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New Zealand Standard

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Standards New Zealand

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Committee representation

This standard was prepared by the P3652 Hydrogen Standards Committee. Membership of the committee was approved by the New Zealand Standards Approval Board and appointed by the New Zealand Standards Executive under the Standards and Accreditation Act 2015.

The committee consisted of representatives of the following nominating organisations:

Coregas

Energy Resources Aotearoa

Fabrum

Fonterra Co-operative Group

Gas Appliance Industry

GasNZ

GNS

Hiringa Energy

HW Richardson Group

HyPotential

Methanex

New Zealand Hydrogen Council

PEC

WorkSafe New Zealand − Energy Safety

Z Energy

Acknowledgement

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New Zealand Standard

Road vehicles – Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel systems

Part 1: Safety requirements

Contents

Preface

The government has a legislated 2050 target of net zero greenhouse gas (GHG) emissions, other than from biogenic methane, and a target under the Paris Agreement to reduce net GHG emissions to 50 per cent below gross 2005 levels by 2030.

Hydrogen is set to play a key role in meeting these targets. (New Zealand has considerable renewable energy resources which could be harnessed to sustainably produce hydrogen for use as a next-generation green fuel source and industrial feedstock.)

To enable the safe integration and novel use of hydrogen in all its forms across New Zealand's energy landscape, a suite of hydrogen-related equipment standards is being adopted.

This standard specifies the minimum safety requirements for the functionality of compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends on-board fuel systems, intended for use on the types of motor vehicles defined in ISO 3833 *Road vehicles – Types – Terms and definitions.*

The use of this standard is applicable to vehicles using compressed gaseous hydrogen (CGH2), in accordance with ISO 14687:2019 *Hydrogen fuel quality – Product specification* and hydrogen/natural gas blends using natural gas, in accordance with ISO 15403-1 *Natural gas – Natural gas for use as a compressed fuel for vehicles – Part 1: Designation of the quality.*

It is not applicable to the following:
(a) Liquefied hydrogen (LH2) fuel system components;
(b) Fuel containers;
(c) Stationary gas engines;
(d) Container mounting hardware;
(e) Electronic fuel management;
(f) Refuelling receptacles; and
(g) Fuel cell vehicles.

NOTE −

(1) It is recognised that miscellaneous components not specifically covered herein can be examined to meet the criteria of this document and tested according to the appropriate functional tests.

(2) All references to pressure in this document are considered gauge pressures, unless otherwise specified.

All matters relating to the skills of installers and converters have been excluded from this document.

The standard was prepared by the P3652 Hydrogen Standards Committee and is identical to and has been reproduced from ISO 21266-1:2018 *Road vehicles – Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel systems – Part 1: Safety requirements*.

As this standard is reproduced from an international standard, the following applies:
(h) In the source text, 'this International Standard' should read 'this New Zealand standard';
(i) A full point substitutes for a comma when referring to a decimal marker.

The terms 'normative' and 'informative' have been used in this standard to define the application of the appendix or annex to which they apply. A 'normative' appendix or annex is an integral part of a standard whereas an 'informative' appendix or annex is for information and guidance.

INTERNATIONAL STANDARD

ISO 21266-1

First edition
2018-10

Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/ natural gas blends fuel systems —

Part 1: Safety requirements

Véhicules routiers — Systèmes d'alimentation pour hydrogène gazeux comprimé (CGH2) et mélanges d'hydrogène et de gaz naturel —

Partie 1: Exigences de sécurité

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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.

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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee 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.

A list of all the parts in the ISO 21266 series can be found on the ISO website.

Introduction

For the purposes of this document, all fuel system components in contact with natural gas have been considered suitable for compressed gaseous hydrogen (CGH2), in accordance with ISO 14687-1 or ISO 14687-2, and hydrogen/natural gas blends using natural gas, in accordance with ISO 15403-1 and ISO/TR 15403-2.

