TECHNICAL SPECIFICATION

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Road vehicles — Liquefied natural gas (LNG) integrated low pressure refuelling and venting connector — 1,8 MPa connector

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

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Contents

Page

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).

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This document was prepared by Technical Committee ISO/TC 22, *Road Vehicles*, Subcommittee SC 41, *Specific aspects for gaseous fuels*.

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.

Road vehicles — Liquefied natural gas (LNG) integrated low pressure refuelling and venting connector — 1,8 MPa connector

1 Scope

This document 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 the nozzle. This document is applicable only to such devices designed for a working pressure of 1,8 MPa to those using LNG as vehicle fuel and having standardized mating components.

NOTE All references to pressures in this document are considered gauge pressures, unless otherwise specified.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 19723 (all parts), *Road vehicles — Liquefied natural gas (LNG) fuel systems*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

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 document, 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
liquefied natural gas
LNG
cryogenic liquid produced by reducing the temperature of natural gas to about –162 °C at atmospheric pressure (depending on LNG composition)

3.6
LNG refuelling connector
joined assembly of *LNG refuelling nozzle* (3.7) and *LNG refuelling receptacle* (3.8) for refuelling and venting via one channel

3.7
LNG refuelling nozzle
device (3.3) which permits quick connection and disconnection of fuel supply hose to the LNG receptacle in a safe manner

3.8
LNG refuelling receptacle
device (3.3) connected to a vehicle or storage system which receives the *LNG refuelling nozzle* (3.7) and permits safe transfer of fuel

3.9
maximum service pressure
maximum pressure of the fuel delivered by the fuelling station

3.10
working pressure
maximum allowable pressure
maximum pressure that an *LNG refuelling connector* (3.6) can be expected to withstand in actual service

3.11
hydrostatic pressure
pressure to which a component is taken to verify the structural strength of the component

3.12
high humidity weather conditions
weather condition with 95 % to 100 % relative humidity at T = + 20 °C

3.13
poppet
movable closing part of the *check valve* (3.1)

3.14
positive locking device
feature which requires actuation of an interlocking mechanism to allow connection/disconnection of the nozzle from the receptacle

3.15
vapour spillage space
dead volume in the LNG refuelling connector between the nozzle and the receptacle measured with trapped water

3.16
non-sparking materials
materials that do not contain, by mass, more than: 7,5 % in total of magnesium, titanium and zirconium

Note 1 to entry: According to IEC EN 60079-0:2011 Clause 8.3 for EPL Gb.

4 General construction requirements

4.1 Design

LNG nozzles and receptacles shall be:

— designed to minimize the possibility of incorrect assembly;

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

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

— able to ensure safe transfer and leak-tight connection at high humidity weather conditions (e.g. freezing or ice crystal damage).

4.1.1 Spillage

LNG nozzles and receptacles shall be designed with a vapour spillage space less than 1 cm^3.

4.1.2 Positive locking device

It shall not be possible, without first actuating the locking release mechanism, to disconnect with normal actuating forces (maximum 100 N or 3 Nm). Under unsafe conditions when an uncontrolled release of LNG can happen which may cause damage to the user and/or the environment.

4.1.3 Design cycle life

All receptacles shall be tested to a durability test for 10 000 coupling cycles for compliance with this document. In addition, all nozzles shall be tested to a durability test for 20 000 cycles.

NOTE 10 000 cycles means one fill per day for 27 years.

4.2 Pressure rating

Working pressure	1,8 MPa
Maximum service pressure	1,5 MPa
Hydrostatic test pressure	2.5 times working pressure

4.3 Working temperature

Working temperature range: –162 °C to +85 °C.

4.4 Materials

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.

4.4.1 Corrosion protection

Corrosion-resistant materials shall be used (see 10.9). Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in contact with each other (analog ISO 15500-2).

4.4.2 Material of the bodies of the receptacle and of the nozzle

Material of the bodies of the pressure containing housings shall be:

a) suitable for the working temperature range,

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

c) non-sparking according to 3.16.

4.5 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 (see 7.2).

