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

**Part 3:
25 MPa (250 bar) connector**

*Véhicules routiers — Connecteur de remplissage en gaz naturel
comprimé (GNC) —*

Partie 3: Connecteur 25 MPa (250 bar)

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Contents

Page

Foreword.....	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions.....	2
4 General construction requirements.....	2
5 Nozzles.....	3
6 Standard receptacle dimensions	4
7 Receptacles	6
8 Instructions	6
9 Marking	7
10 Tests.....	7
10.1 General requirements.....	7
10.2 User interface	8
10.3 Impact resistance.....	8
10.4 Receptacle protective caps	9
10.5 Leakage at room temperature	9
10.6 Valve operating handle.....	10
10.7 Abnormal loads.....	10
10.8 Rocking/Twisting	11
10.9 Mounting hardware torque	12
10.10 Low and high temperatures	12
10.11 Durability	13
10.12 Hydrostatic strength.....	17
10.13 Corrosion resistance.....	17
10.14 Deformation.....	18
10.15 Non-igniting evaluation.....	18
10.16 Pressure-tight protective cap (PTPC).....	18
Annex A (informative) Nozzle characteristics	21
Annex B (informative) Manufacturing and production test plan	22
Annex C (normative) Receptacle test fixture.....	23

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 14469-3 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 25, *Vehicles using gaseous fuels*.

ISO 14469 consists of the following parts, under the general title *Road vehicles — Compressed natural gas (CNG) refuelling connector*:

- *Part 1: 20 MPa (200 bar) connector*
- *Part 2: 20 MPa (200 bar) connector Size 2*
- *Part 3: 25 MPa (250 bar) connector*

Introduction

This part of ISO 14469 was developed for use in the examination, testing and certification of newly produced compressed natural gas (CNG) vehicle fuelling nozzles and receptacles, and as such, applies only to the nozzles and receptacles used in CNG fuelling systems, and not to the system itself.

A nozzle certified to this part of ISO 14469 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 listed nozzles of compatible profile and system pressure.

As there may eventually be many different kinds of nozzle and receptacle available from a variety of manufacturers which, for safety reasons, must all be compatible with one another, this part of ISO 14469 specifies a series of receptacle profiles. These standard profiles incorporate the design specifications (mating materials, geometry and tolerances) which may be considered in the certification of a submitted nozzle or receptacle. This part of ISO 14469 refers only to one working pressure and one application. Other working pressures and applications are under consideration for the future.

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

a) Working pressure

All nozzles and receptacles are designed to have a working pressure of 31,5 MPa (315 bar).

b) Design 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 part of ISO 14469. In addition, all nozzles will be tested according to the following frequency use classifications, as applicable:

- 1) class A nozzle, specifying high frequency use, with a cycle life of 100 000 and equating to approximately 100 fills per day for three years;
- 2) class B nozzle, specifying medium frequency use, with a cycle life of 20 000 cycles and equating to approximately 10 fills per day for five years.

c) Training

Operator training required is in accordance with national requirements.

Road vehicles — Compressed natural gas (CNG) refuelling connector —

Part 3: 25 MPa (250 bar) connector

1 Scope

1.1 This part of ISO 14469 applies to compressed natural gas (CNG) vehicle nozzles and receptacles hereinafter referred to as devices, constructed entirely of new, unused parts and materials. CNG fuelling connection nozzles consist of the following components, as applicable:

- a) receptacle and protective cap (mounted on vehicle) (see Clause 7);
- b) nozzle (see Clause 5).

1.2 This part of ISO 14469 applies to devices which have a service pressure of 250 bar, hereinafter referred to as B250 [see 9 a) 3)].

This part of ISO 14469 refers only to a service pressure of 250 bar.

1.3 This part of ISO 14469 applies to devices with standardized mating components (see 5.8 and 7.7).

1.4 This part of ISO 14469 applies to connectors which:

- 1) prevent natural gas vehicles from being fuelled by dispenser stations with service pressures higher than that of the vehicle;
- 2) allow natural gas vehicles to be fuelled by dispenser stations with service pressures equal to or lower than the vehicle fuel system service pressure.

1.5 This part of ISO 14469 is applicable to compressed natural gas in accordance with ISO 15403.

1.6 All references to pressures (bar) throughout this part of ISO 14469 are to be considered gauge pressures unless otherwise specified.

2 Normative references

The following referenced documents are indispensable for the application 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 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing or heat-resistance tests*

ISO 1817:1985, *Rubber, vulcanized — Determination of the effect of liquids*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 15403, *Natural Gas — Designation of the quality of natural gas for use as a compressed fuel for vehicles*

ISO 15501-1, *Road vehicles — Compressed natural gas (CNG) fuel systems — Part 1: Safety requirements*

3 Terms and definitions

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

- 3.1**
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
- 3.2**
hydrostatic pressure
pressure to which a component is taken to verify the structural strength of the component
- 3.3**
working pressure
maximum pressure that a CNG refuelling connector can be expected to withstand in actual service
- 3.4**
service pressure
settled pressure of 25 MPa (250 bar) at a uniform gas temperature of 15 °C
- 3.5**
positive locking means
feature that requires actuation of an interlocking mechanism to allow connection/disconnection of the nozzle from the receptacle
- 3.6**
CNG refuelling nozzle
device that permits quick connection and disconnection of fuel supply hose to the CNG receptacle in a safe manner, hereafter referred to as CNG nozzle
- 3.7**
CNG refuelling receptacle
device connected to a vehicle or storage system, which receives the CNG refuelling nozzle and permits safe transfer of fuel, hereafter referred to as receptacle
- 3.8**
CNG refuelling connector
joined assembly of CNG nozzle and receptacle, hereafter referred to as connector

4 General construction requirements

- 4.1** CNG nozzles and receptacles manufactured in accordance with this part of ISO 14469 shall be designed in accordance with reasonable concepts of safety, durability and maintainability.
- 4.2** CNG nozzles and receptacles shall be well fitted and manufactured in accordance with good engineering practice. All construction requirements may be met by either the construction specified in this part of ISO 14469 or another construction that gives at least equivalent performance.
- 4.3** CNG 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.

