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# Road vehicles — Liquefied natural gas (LNG) refuelling connector — 3,1 MPa connector

*Véhicules routiers — Connecteur pour le remplissage de gaz naturel liquéfié (GNL) — Connecteur à 3,1 MPa*



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# Foreword

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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 22, *Road vehicles,* Subcommittee SC 25, *Vehicles using gaseous fuels*.

The corrected version of ISO 12617:2015 incorporates the following corrections.

Figure 1 has been corrected and the key to Figure 1 has been updated to reflect the changes.

# Road vehicles — Liquefied natural gas (LNG) refuelling connector — 3,1 MPa connector

## 1 Scope

This International Standard specifies liquefied natural gas (LNG) refuelling nozzles and receptacles constructed entirely of new and unused parts and materials for road vehicles powered by LNG. An LNG refuelling connector consists of, as applicable, the receptacle and its protective cap (mounted on the vehicle) and the nozzle. This International standard is applicable only to such devices designed for a maximum working pressure of 3,4 MPa (34 bar) to those using LNG as vehicle fuel and having standardized mating components.

NOTE All references to pressures given in megapascals and bar (1 bar = 0,1 MPa = 105 Pa; 1 MPa = 1 N/mm$^2$) are to be considered gauge pressures, unless otherwise specified.

## 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 14469, *Road vehicles — Compressed natural gas (CNG) refuelling connector*

ISO 15500-2, *Road vehicles — Compressed natural gas (CNG) fuel system components — Part 2: Performance and general test methods*

## 3 Terms and definitions

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

**3.1**
**check valve**
part of the receptacle, or of the nozzle, mounted inside which prevents return flow or venting of fuel after the nozzle was disconnected from the receptacle

**3.2**
**cycle life**
number of refuelling cycles, as specified in this International Standard, which the component can withstand without leak or without another fail of function

**3.3**
**device**
nozzle or receptacle

**3.4**
**dry air**
air with moisture content such that the dew point of the air at the required test pressure is at least 11 °C below the ambient test temperature

**3.5**
**hydrostatic pressure**
pressure to which a component is taken to verify the structural strength of the component

**3.6**
**liquefied natural gas (LNG)**
cryogenic liquid produced by reducing the temperature of natural gas to about −162 °C at atmospheric pressure

**3.7**
**LNG refuelling connector**
joined assembly of *LNG refuelling nozzle* (3.8) and receptacle

Note 1 to entry: Both parts have to have integrated mechanically opened *check valves* (3.1) which are operated by each other. The volume between the two check valves shall be reduced to a minimum to minimize the loss of fuel during the disconnection process.

**3.8**
**LNG refuelling nozzle**
*device* (3.3) which permits quick connection and disconnection of fuel supply hose to the LNG receptacle in a safe manner

**3.9**
**LNG refuelling receptacle**
*device* (3.3) connected to a vehicle or storage system which receives the *LNG refuelling nozzle* (3.8) and permits safe transfer of fuel

Note 1 to entry: The receptacle consists as minimum from a receptacle body and from a *check valve* (3.1) mounted inside the body.

**3.10**
**maximum service pressure**
maximum pressure of the fuel delivered by the fuelling station

**3.11**
**nominal flow rate**
flow rate through the connector at specified density of LNG and at specified pressure difference

**3.12**
**poppet**
movable closing part of the *check valve* (3.1)

**3.13**
**positive locking means**
feature which requires actuation of an interlocking mechanism to allow connection/disconnection of the nozzle from the receptacle

Note 1 to entry: It shall not be possible, except by actuation of the interlocking mechanism, to disconnect under unsafe conditions when an uncontrolled release of LNG can happen which causes damage to the user and/or the environment.

**3.14**
**probe**
part of the nozzle which enters inner space of the receptacle

**3.15**
**working pressure (maximum allowable pressure)**
maximum pressure that an *LNG refuelling connector* (3.7) can be expected to withstand in actual service

**3.16**
**vapour spillage space**
dead volume between the nozzle and the receptacle measured with trapped water

# 4 General construction requirements

## 4.1 General

This International Standard was developed to use in the examination, testing, and certification of newly produced liquefied natural gas (LNG) vehicle refuelling nozzles and receptacles and, as such, applies only to the nozzles and receptacles used in LNG refuelling systems and not to the system itself.

A nozzle certified to this International Standard will be functionally compatible from a safety and performance perspective with all listed receptacles of compatible profile and system pressure. Similarly, a certified receptacle will be functionally compatible from a safety and performance perspective with all the listed nozzles of compatible profile and system pressure.