When applying this document, it should be understood that a safety device to prevent overfilling the vehicle's fuel system is part of the fuelling station. The pressure gauge has not been considered as a safety component.

When necessary, technical solutions regarding functional requirements are given in this document, as in Annex A.

This document refers to a service pressure of 20 MPa.

NOTE This document is based on a service pressure for compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends as fuels of 20 MPa settled at 15 °C. Other service pressures can be accommodated by adjusting the pressure by the appropriate factor (ratio). For example, pressures to be multiplied by 1,25 for a 25 MPa service pressure system.

Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel systems —

Part 1: Safety requirements

1 Scope

This document specifies the minimum safety requirements applicable for the functionality of compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends on-board fuel systems intended for use on the types of motor vehicles defined in ISO 3833.

It is applicable to vehicles using compressed gaseous hydrogen (CGH2), in accordance with ISO 14687-1 or ISO 14687-2, and hydrogen/natural gas blends using natural gas, in accordance with ISO 15403-1 and ISO/TR 15403-2. It is not applicable to the following:

1) liquefied hydrogen (LH2) fuel system components;

2) fuel containers;

3) stationary gas engines;

4) container mounting hardware;

5) electronic fuel management;

6) refuelling receptacles; and

7) fuel cell vehicles.

NOTE 1 It is recognized that miscellaneous components not specifically covered herein can be examined to meet the criteria of this document and tested according to the appropriate functional tests.

NOTE 2 All references to pressure in this document are considered gauge pressures unless otherwise specified.

All matters relating to the skills of installers and converters have been excluded from this document.

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 1176, *Road vehicles — Masses — Vocabulary and codes*

ISO 12619 (all parts), *Road vehicles —Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components*

ISO 16380, *Road vehicles — Blended fuels refuelling connector*

ISO 17268, *Gaseous hydrogen land vehicle refuelling connection devices*

ISO 21266-2, *Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blend fuel system components — Part 2: test methods*

ISO 20653, *Road vehicles — Degrees of protection (IP code) — Protection of electrical equipment against foreign objects, water and access*

ISO 14687-1, *Hydrogen fuel — Product specification — Part 1: All applications except proton exchange membrane (PEM) fuel cell for road vehicles*

ISO 14687-2, *Hydrogen fuel — Product specification — Part 2: Proton exchange membrane (PEM) fuel cell applications for road vehicles*

ISO 19881[1)], *Gaseous hydrogen — Land vehicle fuel containers*

IEC 60079-10-1, *Explosive atmospheres — Part 10-1: Classification of areas — Explosive gas atmospheres*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12619-1 and the following 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 General terms

3.1.1
service pressure
settled pressure of 20 MPa at a uniform gas temperature of 15 °C

3.1.2
compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends on-board fuel system
compressed natural gas fuel system comprising cylinder, or cylinders according to ISO 19881 or ISO/TS 15869 as applicable, mounting, one or more refuelling receptacles according to ISO 16380 or ISO 17268 as applicable, and the components described in ISO 12619-3 and following parts

3.1.3
main shut-off valve
automatic valve designed to isolate a high-pressure source

3.1.4
bi-fuel HNGV
vehicle that has two independent fuel systems (one of them for compressed gaseous hydrogen and hydrogen/natural gas blend) and can run alternatively on either fuel, but only on one at a time

Note 1 to entry: The term Bi-fuel also applies to vehicles that run on both fuels simultaneously in limited amount or duration.

3.2 Vehicle mass

3.2.1
kerb mass
complete shipping mass of a vehicle fitted with all equipment necessary for normal operation plus the mass of the following elements for M1, N1 and M2 having a maximum authorized mass not exceeding 3 500 kg:

— lubricants, coolant (if needed), washer fluid;

— fuel (tank filled to at least 90 % of the capacity specified by the manufacturer);

1) Under preparation. Stage at the time of publication: ISO/FDIS 19881.