4.6 Sealing exchange

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

4.7 Installation

The receptacle shall be installed according to ISO 19723-1 and ISO 19723-2.

5 Nozzles

5.1 Venting depressurization

Venting depressurization of all nozzle types is required prior to disconnection.

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.

6 Standard receptacle dimensions

The receptacle shall comply with the dimensions, stroke and forces shown in Figure 1.

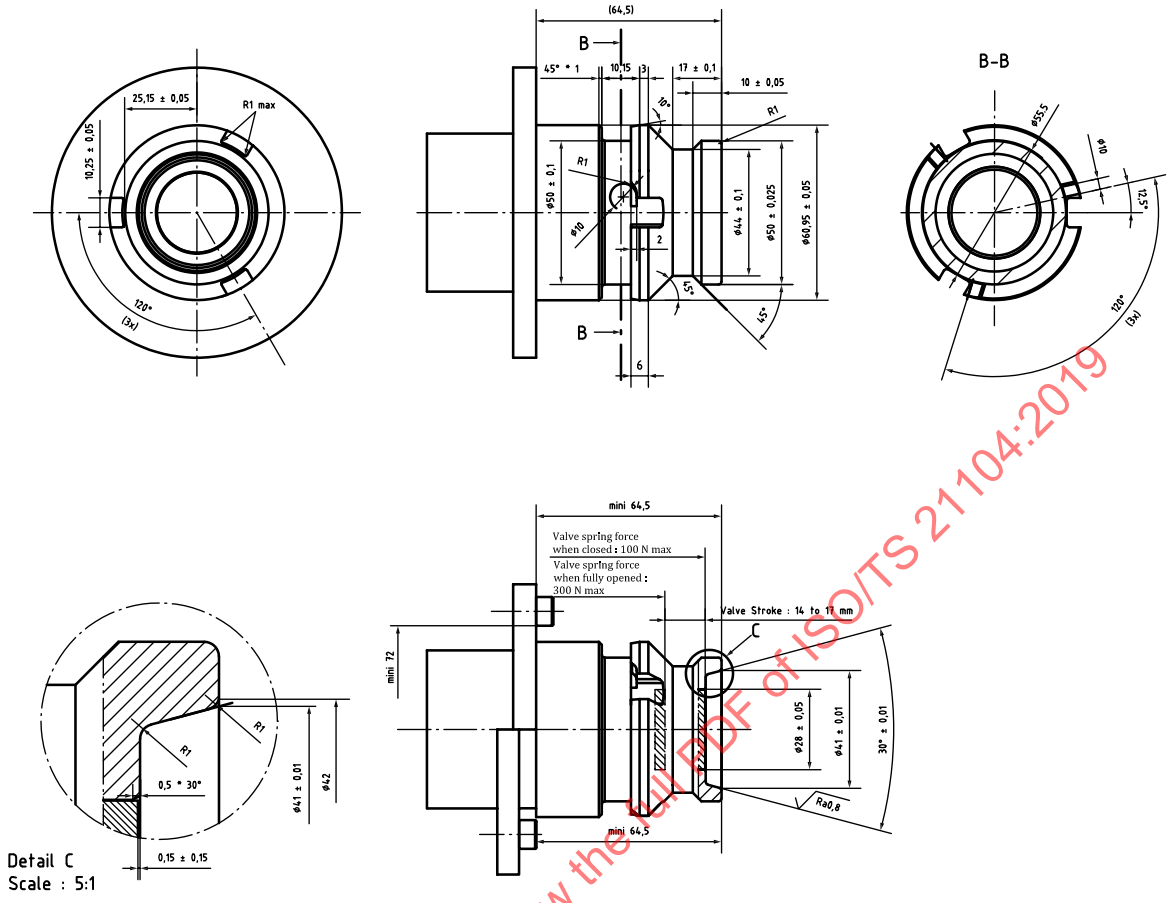


Figure 1 — Dimensions of the receptacle

7 Receptacle

7.1 Cycle life

Receptacle shall have a cycle life as specified in 4.1.

7.2 Design

The receptacle shall have one or more independent check valves mounted inside its body to prevent the escape of gas.