4.4 CNG nozzles and receptacles shall be manufactured from materials suitable and compatible for use with compressed natural gas at the pressure and the temperature ranges to which it will be subjected (see 1.6).

The minimum temperature range shall be selected by the manufacturer between the following ranges:

- 40 °C to 85 °C
- 20 °C to 120 °C

4.5 CNG nozzles and receptacles constructed of brass shall use brass alloys with a copper mass content $\leq 70\%$.

This ensures proper material compatibility with all the constituents of natural gas.

4.6 Separate external three-way valves shall be constructed and marked so as to indicate clearly the open, shut and vent positions.

4.7 CNG nozzles and receptacles shall be operated to connect and disconnect without the use of tools.

4.8 The receptacle shall be mounted on the vehicle in compliance with ISO 15501-1.

4.9 Jointing components shall provide gas-tight sealing performance.

5 Nozzles

5.1 Nozzles shall be one of the three types according to a), b) and c). See also Annex A.

- a) Type 1: is a nozzle for use with dispensing hoses that remain fully pressurized at dispenser shutdown. The nozzle shall not allow gas to flow until a positive connection has been achieved. The nozzle shall be equipped with an integral valve or valves, incorporating an operating mechanism which first stops the supply of gas and safely vents the trapped gas before allowing disconnection of the nozzle from the receptacle. The operating mechanism shall ensure the vent valve is in the open position before the release mechanism can be operated and that the gas located between the nozzle shut-off valve and the receptacle check valve is safely vented prior to nozzle disconnection (see 10.2).
- b) Type 2: is a nozzle for use with dispensing hoses that remain fully pressurized at dispenser shutdown. A separate three-way valve connected directly, or indirectly, to the inlet of the nozzle is required to safely vent trapped gas prior to nozzle disconnection. The nozzle shall not permit the flow of gas if unconnected. Venting is required prior to disconnection of the nozzle (see 10.2).
- c) Type 3: is a nozzle for use with dispensing hoses which are automatically depressurized – 0,5 MPa (5 bar) and below – at dispenser shutdown (see 10.2).

In addition, nozzles shall be classified in terms of cycle life as follows:

- class A, specifying high frequency use, with a cycle life of 100 000;
- class B, specifying low frequency use, with a cycle life of 20 000.

5.2 Venting or de-pressurization of all nozzle types is required prior to disconnection. Disconnection of all nozzles shall be able to be accomplished in accordance with 10.2.

5.3 The method for attaching the nozzle to the fuel dispensing system hose shall not rely on the joint threads between the male and female threads for sealing (e.g. conical threads).

5.4 The three-way valve exhaust port of Type 1 and Type 2 nozzles shall be protected from the ingress of foreign particles and fluid which would hamper the operation of the valve.

5.5 The portions of a nozzle which are held by the user for connection or disconnection may be thermally insulated.

5.6 A Type 1 nozzle shall bear a marking in accordance with Clause 9, indicating the direction of the open and shut operation of the actuating mechanism, if necessary.

5.7 The interface surface of the nozzle shall be constructed of material having a hardness > 75 Rockwell B (HRB 75) and shall be non-sparking and conductive (see 10.11.5 and 10.15).

The exposed surfaces of the nozzles shall be made of non-sparking materials (see 10.11.5 and 10.15).

