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

Part 1: Safety requirements

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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

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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 TC 22, *Road vehicles*, Subcommittee SC 41, *Specific aspects for gaseous fuels*.

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

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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.

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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.

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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*

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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

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

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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);

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— 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

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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

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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

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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.

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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;

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— 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.

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

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— 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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