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Natural gas fuelling stations — CNG stations for fuelling vehicles

Stations-service de gaz naturel — Stations GNC pour le ravitaillement de véhicules

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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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The committee responsible for this document is ISO/PC 252, *Natural gas fuelling stations for vehicles*.

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Natural gas fuelling stations — CNG stations for fuelling vehicles

1 Scope

This document covers the design, construction, operation, inspection and maintenance of stations for fuelling compressed natural gas (CNG) to vehicles, including equipment, safety and control devices.

This document also applies to portions of a fuelling station where natural gas is in a gaseous state and dispensing CNG derived from liquefied natural gas (LCNG) according to ISO 16924.

This document applies to fuelling stations supplied with natural gas as defined in local applicable gas composition regulations or ISO 13686. It also applies to other gases meeting these requirements including biomethane, upgraded coal-bed methane (CBM) and gas supplies coming from LNG vaporization (on-site or off-site).

This document includes all equipment for downstream gas supply connection (i.e. point of separation between the CNG fuelling station piping and the pipeline network). Fuelling station nozzles are not defined in this document.

This document covers fuelling stations with the following characteristics:

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— slow fill;

— fast fill;

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— private access;

— public access (self-service or assisted);

— fuelling stations with fixed storage;

— fuelling stations with mobile storage (daughter station);

— multi-fuel stations.

This document is not applicable to domestic CNG fuelling devices without buffer storage.

NOTE This document is based on the condition that the gas entering the fuelling station is odorized. For unodorized gas fuelling stations, additional safety requirements are included in Clause 10.

2 Normative references

The following documents are referred to in 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 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 834-1, *Fire-resistance tests — Elements of building construction — Part 1: General requirements*

ISO 4126-1, *Safety devices for protection against excessive pressure — Part 1: Safety valves*

ISO 8580, *Rubber and plastics hoses — Determination of ultra-violet resistance under static conditions*

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ISO 9809-1, *Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 1: Quenched and tempered steel cylinders with tensile strength less than 1 100 MPa*

ISO 9809-2, *Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 2: Quenched and tempered steel cylinders with tensile strength greater than or equal to 1 100 MPa*

ISO 11119-1, *Gas cylinders — Refillable composite gas cylinders and tubes — Design, construction and testing —Part 1: Hoop wrapped fibre reinforced composite gas cylinders and tubes up to 450 l*

ISO 11119-2, *Gas cylinders — Refillable composite gas cylinders and tubes — Design, construction and testing — Part 2: Fully wrapped fibre reinforced composite gas cylinders and tubes up to 450 l with load-sharing metal liners*

ISO 11119-3, *Gas cylinders — Refillable composite gas cylinders and tubes — Design, construction and testing — Part 3: Fully wrapped fibre reinforced composite gas cylinders and tubes up to 450L with non-load-sharing metallic or non-metallic liners*

ISO 11439, *Gas cylinders — High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles*

ISO 11925-3, *Reaction to fire tests — Ignitability of building products subjected to direct impingement of flame — Part 3: Multi-source test*

ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13847, *Petroleum and natural gas industries — Pipeline transportation systems — Welding of pipelines*

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ISO 14120, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

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

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ISO 15500-17, *Road vehicles — Compressed natural gas (CNG) fuel system components — Part 17: Flexible fuel line*

ISO 15589-1, *Petroleum, petrochemical and natural gas industries — Cathodic protection of pipeline systems — Part 1: On-land pipelines*

ISO 15649, *Petroleum and natural gas industries — Piping*

IEC 31010, *Risk management — Risk assessment techniques*

IEC 60079-0, *Electrical apparatus for explosive gas atmospheres — Part 0: General requirements*

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

IEC 60079-11, *Explosive atmospheres — Part 11: Equipment Protection by Intrinsic Safety "i"*

IEC 60079-14, *Electrical apparatus for explosive gas atmospheres — Part 14: Electrical installations in hazardous areas (other than mines)*

IEC 60079-25, *Explosive atmospheres — Part 25: Intrinsically safe electrical systems*

IEC 60204-1, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

3 Terms and definitions

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

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

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

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

3.1
assembly
sub-system of fuelling stations comprising several components

3.2
auto-extinguishing
feature of a material that ceases combustion upon removal of flame or ignition source

3.3
biomethane
methane rich gas derived from biogas or from gasification of biomass by upgrading with the properties similar to natural gas

[SOURCE: ISO 14532:2014, 2.1.1.15]

3.4
bonding
equipotential zone where potentially live exposed metallic parts are electrically connected with at least one point connected to ground/earth

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3.5
breakaway device
coupling which separates at a predetermined section when required and each separated section contains a self-closing shut-off valve which seals automatically

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[SOURCE: ISO/TS 18683:2015, 3.1.3]

3.6
buffer storage
one or more suitable pressure vessels designed for the purpose of storing compressed natural gas

3.7
building
structures, usually enclosed by walls and a roof, constructed to provide support or shelter for an intended occupancy