— other equipment if included as basic parts for the vehicle, such as spare wheel(s), wheel chocks, fire extinguisher(s), spare parts and tool kit

Note 1 to entry: The definition of kerb mass may vary from country to country, but in this document it refers to the definition contained in ISO 1176.

3.2.2
maximum authorized mass
kerb mass plus the maximum allowable payload

3.3 Vehicle categories

3.3.1
category M
power-driven vehicles having at least four wheels and used for the carriage of passengers

3.3.1.1
category M1
vehicles used for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat

3.3.1.2
category M2
vehicles used for the carriage of passengers and comprising more than eight seats in addition to the driver's seat and having a maximum authorized mass not exceeding 5 000 kg

3.3.1.3
category M3
vehicles used for the carriage of passengers and comprising more than eight seats in addition to the driver's seat and having a maximum authorized mass exceeding 5 000 kg

3.4.2
category N
power-driven vehicles having at least four wheels and used for the carriage of goods

3.4.2.1
category N1
vehicles used for the carriage of goods and having a maximum authorized mass not exceeding 3 500 kg

3.4.2.2
category N2
vehicles used for the carriage of goods and having a maximum authorized mass exceeding 3 500 kg but not exceeding 12 000 kg

3.4.2.3
category N3
vehicles used for the carriage of goods and having a maximum authorized mass exceeding 12 000 kg

3.5
electronic control unit
device which controls the compressed gaseous hydrogen (CGH2) or hydrogen/natural gas blends demand of the engine and establishes the cut-off of the automatic valve in case of a broken fuel supply pipe or in case of stalling of the engine, or during a crash

4 Requirements

4.1 Design

4.1.1 General

The compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends on-board fuel system components shall comply with ISO 19881[2)] ISO/TS 15869, ISO 16380, ISO 17268 and ISO 12619, as applicable.

For bi-fuel HNGV, provision shall be made to avoid accelerated deterioration of the non-compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system as a result of sustained operation on compressed gaseous hydrogen and hydrogen/natural gas blends. Such measures shall be as recommended by the original vehicle manufacturer (e.g. fuel hoses).

All fuel system components shall fulfil the following conditions.

a) They shall withstand the environmental temperatures and other environmental conditions safely during their operational life.

b) They shall be located with full regard for anticipated damage while the vehicle is being used safely. Such damage can be caused by the vehicle itself, by extraneous factors such as heat, road debris, automotive fluids (brake liquid, oil, petrol, cooling liquid, etc.), or by rust, etc.

c) They shall be fitted so that they are not the outermost, highest or lowest parts of the vehicles; otherwise they shall be protected.

d) They shall be fitted so as not to affect ground clearance, approach angle, ramp (break-over) angle or departure angles as defined by the vehicle manufacturer.

e) They shall be located so that they do not suffer corrosion damage by accumulation of water or cargo chemicals.

f) They shall assure the proper electrical conductivity throughout the fuel system in order to avoid the electrostatic charges. This provision does not apply to gas-tight housing and ventilation hoses.

g) All connections shall be made in locations where access is possible for inspection.

The compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends system shall be installed in such a way that it has suitable protection against damage, such as damage due to moving vehicle components, collision, grit or due to the loading or unloading of the vehicle or the shifting of those loads.

The compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends system shall include automatic valves designed to close when the engine is not running on compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends, and shall be able to be manually opened or closed in case of failure of the automatism (see Annex B).

The compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends on-board fuel system shall include:

— an automatic valve installed directly on every compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends cylinder, with a manual valve rigidly fixed to the compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends cylinder, which may be integrated into the automatic valve. The manual valve shall be able to isolate the cylinder content from the automatic valve;

— a PRD installed on each cylinder, functionally independent from any other component;

2) Under preparation. Stage at the time of publication: ISO/FDIS 19881.

— one or more additional PRD as applicable to the approval of the cylinder according to ISO 19881[3)] or according to any other recommendations of ISO/TS 15869;

— an excess flow valve inside, and optionally outside, every cylinder or a functionally equivalent system to control the gas leakage in the event of an abnormal flow (see Annex A).