As there may eventually be many different kinds of nozzles and receptacles available from a variety of manufacturers which, for safety reasons, must all be compatible with one another, this International Standard specifies a receptacle profile. The nozzle probe shall comply with the receptacle profile. This standard profile incorporates the design specification (mating dimensions, geometry and tolerances, and material requirements) which can be considered in the certification of a submitted nozzle or receptacle. This International Standard refers only to one working pressure and one application.

The construction and performance of nozzles and receptacles are based on the observation that three main parameters affect user safety and system compatibility, namely the following:

a) working pressure;

   All nozzles and receptacles are designed to have a working pressure of 3,4 MPa.

b) design cycle life;

   Frequency of use is the second parameter to be considered. Since frequency of use will differ with the nozzle/receptacle application (i.e. public sector, fleet employee, and residential), all receptacles will be tested at 10 000 connect/disconnect cycles for compliance with this International Standard (one fill per day for 27 years). In addition, all nozzles will be tested to a durability test of 20 000 cycles.

c) training.

   Operator training required is in accordance with national requirements.

## 4.2 LNG refuelling nozzles

LNG fuelling nozzles, hereafter referred to as LNG nozzles, and receptacles, hereinafter both also referred to as devices, manufactured in accordance with this International Standard shall be designed in accordance with reasonable concepts of safety, durability, and maintainability.

## 4.3 LNG nozzles and receptacles

LNG nozzles and receptacles shall be

— designed to minimize the possibility of incorrect assembly,

— designed to be secure against displacement, distortion, warping, or other damage,

— constructed to maintain operational integrity under normal and reasonable conditions of handling and usage, and

— designed with a vapour spillage space less than 25 $cm^3$.

## 4.4 Pressure rating

### 4.4.1 Working pressure (maximum allowable pressure)

3,4 MPa.

### 4.4.2 Maximum service pressure

3,1 MPa.

### 4.4.3 Hydrostatic pressure

2,5 times working pressure.

### 4.4.4 Working temperature

#### 4.4.4.1 Receptacle working temperature range (−196 °C to +85 °C)

#### 4.4.4.2 Nozzle working temperature range

The nozzle shall be designed for the temperature of the fuel −196 °C and for an ambient temperature range of −40 °C to +85 °C.

## 4.5 Materials

### 4.5.1 Corrosion protection

Corrosion-resistant materials shall be used (see 10.10). Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in contact with each other.

### 4.5.2 LNG nozzle and receptacles

LNG nozzles and receptacles shall be manufactured of materials suitable and compatible for use with LNG at the pressure and the temperature ranges to which they will be subjected which shall be declared by the manufacturer in the component documentation delivered with the product.

### 4.5.3 Material of the bodies of the receptacle and of the nozzle

Material of the bodies of the receptacle and of the nozzle should be

a) suitable for the working temperature range,

a) conductive [only conductive materials comply with the electric conductivity test (see 10.8)], and

b) non-sparking according to 10.11.

## 4.6 Hand operation

LNG nozzles and receptacles shall be so designed as to be operated without the use of tools and excessive force for connecting and disconnecting.

## 4.7 Sealing exchange

Design of a device and its check valve sealing shall make possible exchange of the check valve sealing from the front side using suitable jig and related tools.

### 4.8 Installation

The receptacle shall be installed outside engine compartment.

## 5 Nozzles

### 5.1 Venting depressurization

Venting depressurization of all nozzle types is required prior to disconnection. Disconnection of all nozzles shall be accomplished in accordance with 10.2.

### 5.2 Identification

The nozzle shall bear a marking in accordance with Clause 9, if necessary, indicating the direction of the open and shut off operation of the actuating mechanism.