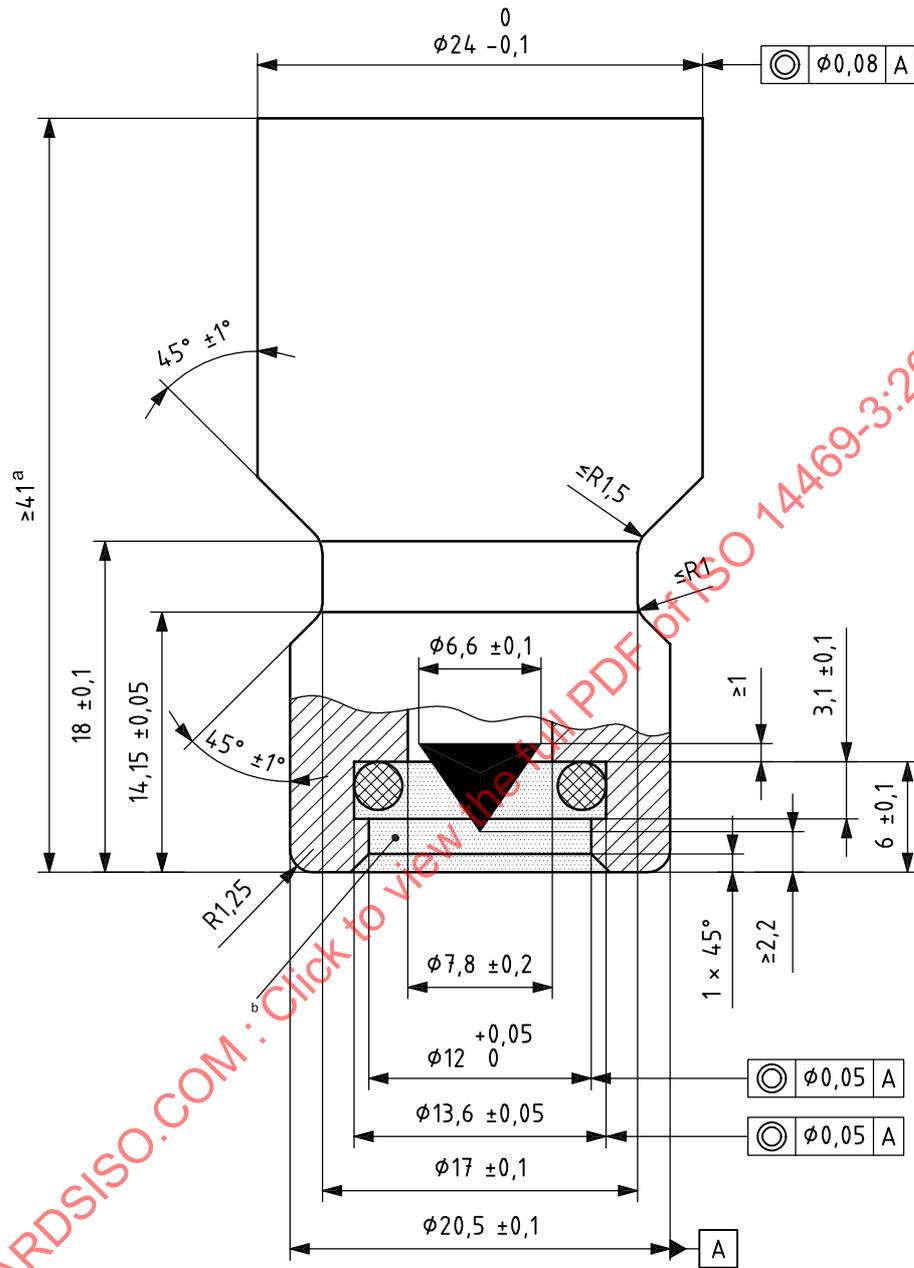
5.8 Nozzles shall comply with the performance requirements of Clause 10 to ensure interchangeability.

6 Standard receptacle dimensions

A receptacle shall comply with the design specifications detailed in Figure 1.

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Dimensions in millimetres



NOTES:

Sealing dimensions: ID $9,19 \text{ mm} \pm 0,127 \text{ mm}$; width $2,62 \text{ mm} \pm 0,076 \text{ mm}$.

Sealing surface finish: $0,8 \mu \pm 0,05 \mu$.

Material hardness: $\geq \text{HRB } 75$.

Surface finish range: $\leq 3,2 \mu$.

- a Minimum length of the receptacle that is clear of provisions for attachment of the receptacle or protective caps.
- b This shaded area shall be kept free of all components.

Figure 1 — Standard receptacle dimensions

7 Receptacles

7.1 Receptacles shall be evaluated using at least two different test nozzles, each nozzle representing a different locking technology.

The failure of any test conducted with the receptacle and nozzle test samples shall constitute a failure of the submitted receptacle, unless the manufacturer can prove the problem was caused by the test nozzle.

7.2 Receptacle designs which employ means on the back diameter as specified in Figure 1 to accommodate mounting, or for mounting accessories or marking purposes, shall not have such means extend beyond the back diameter dimensions of the profile as specified in Figure 1, as applicable. Acceptable means include wrench flats, dust cap anchoring grooves, use of hex stock, undercutting for marking, and threads for pressure-tight caps. Receptacle designs shall not compromise the interchangeability requirements specified in Annex C.

7.3 The receptacle shall be equipped with an internal check valve to prevent the escape of gas. The check valve shall be of the non-contact type, opening by differential pressure only.

7.4 The method for attaching the receptacle to the vehicle fuel system shall not rely on the joint between the male and female threads for sealing, such as conical threads.

7.5 The interfacing surface of the receptacle shall be constructed of material having a hardness \geq HRB 75 and shall be non-sparking and conductive (see 10.11.5 and 10.15).

The exposed surfaces of devices shall be made of non-sparking materials (see 10.11.5).

7.6 Receptacles shall have a means to prevent the ingress of fluids and foreign matter.

7.7 The function described in 7.6 may also be met by either a protective cap (see 10.4) or a pressure-tight protective cap (see 10.16).

7.8 The receptacle shall have provisions to be firmly attached to the vehicle and shall comply with applicable abnormal load tests (see 10.7).

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

7.10 Receptacles shall have a cycle life $>$ 10 000 cycles.

8 Instructions

This information shall be in a form that is easily understood.

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

Manufacturers of receptacles, nozzles and three-way valves shall provide clear and concise printed instructions and diagrams in a form that can be easily understood and which are adequate for:

- a) proper field assembly;
- b) installation;
- c) maintenance;
- d) replacement of components as appropriate;
- e) safe operation by all users;

- f) suitability and use;
- g) storage and handling.

9 Marking

This information shall be in a form that is easily understood. Markings shall be embossed, cast, stamped or otherwise formed on the part in question. This includes markings baked into an enamelled surface.

a) Nozzles and receptacles shall bear the following information:

- 1) manufacturer's or dealer's name, trademark or symbol;
- 2) model designation;
- 3) B250;
- 4) applicable type and class (see 5.1).

b) 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 as follows:

- 1) the first and second digits shall indicate the calendar year in which the nozzle, receptacle or three-way valve was manufactured (e.g. 96 for 1996 and 00 for 2000);
- 2) the third and fourth digits 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 may 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 into the next calendar year.

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.

Additional numbers, letters or symbols may follow the four digit number specified in 1) and 2). If additional numbers are used, they shall be separated from the date code.

c) Marking to identify this part of ISO 14469 shall be provided for each system. This marking may be located on the package or on a notice placed inside the package in which the device is shipped.