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. The cap shall allow small gas venting originated by warming the cold gas inside or a minor leak of the receptacle poppet. 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 10.5).

8 Instructions

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 (e.g. working pressure, temperature range), and

f) storage and handling.

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 document, i.e. ISO 21104.

9.3 Date of manufacture

Nozzles and receptacles shall each bear a date code marking.

9.3.1 Additional marking

Additional numbers, letters, or symbols can follow the date code. If additional numbers are used, they shall be separated from the date code.

Possible additional information:

— material of the body and its traceability number,

— pressure rating,

— temperature rating.

10 Tests

10.1 General requirements

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

Unless otherwise stated;

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

b) all pressure or leak tests, except hydrostatic pressure test (see 10.6.1), 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 Test program

See Table 1.

Table 1 — Test program

Subclause	Test	Validation
10.3	User-interface	
10.3.1	Positive locking	1 piece
10.3.2	Safe disconnection	1 piece
10.3.3	Manual force at T = 20 °C +/-5 °C	1 piece
10.3.4	Manual force at high humidity	1 piece
10.4	Impact resistance of a nozzle	1 piece
10.5	Abnormal loads	
10.5.1	General	1 piece
10.5.2	Test in the unpressurized condition	1 piece
10.5.3	Test in pressurized condition	1 piece
10.6	Leak test	
10.6.1	Hydrostatic pressure test	1 piece
10.6.2	Leak test	1 piece
10.7	Durability of the device (cycle life)	1 piece
10.8	Electrical conductivity	1 piece
10.9	Corrosion resistance	1 piece
10.10	Non-Destructive Examination NDE	

10.3 User-interface

Where applicable, water or another suitable liquid can be applied as test fluid.

10.3.1 Positive locking

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

10.3.2 Safe disconnection

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

10.3.3 Manual force in at *T* = + 20 °C +/-5 °C

Test configurations:

On depressurized devices, the axial force to connect and lock or unlock and disconnect the device shall be limited.

Execution:

The nozzle shall be capable of being connected or disconnected with the forces or torques not exceeding 100 N or 3 Nm. In case of operation with two hands in one direction, total of both hands' forces shall be under the required limit.

10.3.4 Manual force at high humidity

Test configurations:

On depressurized devices, the axial force to connect and lock or unlock and disconnect the device shall be limited.

Execution:

Effect of icing 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 at *T* = + 20 °C +/- 5 °C. The removal force or torque shall then be measured.

Acceptance criteria:

The forces and torque moments shall be in compliance with 10.3.3.

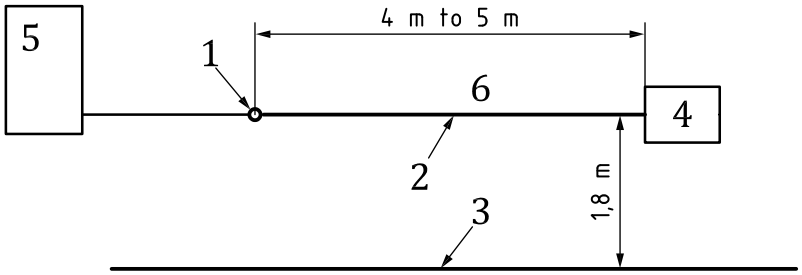
10.4 Impact resistance of a nozzle

Test configurations:

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.

Execution:

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.



Key

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

Figure 2 — Impact resistance test arrangement

Acceptance criteria:

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 this document (see 10.6).

10.5 Abnormal loads

10.5.1 General

Test configurations:

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:

Execution:

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 $F_b = b/L$ (Figure 3).

After completing these tests, the receptacle shall comply with 10.3.

Force *a* pulls along the longitudinal axis of the nozzle or receptacle.

Moment F_b : *b* is applied in a worst-case direction.