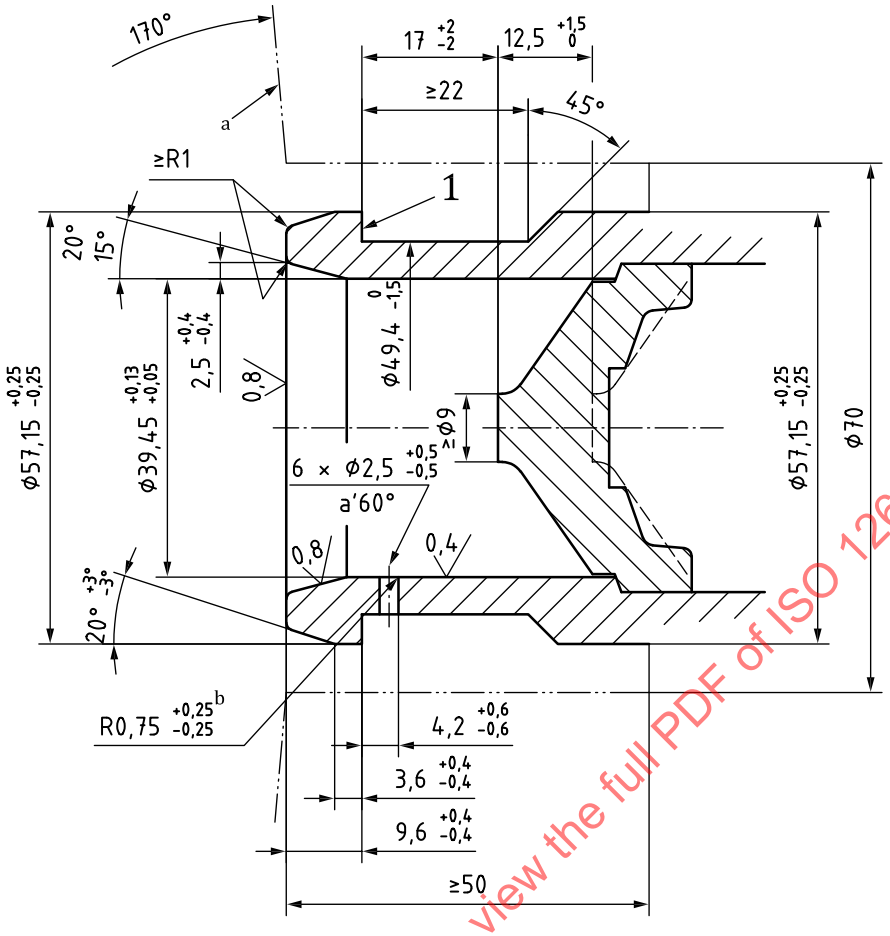
### 5.3 Internal check valve

The nozzle is equipped with an internal check valve to prevent the escape of gas. The check valve poppet face contacts with the receptacle poppet face during connection and pushes the receptacle poppet into the open position to allow rated flow. The reaction force of a nozzle poppet in fully open position, typically supported by firm stop, shall be larger than the reaction force of receptacle in fully open position, defined by the stroke of the nozzle, as specified in 7.1. Provision shall be made that movement of receptacle is not limited by any mechanical part within its stroke as defined in Clause 6.

## 6 Standard receptacle dimensions

### 6.1 Drawing

The receptacle shall comply with the dimensions shown in Figure 1.




**Key**

1 nozzle latch plane

a Clearance.

b Edge radius.

**Figure 1 — Dimensions of the receptacle**



## 7 Receptacle

### 7.1 Cycle life

Receptacle shall have a cycle life as specified in 4.1.

### 7.2 Design

The receptacle shall be equipped with an internal check valve to prevent the escape of gas. The poppet of the check valve shall be pressed against the seat with a force of minimum 200 N at a non-pressurized receptacle. The back force of the receptacle poppet in fully open position shall be maximum of 460 N.

### 7.3 Protective cap

A receptacle manufacturer validated cap or equivalent design feature shall be provided to prevent dust, moisture, and other foreign debris from entering the receptacle. This also requires prevention of the dust entry through the venting holes. The cap has to allow small gas venting originated by warming the cold gas inside or a minor leak of the receptacle poppet (see 10.5.2). The cap shall be marked by an undeletable writing of "LNG ONLY".

### 7.4 Mounting

The receptacle shall have provisions to be firmly attached to the vehicle and shall comply with applicable abnormal load tests (see 10.6).

### 7.5 Maximum working temperature

The receptacle shall not be installed in an area in which the temperature exceeds 85 °C.

## 8 Instructions

### 8.1 Clarity

Information required under this Clause for instructions and provisions for nozzles and receptacles to be specified shall be given in an easily understood form.

The manufacturers of receptacles and nozzles shall provide clear and concise printed instructions and diagrams in a form that can be easily understood and adequate for

a) proper field assembly, installation,

b) maintenance and periodic inspection,

c) replacement of components as appropriate,

d) safe operation by all users,

e) suitability and use, and

f) storage and handling.

### 8.2 List of tools

Special tools required for connection of nozzles and receptacles to tubing and assembly and disassembly of parts shall be clearly identified in the instructions.

## 9 Marking

### 9.1 Clarity

Information required under this Clause to be marked shall be in an easily understood form. Marking should be embossed, cast, stamped, or otherwise, formed in the part. This includes markings baked into an enamelled surface.