10 Tests

10.1 General requirements

A nozzle and receptacle shall be tested with the receptacle and nozzle designs specified in Clauses 1 to 9.

Unless otherwise stated:

- a) tests shall be conducted at room temperature (20 ± 5)°C;
- b) all pressure or leak tests shall be conducted with dry air or dry nitrogen;
- c) devices shall be conditioned to attain equilibrium conditions.

Type 2 nozzles shall be tested in series, with either a three-way valve or some other means to independently pressurize and vent the nozzle. The three-way valve shall not affect temperature, durability or flow characteristics of the nozzle. Failure of the three-way valve shall not constitute failure of the nozzle. A three-way valve that is supplied for utilization with a Type 2 nozzle, shall be evaluated separately.

Nozzle tests shall be carried out with the test fixtures, as specified in Annex C, as applicable. A new receptacle test sample shall be used for each nozzle test. The failure of any test conducted with the nozzle and receptacle test sample shall constitute a failure of the nozzle design.

10.2 User interface

The appearance of the nozzle and receptacle shall be such as to clearly suggest the proper method of use.

It shall not be possible to deliver gas using Type 1 nozzles unless the nozzle and receptacle are connected properly and positively locked.

Upon disconnection, Type 1, 2 and 3 nozzles shall stop the flow of gas. No hazardous condition shall result from disconnection. Type 3 nozzles shall be at 0,7 MPa (7 bar) during this test.

When the contained pressure is less than or equal to 0,7 MPa (7 bar), all nozzles shall be capable of being disconnected with forces or torques not exceeding 225 N or 7 N·m.

The disconnection force/torque shall be applied in a direction that tends to unhook and release the nozzle. The force/torque shall be applied to the unhooking/release actuator. The torque shall be applied through axis rotation of the nozzle handle equal to the exterior handling surface of the nozzle uncoupling mechanism and in a direction such that the nozzle tends to unhook and be released.

On depressurized devices, the axial force to connect and lock or unlock and disconnect the device shall be ≤ 90 N.

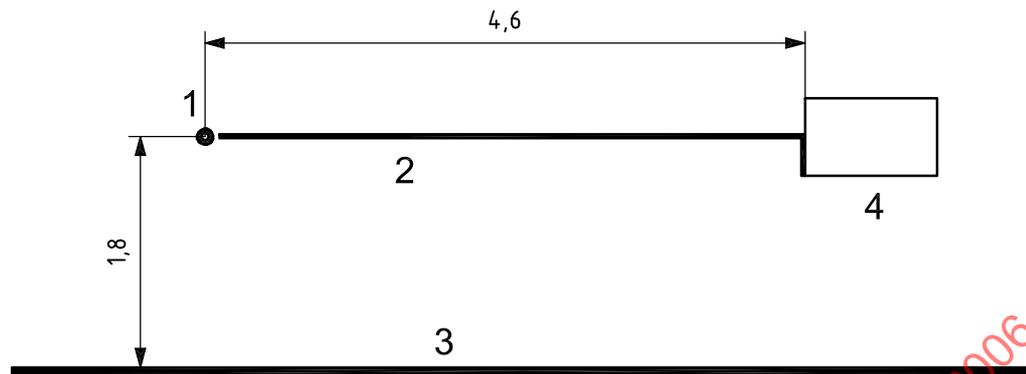
On a positive locking device that incorporates a rotary locking means, the torque needed to lock or unlock the locking means shall not exceed 1 N·m for a device having a diameter $\leq 25,4$ mm and 1,7 N·m for a device having a diameter $> 25,4$ mm.

The minimum force to facilitate disconnection at pressures of 6,25 MPa (62,5 bar) or more, shall be $2,5 \times$ the force when depressurized (Types 1 and 2) or 0,7 MPa (7 bar) (Type 3). Type 1 nozzles shall be tested with the vent port plugged.

10.3 Impact resistance

A nozzle shall be connected to a 4,6 m length of 9,5 mm internal diameter (ID) refuelling hose, conditioned at -40 °C for 24 h and then dropped 1,8 m on to a concrete floor as shown in Figure 2. The nozzle shall be dropped ten times, then pressurized to 25 MPa (250 bar) and subjected to ten additional drops. Following these drops, 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 part of ISO 14469 (see 10.5).

Dimensions in metres

**Key**

- 1 suitable support
- 2 refuelling hose (9,5 mm in diameter)
- 3 concrete floor
- 4 nozzle

Figure 2 — Impact resistance test arrangement**10.4 Receptacle protective caps**

There shall be no permanent distortion or damage to any receptacle protective cap, when tested as follows.

A solid steel ball with a diameter of 50 mm shall be dropped from a height of 300 mm striking the protective cap installed on the receptacle. The test shall be conducted at $-40\text{ }^{\circ}\text{C}$ and at $85\text{ }^{\circ}\text{C}$ at at least the five points of impact most likely to cause damage to the receptacle and the protective cap.

10.5 Leakage at room temperature**10.5.1 Nozzle**

A nozzle, whether coupled or uncoupled, shall be either bubble-free on the leak test for 1 min or have a leak rate of less than $20\text{ cm}^3/\text{h}$ (normalized) when tested as follows.

Tests shall be conducted at 0,5 MPa (5 bar), 37,5 MPa (375 bar) and then 0,5 MPa (5 bar) again.

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 from the time of connection, through full fuel flow, to the time of disconnection.

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 either a vacuum test using helium gas (global accumulation method) or an equivalent method.

10.5.2 Receptacle

The receptacle check valve shall be either bubble-free on the leak test for 1 min or have a leak rate less than $20\text{ cm}^3/\text{h}$ (normalized) when tested as follows.