The automatic valve shall be closed when:

— the vehicle is not operating on compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends;

— the engine is not running.

Where it has to remain open by design, the valve may remain open when the engine stops during the stop phase in start-stop systems.

Only automatic valves that are normally closed when deactivated shall be used in the compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends on-board fuel system.

4.1.2 Components

4.1.2.1 Receptacle

The receptacle shall comply with ISO 16380 or with ISO 17268, as applicable.

The receptacle shall be provided with a protective cap, to prevent the entry of dust, fluid or other foreign matter. The protective cap shall be attached in such a way as to prevent loss of the cap.

The following data shall be displayed near the receptacle (marking shall be permanent):

— type of fuel (i.e. “compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends” for compressed gaseous hydrogen and hydrogen/natural gas blends);

— periodic inspection date for gas cylinders according to ISO 19881 or applicable standards; and

— service pressure for the vehicle.

4.1.2.2 Gas cylinder

Gas cylinders shall be provided with cylinder valves, automatic valves, excess-flow valves (or a functionally equivalent system) and pressure-relief devices, and shall be mounted in accordance with the requirements set out in 4.4.

To prevent heat damage, gas cylinders and appurtenances shall either use a heat shield or be located in relation to the exhaust system such that their skin temperature does not exceed the value specified by the vehicle, valves (including PRD) or cylinder manufacturers and in accordance with ISO 19881, ISO 12619 and ISO/TS 15869. If no shielding is provided, there shall be a clearance of at least 100 mm between the fuel container and the exhaust system.

All fibre-reinforced gas cylinders (types 2, 3, and 4 according to ISO 19881[4)]) shall be protected from ultra-violet radiation and automotive fluids.

4.1.2.3 Pressure regulator

Components located downstream of the pressure regulator shall be protected from over pressurization due to regulator failure. This protection may be provided by components inside the pressure regulator (i.e. pressure relief valve) as specified in ISO 12619-9.

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3) Under preparation. Stage at the time of publication: ISO/FDIS 19881.

4) Under preparation. Stage at the time of publication: ISO/FDIS 19881.

4.1.2.4 PRD and PRV

The suggested configuration for PRDs is parallel combination or thermal relief device for every type of cylinder. Series PRDs may only be used in type 1 steel cylinders and shall not be used in type 2, type 3 and type 4 cylinders.

The PRD shall be protected from dirt and water ingress and shall be located as far away as possible from sources of ignition and heat in the vehicle.

The PRD shall comply with ISO 12619-10, venting gas to protect cylinder rupture.

The PRV shall be used to prevent over pressurization of the system downstream of the first stage of the pressure regulator or regulators. If multiple regulators are used, it may be necessary to provide additional PRVs.

PRVs may be used upstream of the first stage of the pressure regulator.

PRVs shall be protected from dirt and water ingress.

4.1.2.5 Pipework

Pipework shall be laid, if possible on the chassis, in such a way that no damage from intrinsic vibrations occurs (e.g. resonance with engine vibration) and there are no friction points. The intervals between two attachment points shall not exceed 0,60 m, and pipework installation and bending shall be in accordance with the pipe and fitting manufacturer's specifications. Adequate provision shall be made to allow adequate essential flexibility.

4.1.2.6 Electronic control unit

The switching off delay of the automatic valve after stalling of the engine may not be more than 2 seconds.

The electronic control unit may be equipped with an automatic ignition advance timing adjuster integrated in the electronic module or separated.

The electronic control unit may be integrated with dummy injectors to permit a correct functioning of the gasoline electronic control unit during compressed gaseous hydrogen (CGH2) or hydrogen/natural gas blends operation.

The electronic control unit shall be so designed to operate at low temperature of −40 °C or −20 °C, as applicable, and at high temperature of 105 °C or 120 °C, as applicable.

