



**SIGTTO**

Society of International Gas Tanker & Terminal Operators Ltd

# Guidance for Gas Trials on LNG Carriers

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Second Edition



# **Guidance for Gas Trials on LNG Carriers**

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# Introduction and Scope



# 1 Introduction and Scope

## 1.1 Introduction

A gas trial is a process that is carried out on a new gas carrier to check that the cargo system is working properly. The process is typically managed using a comprehensive gas trial plan prepared by the shipbuilder. This document recommends safety measures to assist with planning a gas trial and provides guidance on minimising the impact of greenhouse gas (GHG) emissions.

This document updates and replaces the previous edition, *Guide for Planning Gas Trials for LNG Vessels* (2008).

### 1.2 Scope

This document provides high-level considerations to help with safety and environmental protection when carrying out a gas trial.

This document is written for LNG carriers (LNGCs) only. Specialised ships, such as floating storage and regasification units (FSRUs), may require additional checks. Although this document is written specifically for LNG gas trials, it may be helpful for other gas carriers.

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## Planning for Gas Trials



## 2 Planning for Gas Trials

This chapter covers the considerations for planning a gas trial. This includes preparation of a gas trial procedure and safety, personnel and environmental considerations.

### 2.1 Gas Trial Procedure

The gas trial procedure is a comprehensive document that provides a detailed plan of a gas trial. The procedure should be ship-specific and consider all design and operational aspects. Gas trials are used to test the operational readiness of the cargo system. These tests are designed to simulate all typical cargo operations, including the control and use of LNG boil-off gas (BOG).

The shipbuilder and owner should discuss the procedure well in advance of the gas trial. This provides the opportunity to ensure that safety and environmental considerations are properly addressed. The gas trial procedure is typically part of the construction and delivery schedule and sufficient time should be allowed to safely perform all checks and tests.

### 2.2 Preparations

Once the gas trial procedure has been prepared, it is essential that all organisations involved are aware of the details of the plan. This includes representatives of the ship owner, shipbuilder, cargo system designer, LNG facility, Classification Society and equipment vendors.

Safety and environmental protection issues will need to be reviewed in increasing detail during the preparation stages. The shipbuilder and owner should carefully review all stages of the plan, including consideration of the compatibility of the LNG facility. Pre-arrival and pre-transfer planning should be carried out diligently.

#### 2.2.1 Safety considerations

A gas trial is a unique situation where LNG is introduced into a newly built ship's piping and tanks. Cargo equipment will be started for the first time since installation using LNG, which is a hazardous material. Additional concerns are the number of additional personnel on board and the lack of familiarity with new equipment. The hazards include systems that are electrically energised and under pressure for the first time. Additional hazards may arise from activities such as entry into enclosed spaces.

A structured assessment of all the hazards and the resulting risks is essential. This should be carried out and documented as formal HAZID<sup>1</sup> and HAZOP<sup>2</sup> studies. Risk mitigation measures should be in place to reduce risks to acceptable levels.

It is essential to prevent the time pressure of the gas trial schedule from interfering with proper safety procedures. Relevant industry best practice guidance should be followed, including IMO A.1050(27)<sup>3</sup>.

Before a gas trial can begin, all safety systems should be fully operational on the ship and at the terminal. As there will be extra personnel on board, sufficient firefighting and lifesaving equipment should be available. This may also be dictated by local regulations.

<sup>1</sup> Hazard identification

<sup>2</sup> Hazard and operability

<sup>3</sup> IMO Resolution A.1050(27) – Revised Recommendations for Entering Enclosed Spaces Aboard Ships

### 2.2.2 Personnel considerations

All personnel involved in gas trials should be qualified for the tasks they are expected to carry out and be familiar with their specific duties. They should be aware of their personal responsibilities and the hazards of LNG.

All personnel should be briefed on the safety measures that they are required to adhere to during the gas trial. Clear guidance should be provided on individual responsibilities in an emergency, including alarm signals and muster stations.