Tests shall be conducted at 0,5 MPa (5 bar), 37,5 MPa (375 bar) and then 0,5 MPa (5 bar) again.

The receptacle shall be connected to a pressure vessel capable of safely accommodating the specified test pressures. The receptacle and pressure vessel shall then be pressurized. Once the pressure vessel has reached the specified test pressure, the upstream portion of the receptacle shall be quickly depressurized and the receptacle check valve checked for leakage.

10.6 Valve operating handle

If a nozzle is equipped with a valve operating handle, it shall be capable of withstanding double the manufacturer's specified operating torque or force, without damage to the operating handle or the operating handle stops.

This test with the torque or force applied in both the opening and closing directions shall be performed:

- a) with the nozzle properly connected to a receptacle;
- b) with the nozzle intentionally misaligned relative to the receptacle.

10.7 Abnormal loads

10.7.1 General

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

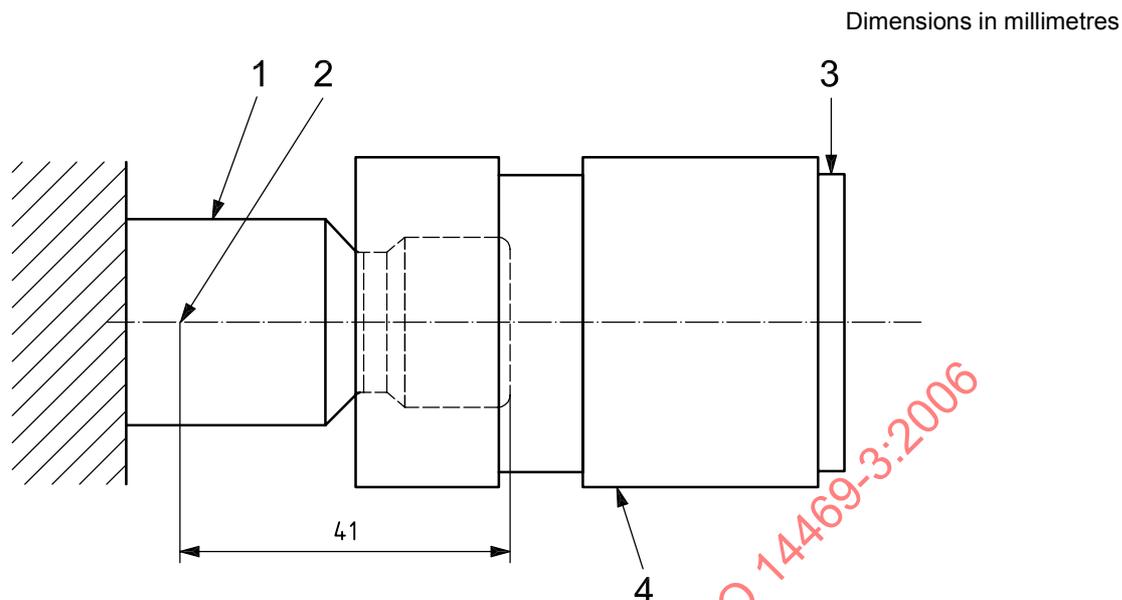
- a) pulls along the nozzle or receptacle longitudinal axis;
- b) moments applied in a worst-case manner.

The nozzle and receptacle shall be able to withstand abnormal loads of:

- 1 350 N [a], 120 N·m [b] without distortion or damage and
- 2 700 N [a], 240 N·m [b] without becoming so damaged as to leak.

The load and moment arm shall be measured about a point 41 mm from the front of the receptacle to the hose inlet of the nozzle (see Figure 3).

After completing these tests, the receptacle shall comply with 10.5.

**Key**

- 1 receptacle
- 2 abnormal load reference
- 3 moment
- 4 nozzle

Figure 3 — Abnormal load test

10.7.2 Abnormal load test in the unpressurized condition

The receptacle test fixture and nozzle shall not be pressurized during the following 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 devices' ability to resist damage shall be as specified in 10.7.1. After completion of the tests, the receptacle shall comply with 10.5.

10.7.3 Abnormal load test in the pressurized condition

The receptacle test fixture and nozzle shall be pressurized to 31,5 MPa (315 bar) during the following abnormal load tests.

The "loose fit" test fixture (see Annex C) shall be used for this test, regardless of the working pressure rating of the nozzle. The test fixture shall be mounted as a cantilever to a supporting member. For the purposes of this test, 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 10.7.1. After completion of the tests, the receptacle shall comply with 10.5.

10.8 Rocking/Twisting

The receptacle and its mounting hardware shall not be loosened or damaged when subjected to the following test.

Utilizing the receptacle mounting hardware submitted by the manufacturer, the receptacle shall be mounted on 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 nozzle, attached to a pressurized hose as installed for normal use, shall be properly connected to the receptacle. An alternating 24 N·m moment shall be applied 2 500 times, at a frequency not exceeding one cycle per second, at a point on the nozzle furthest from the receptacle.

A 4 N·m torque shall then be applied ten times to the receptacle in the direction most likely to loosen the mounting hardware.

Following the above tests, the receptacle shall comply with room temperature leakage tests (see 10.5). Following room temperature leakage tests, the receptacle shall comply with hydrostatic strength tests (see 10.12).

10.9 Mounting hardware torque

The receptacle and mounting hardware shall withstand, without damage, a turning force equal to 150 % of the manufacturer's recommended mounting hardware fastening torque.

10.10 Low and high temperatures

10.10.1 General

Prior to conditioning, the devices shall be purged with nitrogen and then sealed from the atmosphere under a pressure of 7 MPa (70 bar) nitrogen or dry air.