### 9.2 Manufacturer and International Standard information

Nozzles and receptacles shall bear the following information:

— manufacturer's name;

— trademark or symbol;

— model designation and/or part number;

— identification of this International Standard, i.e. ISO 12617.

### 9.3 Date of manufacture

Nozzles and receptacles shall each bear a date code marking.

The four-digit date code marking shall consist of at least four adjacent digits determined in the following Clauses.

#### 9.3.1 First and second digits

It shall indicate the calendar year in which the nozzle, receptacle, or three-way valve was manufactured (e.g. 96 for 1996, 00 for 2000).

#### 9.3.2 Third and fourth digits

It shall indicate the week in which the nozzle, receptacle, or three-way valve was manufactured (e.g. 03 for the third week of the year). For the purpose of this marking, a week shall begin at 00:01 h on Sunday and end at 24:00 h on Saturday.

A date code can be used for more than one week. However, it shall not be used for more than four consecutive weeks or for more than two weeks in the next calendar year.

### 9.4 Alternative marking

When a four-digit date code is not practical, the manufacturer shall submit a plan acceptable to the certifying agency which will outline means of establishing the date of manufacture so that it is traceable to the purchaser.

### 9.5 Additional marking

Additional numbers, letters, or symbols can follow the four digit number specified in a) and b). If additional numbers are used, they shall be separated from the date code.

Possible additional information:

— material of the body and its traceability number.

## 10 Tests

### 10.1 General requirements

The nozzle and receptacle tested shall be of the receptacle and nozzle designs specified in this International Standard.

Unless otherwise stated

a) tests shall be conducted at room temperature (20 ± 5) °C;

b) all pressure or leak tests, except hydrostatic test (10.9), shall be conducted with dry air or dry nitrogen as test gas;

c) whenever cryogenic fluid is required, tests shall be conducted with liquid nitrogen or LNG;

d) devices shall be conditioned to attain thermal equilibrium conditions.

Nozzle tests shall be done with the test fixtures which would use the receptacle dimensions as defined in Clause 6. They can be equipped with special ports for test fluids more inboard than the flange plane.



## 10.2 User interface

### 10.2.1 Positive locking

It shall not be possible to deliver LNG unless the nozzle and receptacle are connected properly and positively locked.

### 10.2.2 Safe disconnection

Upon disconnection, the nozzle and the receptacle shall stop the flow of fluid. No hazardous condition shall result from disconnection.

### 10.2.3 Manual force in warm conditions

On depressurized devices, the axial force to connect and lock or unlock and disconnect the device shall be <90 N. The nozzle shall be capable of being disconnected with the forces or torques not exceeding 225 N or 7 Nm. In case of operation with two hands in one direction, total of both hands forces shall be under the required limit.

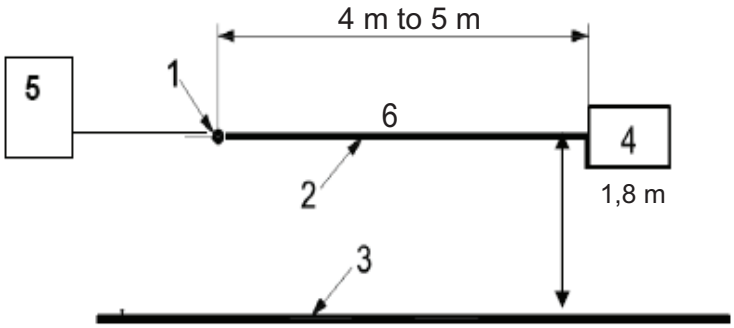
### 10.2.4 Manual force at cold conditions under frost

Effect of frost on removal force: the nozzle shall be conditioned to the temperature of liquid nitrogen under atmospheric pressure. It shall then be allowed to rest for 10 min while exposed to 95 % to 100 % relative humidity. The removal force or torque shall then be measured. The forces and torque moments shall be in compliance with 10.2.3.

## 10.3 Impact resistance of a nozzle

A nozzle shall be connected to a 5 m long and 25 mm nominal internal diameter (ID) refuelling hose, full of liquid nitrogen (LIN) under atmospheric pressure, conditioned to the temperature of the fluid, and then dropped 1,8 m onto a concrete floor as shown in Figure 2. The nozzle shall be dropped four times from which the first drop shall be on the most critical area and the remaining three drops shall be equally distributed to each 90° rotational increment from this location. Then, the nozzle shall be conditioned to atmospheric temperature pressurized by dry nitrogen to 80 % of working pressure and subjected to four additional drops in the same locations as specified above. Following this, the nozzle shall be capable of normal connection and disconnection to the receptacle. In addition, the nozzle shall comply with all leakage tests specified in 10.5.