It is worth noting that a gas trial is a unique training opportunity for ship staff, and the information gathered during a gas trial can be useful to subsequent crews.

### 2.2.3 Environmental considerations

Methane and carbon dioxide (CO<sub>2</sub>) are considered to be GHGs and emissions during a gas trial should be minimised as much as practicable. This should be considered during the planning process and in discussion between the shipbuilder, cargo system designer and ship owner.

It may be possible to organise the commissioning sequence of the gas trial to minimise emissions. Permanent or temporary modifications to the main deck cargo system piping can help to more efficiently gas up and cool down the cargo tanks. This may help with the reduction of emissions during gas trials.

Operational measures to reduce methane emissions include ensuring that the full operating capacity of the compressors and gas combustion unit (GCU) are available for maximum gas handling flexibility. Using nitrogen rather than inert gas in the cargo system before starting gas trials can increase efficiency and reduce both methane and CO<sub>2</sub> emissions.

The measures discussed may also reduce the total quantity of LNG needed for gas trials. Accurate estimation of the actual quantity of LNG required can reduce CO<sub>2</sub> emissions by helping to minimise use of the GCU or steam dumping to deal with excess LNG.





## 3 Gas Trials

This chapter covers the stages of a typical gas trial, from the shipyard to the LNG facility and back to the shipyard.

### 3.1 Before Departing the Shipyard

Tightness testing of the cargo system is typically carried out at the shipyard using liquid nitrogen. The extent of the cold testing should be agreed between the shipyard and the owner.

All safety equipment and systems should be confirmed as operational. Piping should be checked for any blockage or debris. All necessary sections of removable piping or valves should be fitted or removed according to the gas trial procedure.

It is important to carry out these preparations before moving to the safety checks.

#### 3.1.1 Safety checks

All safety systems should be systematically checked to ensure they are working properly. These include, but are not limited to, emergency shutdown (ESD)<sup>4</sup>, gas detection, firefighting and water spray systems. Relief valves should be checked to ensure they are installed correctly and cleared of blanks.

Cargo system instrumentation and controls should be tested to confirm that the system is working. Cargo system equipment, including cargo pumps, stripping pumps, spray pumps and fuel gas pumps, should undergo all necessary checks prior to start-up to ensure correct rotation.

Vapour compressors should be checked to confirm correct rotation and a functional test of the surge control systems, where fitted, should be carried out with the unit running on air. Where applicable, the correct operation of cofferdam heating systems should be confirmed.

#### 3.1.2 Final preparations

Following safety checks, final preparations for the LNGC to depart the shipyard should focus on ensuring all required personnel and equipment are available and briefed on the safety protocols for the gas trial.

The quantity of LNG required to carry out the gas trial and the condition of the tanks prior to arrival at the facility should be agreed between the shipbuilder, LNG facility and cargo system designer.

### 3.2 Loading of LNG

The typical pre-arrival and pre-loading checks for LNG transfers should be carried out. After manifold connection and gassing up and cooling down of cargo piping and tanks, LNG can be loaded.

LNG loading should be conducted at the same safety level as is typical in the LNG industry. Effective communication and close coordination should be set up between the LNG facility and the ship. All safety systems should be active, and the gas trial should be stopped if any safety system stops working.

<sup>4</sup> See SIGTTO – ESD Systems

Only essential activities, with minimum required personnel, should be carried out during loading operations. All testing that can be carried out at a later stage should be deferred until after LNG loading is complete and the manifold is safely disconnected.

### 3.3 Operations at Sea

Once the required quantity of LNG is loaded, then the process can be started to check the cargo and gas management systems according to the gas trial procedure. It is important that personnel follow all safety procedures, including the permit to work and lock out tag out systems. This is essential as there may be multiple operations at the same time, including entry into enclosed spaces.

This phase of the gas trial has the potential to generate large volumes of vapour due to the transfer of LNG within the cargo system while equipment is being tested. Effective planning should help to reduce emissions to the minimum practical amount.