4.1.2.7 Electrical connections

The electrical connections inside the boot and passengers compartment shall comply with protection degree class IP 40 according to ISO 20653

All other electrical connections shall comply with protection degree class IP 54 according to ISO 20653.

4.2 Refuelling connection

4.2.1 General

The piping, receptacle and all valves and fittings installed on board the compressed gaseous hydrogen and hydrogen/natural gas blends vehicle should be selected to minimize the pressure drop along the lines, and hence minimize the filling time of, and maximize the fill volume into, the compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends on-board fuel system.

4.2.2 Receptacle location

The receptacle should be installed in a suitable on-board location that is easy to reach, allowing safe operation. The preferred location is on the side of the vehicle.

Receptacles installed inside the engine compartment shall be attached to the vehicle chassis or body.

They shall not be fixed near the battery or the ignition high-tension circuit or possible ignition sources.

The receptacle shall not be installed in a wheel arch, or close to a heat source such as the exhaust.

4.2.3 Receptacle mounting

The vehicle's compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends on-board fuel system shall be able to withstand the values of force and torque specified in ISO 21266-2, of loading on the receptacle in any direction without its gas tightness being affected (in the case of a refuelling hose breakaway).

4.2.4 Minimum receptacle clearance

The minimum receptacle clearances are specified in ISO 16380 or ISO 17268 as applicable.

4.3 Leakage control

4.3.1 Pressurized gas systems shall be designed so that they withstand the stresses that can be expected during operation.

4.3.2 Connections shall either be bubble-free for 3 minutes or have a leak rate for each connection that is in compliance with the leak test in ISO 21266-2. After assembly, the vehicle's compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends on-board fuel system shall be tested for leakage in accordance to ISO 21266-2.

4.3.3 The cylinder or parts of the gas system, or both, shall be mounted in a position which ensures that any leaking or venting gas from the fuel systems does not directly enter the driver or passenger compartment, boot or other spaces not sufficiently ventilated. Alternatively, it shall be ensured that any leaked gas is directed safely to the atmosphere (see Annex A).

4.3.4 Where a cylinder is located within the driver or passenger compartment, or other insufficiently ventilated space, the valves, connections and pipework shall be enclosed in a gas-tight housing such that any gas leakage is vented and directed to the outside of the vehicle. When the valves are self-venting, the gas tight housing/ventilation hose shall enclose the connections, pipework and venting orifices. There is no need to enclose the body of the valve, if all the possible leakage sources (included the cylinder-valve interface) are sealed and vented into the valve's interior venting passages.

In case of fire, the requirement of venting gas to the outside of the vehicle does not apply.

4.3.5 Any ventilation opening shall be positioned away from any openings into any vehicle compartment, away from any ignition source, and in a location where it is not susceptible to blockage.

4.3.6 Any enclosure containing the thermal-reactive elements of a PRD shall be permeable to heat to allow the temperature of the PRD to rise to the temperature of the cylinder surroundings.

4.4 Mounting of the cylinder(s)

4.4.1 The cylinder or cylinders shall be securely attached to the vehicle to prevent slipping, rotating and dislodging.

The installation shall be according to the cylinder manufacturer's instructions and ISO 19881[5)] or ISO/TS 15869.

The cylinder shall be mounted on the same vehicle as the engine and any equipment being fuelled by the fuel container.

The cylinder shall be mounted in a manner that prevents contact of the container with other vehicle components that would lead to container damage or abrasion over time.

The cylinder shall be at two support points designed to minimize the effects of external loads on the fuel container.

Mounting hardware and instructions specified by the cylinder manufacturer shall be used, if available. The mounting system shall minimize damage or corrosion between the cylinder and the mounting system.

A resilient gasket that does not retain water shall be installed between the supports or clamping bands and a fuel cylinder such that there is no direct contact between metal on the bracket and the fuel cylinder. The gasket material shall be of a thickness and hardness such that the fuel cylinder remains secure at all fuel cylinder fill pressures and all operating temperatures.