All tests shall be conducted while the devices continue to be exposed to the specified test temperatures. The outlet of the device shall be plugged and the test pressure shall be applied to the inlet of the device. The device shall be either bubble-free on the leak test for a specified time period or have a leak rate less than 20 cm³/h (normalized).

10.10.2 Leakage test

10.10.2.1 Preconditioning

At each test condition the devices shall be maintained at the specified temperature for 2 h, then tested in accordance with 10.10.2.2.

- a) The nozzle and receptacle coupled, conditioned at – 40 °C and pressurized at 0,5 MPa (5 bar) and 15 MPa (150 bar).
- b) The nozzle and receptacle coupled, conditioned at 85 °C and pressurized at 1 MPa (10 bar) and 37,5 MPa (375 bar).
- c) The receptacle uncoupled, conditioned at – 40 °C and pressurized at 0,5 MPa (5 bar) and 15 MPa (150 bar).
- d) The receptacle uncoupled, conditioned at 85 °C and pressurized at 1 MPa (10 bar) and 37,5 MPa (375 bar).
- e) The nozzle uncoupled, conditioned at – 40 °C and pressurized at 0,5 MPa (5 bar) and 15 MPa (150 bar).
- f) The nozzle uncoupled, conditioned at 85 °C and pressurized at 1 MPa (10 bar) and 37,5 MPa (375 bar).

10.10.2.2 Test

Pressurized air or nitrogen shall be applied to the test components. The external body shall then be checked for bubble-tight leakage using

- a) at – 40 °C, immersion in a 70 % glycol and 30 % water mixture for 2 min;
- b) at 85 °C, immersion in 85 °C water for 1 min.

For test b), the use of glycol up to 30 % is permitted.

10.10.2.3 Requirement

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.

10.10.3 Operation test

The devices shall function normally and deliver gas when tested under the following conditions.

- a) The nozzle and receptacle connected and disconnected ten times when conditioned at – 40 °C and pressurized to 15 MPa (150 bar).
- b) The nozzle and receptacle connected and disconnected ten times when conditioned at 85 °C and 25 MPa (250 bar).

10.11 Durability

10.11.1 Durability cycling

10.11.1.1 Nozzle test

All nozzles shall be capable of withstanding the number of specified operational cycles listed in Table 1. During the following tests, all nozzles shall be maintained according to the manufacturer's instructions. Requirements for maintenance at intervals less than specified by the manufacturer shall be considered as not complying with this part of ISO 14469.

Table 1 — Nozzle usage frequency

Nozzle type	Frequency of use (by class)	
	Class A	Class B
Type 1	100 000	—
Type 2	100 000	20 000
Type 3	100 000	20 000

For the purposes of this test, one cycle of operation shall be:

- a) properly connecting the nozzle to the test fixture;
- b) pressurizing the nozzle to 31,5 MPa (315 bar) using dry, oil-free air or nitrogen;
- c) depressurizing the nozzle;
- d) disconnecting the nozzle.

At each disconnection, the test fixture shall be rotated relative to the nozzle at random or equal degree increments throughout this test. This is to be repeated until 10 000 cycles are completed, after which time the nozzle shall be examined for wear. For a Type 3 nozzle, the pressure shall be reduced to 0,5 MPa (5 bar) during the disconnection phase.

The working pressure shall be maintained on the inlet of each nozzle throughout the test. For a Type 1 nozzle, the working pressure shall be maintained on the inlet. For a Type 2 nozzle, the working pressure shall be maintained on the inlet of the three-way valve.

At 20 % intervals, the nozzle shall comply with 10.5 and 10.10.2. In addition, at these intervals, the nozzle locking mechanism shall be checked at the normal disconnection pressure to ensure it is properly engaged on the nozzle.

For a Type 1 nozzle, the vent valve operating mechanism shall be manually operated ten times at both high and low temperatures at each of the cycle intervals prior to checking for leakage.

The test fixture shall be replaced at 10 000 cycle intervals. The test fixture shall be selected from Table 2. The worn test fixtures resulting from cycling the test nozzle shall not be in excess of wear patterns shown in Figure 4. In addition, following completion of the required number of cycles, the test nozzle shall comply with 10.5 and 10.12 when tested with the receptacle test piece of Figure 4. Failure to comply with any of the tests specified in 10.11.1 shall be deemed as a failure of the test nozzle. The replacement of nozzle seals shall be acceptable at intervals of 40 % of the total number of cycles.

For Class A devices, the seal(s) may be replaced at 40 000 and 80 000 cycles if the manufacturer's instructions clearly state that this is recommended practice.

Table 2 — Test fixture selection for nozzle durability

Cycle numbers	Figure	Replacement frequency
0 – 50 000	C.1	Every 10 000 cycles
50 001 – 100 000	C.2	Every 10 000 cycles

10.11.1.2 Receptacle check valve test

The receptacle check valve shall be bubble-free on the leak test for 1 min and be capable of withstanding 100 000 cycles of operation and 24 h of the flow conditions that cause the most severe chatter.

The receptacle shall be connected to a nozzle test fixture. A pressure of 31,5 MPa (315 bar) shall be applied to the nozzle and receptacle. Pressure shall then be vented from the upstream side of the receptacle check valve. Pressure on the downstream side of the receptacle check valve shall be lowered to between 0 and a maximum of 12,5 MPa (125 bar) prior to the next cycle.

Following 100 000 cycles of operation, the receptacle check valve shall then be subjected to 24 h of flow at the inlet/outlet flow conditions that cause the most severe chatter. The receptacle shall then be tested for compliance with 10.5 and 10.10.2.

