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Ships and marine technology — Performance test procedures of LNG BOG re-liquefaction system on board a ship

Navires et technologie maritime — Modes opératoires d'essais de performance d'un système de re-liquéfaction BOG GNL à bord d'un navire

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Foreword

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This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 25, *Maritime GHG reduction*.

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

The shipbuilding and marine industries have shown growing interest in the use of liquified natural gas (LNG) to meet the increasingly strict international, regional and national regulations on gas emissions which are harmful to the environment. One of the most important pieces of equipment used in the LNG vessel system is the LNG boil-off gas (BOG) re-liquefaction system, since it can change natural gas to liquefied natural gas. This allows the LNG ship to decrease fuel consumption and contribute to marine environmental protection.

The LNG fuelled vessel or bunkering vessel is expected to be designed and manufactured according to the requirements of internationally recognized standards such as IMO IGF[1] and IGC Codes.[2] However, an internationally recognized standard on the performance testing of LNG BOG re-liquefaction systems on board a ship has not yet been established. As the LNG BOG re-liquefaction system is tested according to a case-by-case agreement between the owner and manufacturer, such an internationally recognized standard would enable a test method which is commonly accepted by all stakeholders (e.g. ship owners, classification societies, equipment manufactures and shipyards). For this reason, it is important to have an objective document to test the performance of the LNG BOG re-liquefaction system on board a ship, which is commonly acceptable to all stakeholders (e.g. ship owners, classification societies, equipment manufacturers and shipyards).

In this regard, this document is designed to set a test procedure to evaluate the performance of the LNG BOG re-liquefaction system on board a ship. This document aims to:

a) enable the performance of LNG BOG re-liquefaction system to be identified from an objective point of view;

b) provide useful requirements and guidelines to all stakeholders;

c) facilitate the development of more reliable LNG BOG re-liquefaction systems, with a view to contributing to the growth of relevant industries and benefitting all stakeholders.

This document is intended to be applied in various situations, including factory acceptance tests or onboard tests. The LNG BOG re-liquefaction system provider and ship owner are expected to agree on any additional requirements that apply beyond the test requirements outlined in this document.

NOTE Relevant IACS requirements and legal requirements can apply.

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Ships and marine technology — Performance test procedures of LNG BOG re-liquefaction system on board a ship

1 Scope

This document specifies requirements and procedures for the performance test to verify the mechanical features of the liquified natural gas (LNG) boil-off gas (BOG) re-liquefaction system on board a ship. These test procedures can be prepared for LNG BOG re-liquefaction systems of LNG ships such as LNG carriers, LNG bunkering vessels and LNG fuelled vessels. Functions which are specific to manufacturers and any additional tests or specifications required by clients are not covered in this document.

2 Normative references

There are no normative references in this document.

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
design pressure
pressure at which each component of a piping system is designed to operate

Note 1 to entry: The design pressure must not be less than the pressure at the most severe condition of coincidental internal or external pressure and temperature (maximum or minimum) expected during service.

3.2
design temperature
maximum temperature at which each component is designed to operate

Note 1 to entry: The design temperature must not be less than the temperature of the component material at the most severe condition of temperature and coincidental pressure expected during service.

3.3
minimum working temperature
lowest temperature at which each equipment is designed to operate

3.4
maximum allowable working pressure
MAWP
maximum pressure of a piping system determined, in general, by the *design pressure* (3.1) of the weakest piping component in the system or by the relief valve setting

Note 1 to entry: The MAWP shall not exceed the design pressure of a piping system.

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3.5
liquefied natural gas
LNG
natural gas that has been cooled at atmospheric pressure to very low temperatures and condensed into liquid form

Note 1 to entry: It is characterized as a cryogenic liquid having a temperature typically around –162 °C under normal atmospheric pressure.

[SOURCE: ISO 20519:2021, 3.12, modified — "at atmospheric pressure to very low temperatures" has been added to the definition; "–161 °C" has been changed to "–162 °C" in the note to entry.]

3.6
liquefaction
transformation of a gas into a liquid

3.7
boil-off gas
BOG
evaporation of *liquefied natural gas* (*LNG*) (3.5)

Note 1 to entry: Although the tanks are insulated, a small amount of warming occurs, causing the LNG cargo to evaporate as it reaches its boiling point. This natural evaporation, known as boil-off, is unavoidable and the generated boil-off gas (BOG) must be removed to preserve the tank pressure.

3.8
re-liquefaction system
system that consists of joule-thomson valve, separator, re-condensor, compressor, etc. for the purpose of liquefying *boil-off gas* (*BOG*) (3.7)

Note 1 to entry: During *liquid natural gas* (*LNG*) (3.5) filling in a cargo tank and under navigation condition of LNG fuel tanks, boil off gas occurs, exchanging heat between the ambient temperature and fluid cooling temperature. This gas increases inside of the cargo tank. In order to maintain stable storage pressure, BOG can be used and incinerated by other equipment. Especially for LNG carriers, BOG can be re-liquefied through a re-liquefaction system such as partial re-liquefaction cycle and methane re-liquefaction cycle for greater operational efficiency.

4 Abbreviated terms

For the purpose of this document, the following abbreviated terms apply.

ASME BPVC	American Society of Mechanical Engineers Boiler and Pressure Vessel Code
IMO	International Maritime Organization
IGC Code	International Code of the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk
IGF Code	International Code of Safety for Ships using Gases or Other Low-flashpoint Fuels
IACS	International Association of Classification Societies
KO	Knock out drum

5 Inspection and tests

5.1 General

This clause specifies the tests for the various models and capacities of the LNG BOG re-liquefaction system. The tests are intended to show typical characteristics of the system.

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