3.8
burst pressure
p_b
pressure that causes failure and consequential fluid loss through the component envelope

3.9
canopy
roof, overhead shelter, or hood, that affords a degree of weather protection

3.10
CNG fuelling station
facility at which compressed natural gas is dispensed to vehicles

3.11
competent person
person having the ability, appropriate training, knowledge and experience, to supervise or carry out the work being undertaken in a safe and proper manner

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3.12
compressed natural gas
CNG
natural gas which has been compressed and stored for use as a vehicle fuel

[SOURCE: ISO 15500-1:2000, 3.2]

3.13
compressor
machine that increases the pressure of gas

3.14
conduit
casing, tubing or liner, either metallic or non-metallic

[SOURCE: ISO 14310:2008, 3.6]

3.15
cylinder
pressure vessel used for the storage of compressed natural gas

3.16
cylinder working pressure
settled pressure of a fully filled cylinder at a uniform temperature of 15 °C

3.17
dispenser
equipment through which the fuel is supplied to the vehicle

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Note 1 to entry: This equipment can include metering.

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3.18
dryer
equipment which decreases the water vapour content (moisture) of natural gas

3.19
enclosure
structure, not being a building or canopy, that encloses a component of the fuelling station

EXAMPLE Housing, container and machine cabinet.

3.20
explosive gas atmosphere
mixture of substances with air, under atmospheric conditions, in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture

[SOURCE: IEC 61340–4-4:2014, 11, 3.4]

3.21
fail-safe
design feature that ensures that safe conditions are maintained in the event of a malfunction of a control device or an interruption of a supply source

3.22
fast fill
fuelling operation which has a designed flow rate greater than 100 $m^3(N)/h$ per nozzle

3.23
field piping
piping installed for interconnection between equipment at the site

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3.24
fire resistant
property that prevents or retards the passage of excessive heat, hot gases or flames under specified conditions

3.25
fire wall
wall, or separating partition erected to reduce the effects of radiated heat

3.26
fuelling
transfer of fuel from dispenser to the vehicle

3.27
fuelling pressure
pressure at which the fuel is delivered to the vehicle

3.28
fuelling station
facility at which vehicles fuels are dispensed

3.29
grounding
electrical connection of potentially live exposed metallic parts to earth

3.30
hazardous area
area in which an explosive gas atmosphere is present, or can be expected to be present, in quantities such as to require special precautions for the construction, installation and use of apparatus to prevent ignition

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[SOURCE: IEC 60079-10-1:2008, 3.3]

3.31
hose
pipeline of flexible material with end fittings attached

3.31.1
vent hose
pipeline of flexible material through which natural gas is vented from the fuelling connection at a vehicle

3.31.2
hose assembly
hose or hoses with ancillary components, such as bend restrictors, breakaways and nozzles, attached

3.32
intrinsically safe circuit
circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under specified test conditions

3.33
lower explosive limit
LEL
volume concentration of flammable gas or vapour in air, below which the mixture is not flammable

[SOURCE: ISO 19372:2015, 3.7, modified — “explosive” has been changed to “flammable”.]

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3.34
maximum allowable operating pressure
MAOP
maximum pressure that the component or system is subjected to during normal operation

Note 1 to entry: MAOP is typically not greater than 90 % of the maximum allowable working pressure of the component or system.

3.35
maximum allowable working pressure
MAWP
maximum pressure to which a component or system is designed to be subjected and which is the basis for determining the strength of the component or system

[SOURCE: ISO 12991:2012, 3.10, modified — “or system” has been added and “under consideration” has been removed.]

3.36
mobile storage
multi-cylinder or tank fixture mounted on a vehicle or trailer and used for the transportation of natural gas to CNG fuelling stations

3.37
multi-fuel dispenser
dispenser delivering CNG and other fuels (liquid or gaseous)

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3.38
multi-fuel station
fuelling station that can fuel natural gas as well as other fuels, for example diesel, petrol, LPG

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3.39
natural gas
complex gaseous mixture of hydrocarbons, primarily methane, but generally includes ethane, propane and higher hydrocarbons, and some non-combustible gases such as nitrogen and carbon dioxide

Note 1 to entry: Natural gas can also contain components or containments such as sulfur compounds and/or other chemical species.

[SOURCE: ISO 14532:2014, 2.1.1.1]

3.40
non-combustible
not capable of undergoing combustion under specified conditions

[SOURCE: ISO 13943:2008, 4.239]

3.41
normal operation
situation when the equipment is operating within its design parameters

[SOURCE: ISO 16110-1:2007, 3.50]

3.42
non-hazardous area
area in which an explosive gas is not expected to be present in quantities such as to require special precautions for the construction, installation and use of apparatus

[SOURCE: ISO 16110-1:2007, 3.48]

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3.43
odorant
intensely smelling organic chemical or combination of chemicals added to natural gas at low concentration and capable of imparting a characteristic and distinctive (usually disagreeable) warning odor so gas leaks can be detected at concentrations below their lower flammability limit

Note 1 to entry: ISO/TR 16922 gives the specifications and guidelines for the methods to be used in the odorization of natural gas under a safety point of view and specifies the principles for the odorization technique (including handling and storage of odorants) and the control of odorization of natural gas.