When the cylinder is clamped by the neck, a resilient gasket may not be required.

When installing the cylinder, consideration should be given to factors such as:

— the undue stresses created in an overwrap by cylinder expansion against a metal support;

— the need to specify a gasket material to prevent support damage to cylinder(s); and

— the required properties of any gasket material.

Type 2, Type 3, and Type 4 designs should be provided with shielding arrangements to protect the composite wrapping from mechanical damage.

4.4.2 Gas cylinder and attachments for mounting on the vehicle shall be constructed so that the mountings are not be subject to failure by wear, corrosion or fatigue during the service life of the vehicle. Welding on cylinders is not permitted.

4.4.3 When tested in accordance with ISO 21266-2, the cylinder shall remain attached to the vehicle under the following accelerations, where g is the gravitational acceleration.

The fuel container(s) or cylinder(s) shall be mounted and fixed so that the following accelerations can be absorbed (without damage occurring) when the containers are full at the service pressure:

1) Vehicles of categories M1 and N1:
   a) 20g in the direction of travel (forward/backward);
   b) 8g horizontally perpendicular to the direction of travel;
   c) if the cylinders are mounted under the vehicle, 5g in the vertical downward direction.
2) Vehicles of categories M2 and N2:
   a) 10g in the direction of travel (forward/backward);

5) Under preparation. Stage at the time of publication: ISO/FDIS 19881.

b) 5*g* horizontally perpendicular to the direction of travel;

c) if the cylinders are mounted under the vehicle, 5*g* in the vertical downward direction.

3) Vehicles of categories M3 and N3:

a) 6,6*g* in the direction of travel (forward/backward);

b) 5*g* horizontally perpendicular to the direction of travel;

c) if the cylinders are mounted under the vehicle, 5*g* in the vertical downward direction.

A calculation method may be used instead of practical testing if its equivalence can be demonstrated.

Cylinders shall be located or given protection such that its piping, fittings, and valve are protected from damage due to contact with objects encountered during operation of the vehicle.

4.5 Heat protection

Components (except gas cylinders and appurtenances, which shall comply with 4.1.2.2) shall be installed at least 100 mm from the exhaust system; otherwise heat shields shall be installed.

4.6 Minimizing risk of gas ignition

To prevent fire in a vehicle, the ignition sources shall be minimized.

Electric and electronic components in gas-tight housings over cylinder valve fittings shall be suitable for hazardous areas as defined in IEC 60079-10-1.

The location of electrical cables and mountings of compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends on-board fuel system components shall be designed to protect against the potential ignition of leaked gas.

4.7 Venting system

4.7.1 General requirements

There is no general best direction to release the gas through the PRV or PRD; it should be evaluated on a case by case design. The gas shall be released in a dispersed manner.

The dispersion method shall not restrict the venting capacity of any PRV or PRD.

Vent systems must prevent the accumulation of water or debris in the tubes or in the PRV or PRD, as this can cause the PRV or PRD to fail or prevent proper venting after activation. Ice, in particular, can damage PRDs or vent lines. Care shall be taken that any vent line closures are durable and not damaged by use, including power washers and brushes, impact with overhead branches, or other handling.

In addition, the PRV or PRD vent ports on each fuel cylinder shall be arranged such that no gas jet can impinge directly on other compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends cylinders in the on-board fuel storage systems.

Leakage and venting of compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends (or other flammable substances) from the PRVs shall be dealt with properly to avoid the dangers due to releasing flammable substances in enclosed spaces.