Annex 1 provides a summary of different cargo containment systems and points to consider during commissioning.

After all tests have been completed, the ship typically returns to the LNG facility to discharge all LNG liquid.

### 3.4 Discharge of LNG

After any final tests are carried out while the ship is connected to the LNG facility, the maximum possible LNG liquid is then pumped to the terminal. The terminal may require the use of strainers when pumping liquid back and this should be agreed during the compatibility study.

Once all possible LNG liquid is pumped ashore, the ship departs the LNG facility to carry out operations to remove all flammable vapour and make the ship gas free.

### 3.5 Completion of Gas Trials

The ship should be gas free before returning to the shipyard. Gas freeing operations should be carefully carried out to ensure all traces of flammable vapour are removed from the cargo and fuel systems.

Any temporary equipment fitted for the gas trial, including spool pieces and valves, should be removed and the ship returned to its normal operating condition. Post gas trial checks should be detailed in the gas trial procedure and carried out to check the condition of equipment. A thorough inspection of all systems, including cargo tanks, cargo equipment and cargo hold spaces, should be carried out.

## Annexes

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## Annex 1 – Cargo Containment System Inspection

Different types of cargo containment systems (CCS) may have specific inspection criteria associated with them. Table A1 provides a list of points to consider when developing the gas trial procedure. CCS manufacturers may provide a more detailed list of inspection points.

Inspection Consideration	Type A	Type B Prismatic	Type B Spherical	Type C	Membrane
<ul style="list-style-type: none"> <li>Initial cool down requirements</li> <li>Timing</li> </ul>	As per CCS designers, depending on tank material and insulation arrangements	As per CCS designers, depending on tank material and insulation arrangements	As per CCS designers, depending on tank material and insulation arrangements	As per CCS designers, depending on tank material and insulation arrangements	As per CCS designers
<ul style="list-style-type: none"> <li>Interbarrier dew point</li> <li>Flow rate</li> </ul>	May not be relevant	As per CCS designers	As per CCS designers	Not applicable	As per CCS designers
<ul style="list-style-type: none"> <li>Hold space</li> <li>Cold spot inspections</li> </ul>	Refer to IGC Code <sup>5</sup> for full cold spot inspection at first loading	Refer to IGC Code for full cold spot inspection at first loading	Refer to IGC Code for full cold spot inspection at first loading	Refer to IGC Code for full cold spot inspection at first loading	Refer to IGC Code for full cold spot inspection at first loading
<ul style="list-style-type: none"> <li>Tank mounting</li> <li>Cradle structure inspections</li> </ul>	Applicable	Applicable	Not applicable during gas trials	Applicable	Not applicable during gas trials

**Table A1: Cargo containment system inspection considerations**

It should be noted that due to the relatively small amount of LNG used during gas trials, only a limited area of the associated tank structure may be fully assessed for cold spots. It is recommended that a full cold spot inspection takes place once the LNGC is loaded with the appropriate amount of cargo required by the ship's CCS manufacturer, Classification Society and Flag State.

<sup>5</sup> IMO – International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)

## Annex 2 – Glossary of Terms and Abbreviations

**BOG** Boil-off Gas

**CCS** Cargo Containment System

**CO<sub>2</sub>** Carbon Dioxide

**ESD** Emergency Shutdown

**FSRU** Floating Storage and Regasification Unit

**GCU** Gas Combustion Unit

**GHG** Greenhouse Gas

**HAZID** Hazard Identification

**HAZOP** Hazard and Operability

**IMO** International Maritime Organization

**LNG** Liquefied Natural Gas

**LNGC** Liquefied Natural Gas Carrier

## Annex 3 – Reference List

1. IMO Resolution A.1050(27) – Revised Recommendations for Entering Enclosed Spaces Aboard Ships
2. SIGTTO – ESD Systems
3. IMO – International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)





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