[SOURCE: ISO 14532:2014, 2.8.1, modified — Note 1 to entry has been added.]

3.44
odorization
process of introducing odorant(s) into natural gas

3.45
overpressure
condition under which the pressure exceeds the maximum allowable working pressure

3.46
power failure
reduction in power such that any electrical component or sub system (such as flow control) are operating outside manufacturers specification

3.47
refuelling receptacle
<CNG> device connected to a vehicle or storage system which receives the CNG refuelling nozzle and permits safe transfer of fuel

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[SOURCE: ISO 14469-1:2004, 3.7]

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3.48
separation distance
minimum separation between a hazard source and an object, which is required to mitigate the effect of a likely foreseeable incident and prevent a minor incident escalating into a larger incident

3.48.1
external separation distance
separation distance between a hazard source and an object situated outside the boundaries of the fuelling station

3.48.2
internal separation distance
separation distance between a hazard source and an object situated within the boundaries of the fuelling station

3.49
service duct
enclosed conduit through which gas piping, utility piping, electrical cabling, etc. is routed

3.50
settled pressure
gas pressure when a given settled temperature is reached and there is no gas flow

3.51
settled temperature
uniform gas temperature in the cylinder after the dissipation of any heat caused by fuelling

3.52
slow fill
fuelling operation which has a designed flow rate equal or less than 100 $m^3(N)/h$ per nozzle

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3.53
vault
room or space, typically situated underground

3.54
ventilation
movement of air and its replacement with fresh air due to the effects of wind, temperature gradients, or artificial means (for example fans or extractors)

3.55
venting
controlled release of natural gas to the atmosphere

3.56
zone
hazardous area classified based upon the frequency of the occurrence and duration of an explosive gas atmosphere

[SOURCE: IEC 60079-10-1:2015, 3.3.3, modified — "gas" has been added.]

4 Symbols and abbreviated terms

4.1 Symbols

p_b	burst pressure
p_{MAWP}	maximum allowable working pressure

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4.2 Abbreviated terms

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CNG	compressed natural gas
IS	intrinsically safe
ERP	emergency response plan
LEL	lower explosive limit
MAOP	maximum allowable operating pressure
MAWP	maximum allowable working pressure
NGV	natural gas vehicle
P&I	process and instruments

5 Risk management

5.1 Risk assessment shall follow the techniques described in ISO 12100 for assessment of machinery safety and IEC 31010 for general site risk management, or local applicable standards.

5.2 The CNG fuelling station installation shall be sited to minimize risk to users, operating personnel, properties, and environment.

5.3 Risk assessment shall include design, construction, operation and maintenance of the CNG fuelling station. The risk assessment process shall be used to evaluate the consequences of hazardous events and to determine appropriate means of risk reduction and/or mitigation of consequences.

5.4 Measures to reduce fire and explosion risks shall be applied, including but not limited to:

— prevention of the formation of a flammable or explosive mixture;

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— prevention of static charge build-up;

— avoidance of ignition sources;

— mitigation of the effects of a fire or explosion.

5.5 Protection from ignition in explosive atmospheres shall be by the use of protection systems defined in the IEC 60079 series where the applicable hazard zones are defined in IEC 60079-10-1.

NOTE Examples of hazardous area classifications are given in Annex A.

6 General design requirements

6.1 General

6.1.1 Installation and equipment design shall minimize the number of connections and other possible points of leakage or release to atmosphere.

6.1.2 Configurations generating the possibility of a confined explosive atmosphere should be avoided. Fire and explosion risk prevention shall take into account foreseeable malfunctions and misuse.

6.1.3 Underground service ducts routing natural gas pipeline shall not be shared with other services (e.g. water piping, fuel piping, electrical cabling).

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6.1.4 Pressure indication shall be provided such that the pressure on any piping segment can be determined.

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6.1.5 Pressure piping system shall have provision for safe manual depressurization. Depressurization shall not be performed by opening pipe joints.

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6.1.6 The mounting of equipment and supporting foundations shall be designed and constructed to be suitable for local seismic and geological conditions.

6.1.7 All CNG equipment exposed to the risk of vehicle collision shall be provided with barriers or other mechanisms to protect the gas equipment from collision damage.

6.1.8 The CNG fuelling station shall be designed to shut down safely in the event of a loss of power. Restoration of power shall be in accordance with 16.2.

6.1.9 The CNG fuelling station shall include firefighting equipment in accordance with local applicable regulations.

6.1.10 The CNG fuelling station shall have means of ensuring that oil carryover from the compressor, dust, water and other contaminants in the gas stream meet the local applicable gas quality standards or regulations.

6.1.11 All equipment shall be operated within temperature and pressure limits specified by the manufacturer.

6.1.12 The CNG fuelling station shall be designed while taking into account the specific climatic conditions of the site location and expected minimum and maximum temperatures.

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