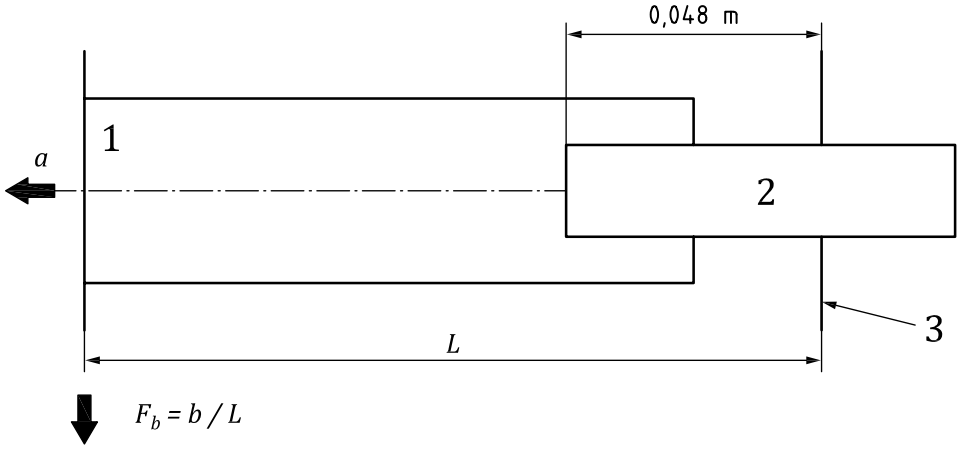
Test I: *a* = 1 350 N and *b* = 120 Nm

Test II: *a* = x N and *b* = x Nm (figures to be defined in alignment with existing break away coupling).

Acceptance criteria:

Test I: The nozzle and receptacle shall be able to withstand the abnormal loads without distortion or damage.

Test II: The nozzle and receptacle shall be able to withstand the abnormal loads without becoming so damaged as to leak.



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

10.5.2 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 10.5.1.

After completion of the tests, the receptacle shall comply with 10.3.

10.5.3 Test in pressurized condition

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

The test fixture shall be mounted as a cantilever to a supporting member. The supporting member shall be capable of withstanding the specified loads without displacement or deflection. The nozzle shall be properly connected to the test fixture.

The loads applied and the devices' ability to resist damage shall be as specified in 10.5.1.

After completion of the tests, the receptacle shall comply with 10.3.

10.6 Leak test

10.6.1 Hydrostatic pressure test

CAUTION — Since the hydrostatic pressure test is a terminal test, do not use the test samples for any further testing.

For safety reasons, water or another suitable liquid can be applied as test fluid.

Test configurations:

The hydrostatic pressure test shall be applied to the following assemblies:

a) an uncoupled nozzle from the inlet side;

b) an uncoupled receptacle from the outlet side;

c) a connected nozzle and receptacle (with the check valves open).

Execution:

Any uncoupled nozzle, uncoupled receptacle, and coupled nozzle and receptacle shall not rupture when subjected to the following test. Outlet openings of the respective assembly, a) to c), shall be plugged and valve seats or internal blocks made to assume the open position.

Hydrostatic pressure according to 4.2.2 shall be applied to the assembly for at least 3 min.

Acceptance criteria:

Zero leakage: If there are no bubbles for a period of 3 min, the sample passes the test.

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

10.6.2 Leakage test

10.6.2.1 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, at working pressure and then again at 0,5 MPa. The maximum allowed leak is 15 cm^3/h or be bubble free for 5 min.

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

If there are no bubbles for the specified time period, the sample passes the test. If bubbles are detected, then the leak rate shall be measured by either a vacuum test using helium gas (global accumulation method) or an equivalent method.

10.6.2.2 Receptacle

The receptacle check valve shall have a leak rate not exceeding 15 cm^3/h at the working pressure or be bubble free for 5 min.

10.7 Durability of the device (cycle life)

10.7.1 Concept of the test of a device

The test of the nozzle or receptacle shall be done for the number of refuelling cycles as specified in 4.1.3.

Each cycle shall be sequence of actions as specified in 10.7.2. The test can then be split into test series as defined in 10.7.3.

10.7.2 Cycle definition

a) The nozzle shall be connected to the receptacle.

b) A pressure of 1,8 MPa shall be applied to the nozzle and held during the test.