4.7.2 Ventilation lines for PRDs and PRVs

If a ventilation line is installed on a pressure relief device or on a pressure relief valve, it shall be of sufficient diameter for its purpose. In addition, this ventilation line and system shall:

a) have a minimum internal diameter not less than the pressure relief device/valve discharge opening(s), and the diameter shall be of sufficient size to not be obstructed by any material discharged by the PRD or PRV;

b) be secured at intervals in a manner that minimizes the possibility of damage, corrosion, or breakage due to expansion, contraction, vibration, strains, or wear and that precludes any loosening while in operation;

c) have a minimum burst pressure at least 1,5 times the service pressure of the fuel cylinder. Where vent lines are discharged into an increased diameter manifold or line, the pressure requirement of that manifold or line shall be fit for purpose;

d) not lose its gas-carrying capability when exposed for 12 min to a temperature of 590 °C. The vent lines may be shielded or sleeved to comply with this requirement;

e) not direct the discharge into or toward the passenger or luggage compartment, into or toward wheel housings, toward compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends storage systems, or toward the front of the vehicle;

f) minimize the possibility of external hazards (e.g. projectiles) resulting from activation of the device;

g) be constructed of materials that mitigate the risk of corrosion, and shall not cause galvanic corrosion at the interface connection to the pressure relief device/valve.

5 Instruction for use

An instruction manual shall be provided which includes specific instructions regarding compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends operation and that alerts the owner to the cylinder inspection or expiration date.

6 Marking

If other than vehicle original equipment manufacturer (OEM), a label or plate identifying the installer of the compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends system with reference to this document shall be permanently attached to the vehicle.

Annex A
(informative)

Technical solutions to functional requirements

A.1 Prevention of hydrate and ice formation

As a guideline, in order to prevent hydrate and ice formation:

— the gas quality designation should be as defined in ISO 15403-1 and ISO 15403-2; and

— the high-pressure regulator should be heated.

A.2 Ventilation

Ventilation of the valves, connections and pipework may be achieved by either:

a) placing the cylinder and its fittings in a durable enclosure which is sealed such that it is gas tight to the compartment or space and which is provided with permanent ventilation;

b) enclosing the neck of the cylinder and its fittings with a specially designed durable envelope that is gastight to the compartment and that is provided with permanent ventilation;

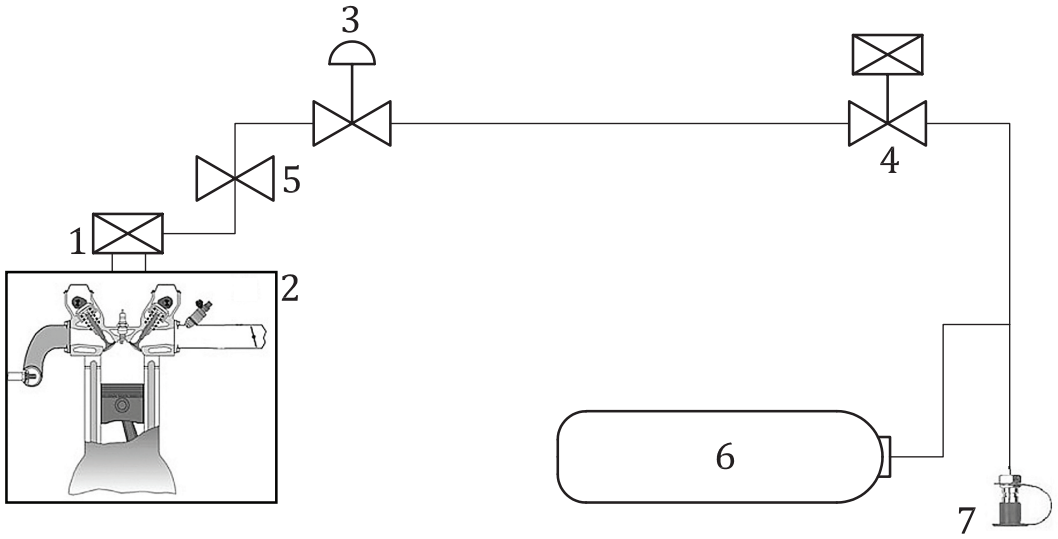
c) installing a self-venting valve that vents every possible leakage source (including the connection between the valve and the cylinder) through internal passages, and enclosing pipework, connections and the valve's venting outlets in venting hoses that direct the gas to a safe location outside the vehicle;