10.11.1.3 Nozzle check valve test

Without being connected to the receptacle, the nozzle check valve (which prevents the flow of gas unless properly connected) shall be capable of withstanding 500 cycles of the application of 31,5 MPa (315 bar). Following this test, the nozzle check valve shall be bubble-free on the leak test for 1 min when tested, in accordance with 10.2, 10.5 and 10.10.2.

10.11.1.4 Receptacle test

A receptacle shall be capable of withstanding 10 000 cycles of operation as specified in the following test.

For the purposes of this test, one cycle of operation shall be:

- a) properly connecting the nozzle to the receptacle;
- b) pressurizing the devices to 31,5 MPa (315 bar) using dry, oil-free air or nitrogen;
- c) depressurizing the devices;
- d) disconnecting the nozzle.

After every 100 cycles, a 20 N·m torque shall be applied around the longitudinal axis of the pressurized nozzle, through a maximum rotation of 30°, after which the test will continue as before. Following this test the receptacle shall pass the test given in 10.2, 10.5 and 10.10.2.

10.11.1.5 Receptacle full flow test

The receptacle shall be capable of withstanding full flow condition, as specified in the following test.

The receptacle shall be connected to a nozzle. The outlet of the receptacle shall be open to atmospheric pressure. The supply port of the nozzle shall be connected to a system which shall supply sufficient compressed dry air or nitrogen.

Each receptacle shall undergo 30 cycles. Each cycle shall consist of the full flow of gas with the supply pressure starting at 27,5 MPa (275 bar). A cycle shall be 2 s in length and the supply pressure shall not fall below 20 MPa (200 bar) at the end of each cycle. The test system shall not limit the flow during this test.

Following this test the receptacle shall pass the test given in 10.5.

10.11.2 Oxygen ageing

Sealing materials shall be listed and rated by the manufacturer as being resistant to oxygen ageing. Otherwise, the materials shall not crack or show visible evidence of deterioration subsequent to oxygen ageing as follows.

Samples shall be subjected to 96 h of exposure at 70 °C and at 2,5 MPa (25 bar). This test shall be conducted in accordance with ISO 188.

10.11.3 Seal material compatibility

Sealing materials shall be listed and rated by the manufacturer for this application. Otherwise, they shall not show excessive volume change or loss of weight when tested as follows.

- a) Representative sample(s) of seal materials shall be prepared, measured and weighed. The samples shall then be immersed in natural gas at 31,5 MPa (315 bar) for 70 h. Following this time period, the test pressure shall be rapidly reduced to atmospheric pressure, after which the test samples shall not exhibit evidence of shredding. In addition, the samples shall not swell by more than 25 %, shrink by more than 1 % or incur a weight loss in excess of 10 %. See ISO 1817 for determination of the effect of liquids.
- b) To evaluate the possible deleterious effects of compressor oils on any seal material, the material shall also be immersed for a period of 70 h in both a petroleum-based and a synthetic compressor oil. Following these time periods, observations shall be made as to the condition of the material.
- c) Seal materials shall pass the following test procedure, with either dry air or nitrogen, using one sample only, while maintained at the specified temperature, – 40 °C or 85 °C, for 8 h and at 25 MPa (250 bar), as follows.

The test sample pressure shall not fall below the initial 25 MPa (250 bar) setting. The test sample shall be bubble-tight [$< 20 \text{ cm}^3/\text{h}$ (normalized)] at the noted test temperature. Upon completion of all tests, the test sample shall be disassembled and the seal material interface checked to ensure that the samples did not swell by more than 25 %, shrink by more than 1 %, change by more than $\pm 5^\circ$ Shore D hardness or incur a weight loss in excess of 10 %.

10.11.4 Ten-day moist ammonia-air stress cracking

After being subjected to the following conditions, a brass part containing more than 15 % zinc shall show no evidence of cracking when examined using 25 × magnification.

Each test sample shall be subjected to the physical stresses normally imposed on or within a part as the result of assembly with other components. Such stresses shall be applied to the sample prior to, and maintained during, the test. Samples with threads, intended to be used for installing the product in the field, shall have the threads engaged and tightened to the torque specified by the manufacturer. Polytetrafluorethylene (PTFE) tape or pipe compound shall not be used on the threads.

Three samples shall be degreased and then continuously exposed in a set position for ten days to a moist ammonia-air mixture maintained in a glass chamber of approximately 3 l capacity having a glass cover.

Approximately 0,6 l of aqueous ammonia having a specific gravity of 0,94 shall be maintained at the bottom of the glass chamber below the samples. The samples are each to be positioned 40 mm above the aqueous ammonia solution and supported by an inert tray. The moist ammonia-air mixture in the chamber shall be maintained at atmospheric pressure and at a temperature of $34\text{ °C} \pm 2\text{ °C}$.

10.11.5 Electrical resistance

The electrical resistance of the connected receptacle and nozzle shall not be greater than $0,1\ \Omega$ in the pressurized and unpressurized states. Tests shall be conducted prior to, and after, durability cycling (see 10.11.1).

10.12 Hydrostatic strength

CAUTION — Because the hydrostatic strength test is a terminal test, do not use the test samples for any other testing.

An uncoupled nozzle, uncoupled receptacle and coupled nozzle and receptacle shall not rupture when subjected to the following test.

Outlet openings of the uncoupled or coupled connector shall be plugged and valve seats or internal blocks made to assume the open position. A hydrostatic pressure of 125 MPa (1 250 bar) shall be applied to the inlet of the nozzle or outlet of the receptacle for a period of at least 3 min.

10.13 Corrosion resistance

Nozzles and receptacles shall not sustain corrosion or loss of protective coatings, and shall be capable of performing safely subsequent to the following test.

