic parameters (density and sulphur content) required to show compliance with MARPOL regulation 18. The sample is for the exclusive use of Port State Control.

Mole – a unit of measurement used in chemistry to express the quantity of a chemical substance in terms of the number of atoms or molecules.

MSDS – Material Safety Data Sheet – a document which provides workers and emergency personnel with procedures for

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handling or working with that material in a safe manner. It includes information such as physical data toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures.

mtpa – million (short) tons per annum, a unit often used to state annual production or regasification volumes of LNG.

Natural gas – a mixture of hydrocarbon gases, mostly containing methane, used as a fuel or chemical feedstock.

NOx – oxides of nitrogen associated with atmospheric pollution consisting of nitric oxide (NO) and primarily nitrogen dioxide (NO_2). Corrosive in the presence of water and has a role in lung diseases such as asthma and heart disease. They are a primary constituent of smog and contribute to the formation of atmospheric ozone.

OSV – an Offshore Support Vessel, also known as a platform support vessel, which provides stand by, rescue and logistic support to offshore oil and gas facilities.

Particulate Matter – particles of soot or smoke resulting from the burning of, primarily, heavier oils. A major health hazard because the particles can penetrate deep into the lungs and blood and cause cancer.

Rich – in gas combustion terms a gas which although mostly methane contains appreciable amounts of heavier hydrocarbons.

SGMF – Society for Gas as a Marine Fuel, a London-based association for companies involved in the use of LNG as a marine fuel.

Shale gas – natural gas released from low-permeability shale rock formations by horizontal drilling and hydraulic fracturing.

Soot – particles of carbon given off by the combustion of fuel in oxygen concentrations insufficient for the production of carbon dioxide or carbon monoxide.

Vapour pressure – the pressure exerted by a vapour. It varies with changes in temperature.

Weathering – the changing of LNG composition with time through evaporation of more volatile components. Also known as aging.

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1. Purpose and Scope

This guide provides an overview of the custody transfer process involved in physical and commercial transfer of LNG from one owner to another – in this case from an LNG supplier (sometimes the bunkerer) to a fuel consumer.

LNG is sold in terms of energy content. This means that both the quantity transferred and the quality (or composition) of the LNG have to be measured and documented. This guide therefore provides an overview of the technologies used to measure quantity, and the techniques, equipment and methodologies preferred for the determination of the quality – and therefore the energy content – of LNG by analysis of samples.

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