Any ventilation method used shall not prevent proper function of the PRD, particularly by separating it from the heat that the cylinder is exposed to. Fire testing of the cylinder and PRD combination should be done with representative ventilation enclosures

Annex B
(informative)

Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends on-board fuel systems

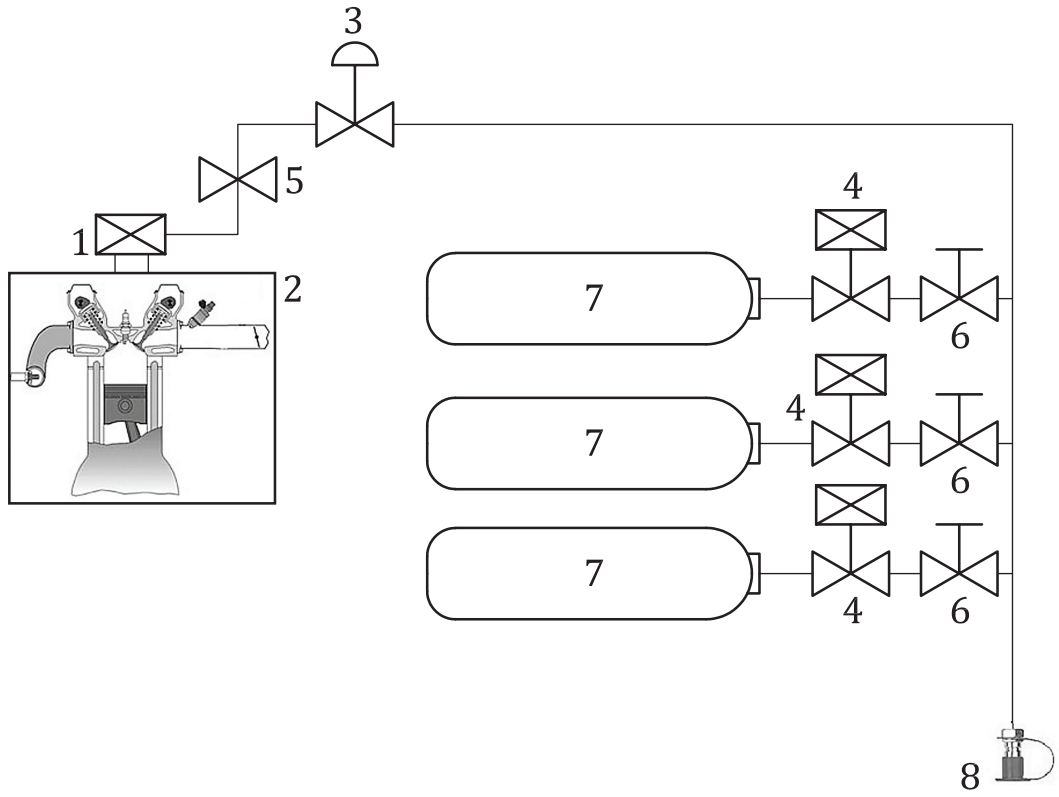
Examples of compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends on-board fuel systems are shown in Figure B.1 and Figure B.2.



Key

1 gas/air mixer (or gas injection system)
2 engine
3 pressure regulator
4 main shut-off valve
5 PRV (safety device to prevent overpressure)
6 gas cylinder + cylinder valve + PRD
7 refuelling receptacle

Figure B.1 — Single-cylinder system



Key

1 gas/air mixer (or gas injection system)
2 engine
3 pressure regulator
4 main shut-off valve
5 PRV (safety device to prevent overpressure)
6 manual shut-off valve
7 gas cylinder + PRD
8 refuelling receptacle

Figure B.2 — Multiple-cylinder system

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