Previously untested samples shall be used. Protective caps shall be in place. Vent holes shall not be plugged.

The devices shall be supported in a horizontal position. The devices shall be exposed for 96 h to a salt spray as specified in ISO 9227.

Throughout the test, the temperature within the test chamber shall be maintained at between 33 °C and 36 °C . The salt spray solution shall consist of 5 % sodium chloride and 95 % distilled water (by weight).

A pressure of 0,5 MPa (5 bar) air shall also be continuously applied to the inlet of the nozzle. The nozzle shall be operated once an hour to dispense air to the atmosphere through a dummy receptacle during the first 8 h test period.

The nozzles and receptacles shall then be rinsed and gently cleaned of salt deposits. The nozzles and receptacles shall then comply with room temperature leakage tests (see 10.5).

10.14 Deformation

Connectors shall be capable of withstanding a turning effort of 150 % of the manufacturer's recommended assembly torque, without significant deformation, breakage or leakage.

A sample not previously subjected to hydrostatic strength tests shall be used.

Straight-thread O-ring seals shall be lubricated with ISO 1817:1985 oil No. 1. Connectors shall be connected and assembled to the applicable torque specified above in a worst-case manner in accordance with good assembly practices. While still connected and assembled, the assembly shall comply with 10.5 and 10.10.2 and then pass the hydrostatic strength test according to 10.12.

10.15 Non-igniting evaluation

Materials that have been demonstrated to be non-sparking, as determined by a notified body, shall be deemed as being non-igniting. Otherwise they shall be subjected to the following test.

Each sample material shall be held against a coarse emery grinding wheel (grit size 36) rotating with a surface speed of approximately 26 m/s. Contact with the grinding wheel shall be maintained for 30 s with a force of $22,0 \text{ N} \pm 4,4 \text{ N}$. The material removed from each sample by the grinding wheel shall be directed on to a $10,0 \text{ cm} \times 10,0 \text{ cm} \times 0,4 \text{ cm}$ pad of cotton batting located directly beneath, and within 10,0 cm of, the point of contact between the sample and the grinding wheel. The fresh cotton pad shall be saturated with petrol immediately prior to each test. Each sample is tested with gasoline to determine if the material removed by the grinding wheel will cause ignition. This test shall be repeated using a stoichiometric mixture of natural gas and air. The mixture shall be directed into the path of the removed particles at the point most likely to cause ignition.

10.16 Pressure-tight protective cap (PTPC)

10.16.1 General

Pressure-tight protective caps will be referred to in this subclause as either PTPC or device. All receptacles referred to in 10.16 are to be in accordance with the profile shown in Figure 1, and shall be tested without the internal check valve mechanism.

10.16.2 Leakage

A PTPC/receptacle assembly shall be bubble-tight for 5 min on the leakage tests over the range of test conditions specified in the following test.

A new PTPC/receptacle sample shall be used for this test.

Nitrogen shall be used as the test gas and pressure source, except during room temperature tests where dry air may be used.

All leakage tests shall be conducted at both the manufacturer's maximum and minimum specified installation forces or torques.

The PTPC shall be attached to the test fixture receptacle.

This test shall be conducted at all of the pressure and temperature conditions specified in Table 3.

The test sample shall be conditioned at the specified test temperature for at least 2 h. The PTPC shall be removed and reinstalled using the manufacturer's maximum specified installation torque. To minimize temperature deviation, this removal/installation cycle shall be accomplished within two minutes following removal of the device from the temperature chamber. The test sample shall be exposed to the pressure and temperature conditions according to Table 3. The test sample shall not leak over the complete test range measured during the first 5 min period of each test.

The manufacturer has the option of performing this test once only, upon completion of all tests given in 10.16.6.

Table 3 — Pressure and temperature test conditions

Pressure MPa (bar)	Temperatures		
	– 40 °C	Room	85 °C
1 (10)			×
37,5 (375)		×	×
0,5 (5)	×	×	
15 (150)	×		

10.16.3 Durability cycling

A PTPC shall comply with 10 000 cycles of durability testing as outlined in the following test method. Following the durability test, the test sample shall comply with 10.16.2 with an O-ring that has been cycled through 2 000 cycles of durability.

The PTPC shall not be pressurized during this test.

One cycle shall be defined as:

- a) attaching the PTPC to a test fixture receptacle in accordance with the manufacturer's specified force or torque;
- b) removing the PTPC until the PTPC is fully disengaged.

This shall be repeated for 2 000 cycles. The temperature of the PTPC shall be monitored during the first 100 cycles to ensure that the frequency and frictional effects of the test do not interfere with the integrity of durability testing.

The above cycling operation shall be repeated at 2 000 cycle intervals for a total of 10 000 cycles. The room temperature leak test shall be conducted at 2 000, 6 000 and 10 000 cycles as specified in 10.5.1. O-ring seals in the PTPC shall be replaced according to manufacturer's instructions after the leakage tests following every 2 000 cycles.

Failure of any leakage test during durability cycling, or failure of the PTPC to operate at the manufacturer's specified forces, or the forces defined in 10.2, shall constitute a failure of the device.

10.16.4 Abuse

A PTPC shall be capable of being safely removed from the receptacle in the event of a leak in the receptacle check valve under extreme load conditions.

The following test shall be conducted at pressures of 31,5 MPa (315 bar) and 12,5 MPa (125 bar). Test samples and O-rings previously cycled under the durability test shall be used.

Nitrogen shall be used as the test gas and pressure source.

The PTPC shall be attached using the maximum and minimum forces/torques in accordance with the manufacturer's instructions.

The test fixture receptacle shall be connected to a vessel having an internal volume of 27 ml.