There shall be no evidence of damage to the nozzle that would affect the performance of the unit. If the carrying handles are bent following the test to a level sufficient enough to prevent operation, they shall be bent back to a position that allows operation. Breakage of the handles shall be considered a failure.




**Key**

1 suitable support
2 refuelling horse
3 concrete floor
4 nozzle
5 LIN vessel under atmospheric pressure
6 slope 10% to the right

**Figure 2 — Impact resistance test arrangement**

## 10.4 Receptacle protective cap

Receptacle manufacturer's or car manufacturer's declaration on suitability for as minimum 2 000 open/close operations and five year aging shall be available for approval.

## 10.5 Leakage at room temperature

### 10.5.1 Nozzle

A nozzle, whether coupled or uncoupled, shall be either bubble free for 1 min during the leak test or have a specified leak rate when tested as follows.

Tests shall be conducted at 0,5 MPa (5 bar) at the working pressure and then again at 0,5 MPa (5 bar). The maximum allowed leak is 30 $cm^3/h$ at 0,5 MPa and 60 $cm^3/h$ at working pressure.

Pressurized air or nitrogen shall be applied to the inlet of the coupled (or uncoupled) device. The external body shall then be checked for bubble tight leakage using immersion in room temperature water.

All connectors shall be checked for leakage for the period of five minutes after connection is finished and before disconnection is started. If there are no bubbles for a period of 1 min, the sample passes the test. If bubbles are detected, then the leak rate shall be measured by accumulation of the test gas leak trapped under water.

Alternatively, other methods of leak detection with equivalent or better sensitivity are applicable.

### 10.5.2 Receptacle

The receptacle check valve shall have a leak rate not exceeding 30 $cm^3/h$ at 0,5 MPa (5 bar) and 60 $cm^3/h$ at the working pressure or be bubble free for 5 min.

## 10.6 Abnormal loads

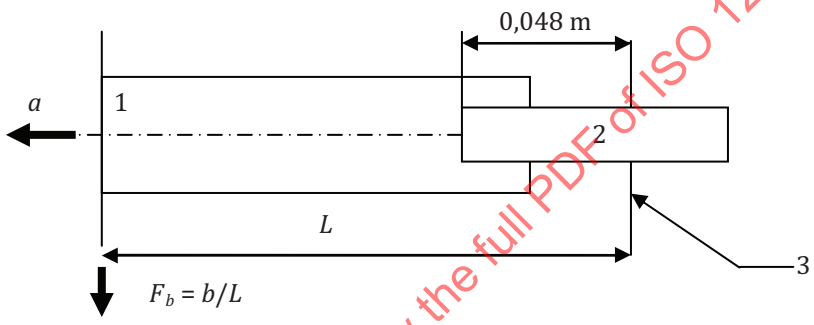
### 10.6.1 General

The connected nozzle and receptacle shall be subjected to the following abnormal loads for a period of 5 min in service. These tests (Figure 3) are to be conducted separately:

a) force *a* pulls along the longitudinal axis of the nozzle or receptacle;

b) moment *b* is applied in a worst-case direction.

The nozzle and receptacle shall be able to withstand abnormal loads of $a$ = 1 350 N and $b$ = 120 Nm without distortion or damage and of $a$ = 2 700 N and $b$ = 240 Nm without becoming so damaged as to leak. For moment *b*, the moment arm shall be measured as the length, *L*, from the reference point which is 0,048 m from the front of the receptacle to the hose inlet of the nozzle. The load for achieving the moment *b* shall be $F_b = b/L$ (see Figure 3). After completing these tests, the receptacle shall comply with 10.5.




**Key**

1 nozzle
2 receptacle
3 reference point
*a* force acting in the axis of the nozzle and receptacle
$F_b$ force acting perpendicularly to the axis in the distance, *L*, from the reference point

**Figure 3 — Scheme of the loads for tests**

### 10.6.2 Test in the unpressurized condition

The receptacle test fixture and nozzle shall not be pressurized during the abnormal load tests.

The receptacle shall be mounted as a cantilever to a supporting member in accordance with the manufacturer's instructions. For the purposes of this test, the supporting member shall be capable of withstanding the specified loads without displacement or deflection.

The loads applied and the device's ability to resist damage shall be as specified in 10.6.1.

After completion of the tests, the receptacle shall comply with 10.5.

### 10.6.3 Test in pressurized condition

The receptacle test fixture and nozzle shall be pressurized to 80 % of working pressure during the abnormal load tests.