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Gaseous hydrogen — Fuelling stations — Part 8: Fuel quality control

Hydrogène gazeux — Stations de recharge — Partie 8: Contrôle qualité du carburant

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Contents

Foreword	7
Introduction.....	8
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions	1
4 Abbreviated terms.....	3
5 Hydrogen specifications	4
6 Quality control approaches	4
7 Potential sources of impurities.....	4
8 Hydrogen quality assurance methodology	4
Table 1 — Occurrence classes for an impurity	6
Table 2 — Severity classes for an impurity	6
Table 3 — Combined risk assessment.....	7
Table 4 — Impact of impurities on fuel cell powertrain	9
9 Routine quality control.....	9
10 Non-routine quality control.....	10
11 Remedial measures and reporting.....	10
Annex A (Informative) Impact of impurities on fuel cell powertrains.....	11
A.1 General	11
A.2 Inert gases	11
A.3 Oxygen	11
A.4 Carbon dioxide	11
A.5 Carbon monoxide	11
A.6 Methane.....	12
A.7 Water.....	12
A.8 Total sulphur compounds	12
A.9 Ammonia.....	12
A.10 Total hydrocarbons	12

A.11	Formaldehyde	12
A.12	Formic acid	13
A.13	Halogenated compounds	13
A.14	Helium	13
A.15	Solid and liquid particulates (aerosols)	13
Annex B (informative) Example of risk assessment		15
B.1	Centralized production, pipeline transportation	15
B.2	Steam methane reformation	15
B.2.1	General	15
B.2.2	Purification by pressure swing adsorption	15
Table B.1 — Probability of occurrence for off-site SMR		16
Table B.2 — Probability of occurrence for pipeline		18
Table B.3 — Probability of occurrence for fuelling station to be source of impurities		19
Table B.4 — Combined risk assessment		20
B.3	Alkaline electrolysis	22
Annex C (informative) Example of Japanese hydrogen quality guidelines		24
C.1	General	24
C.2	Approaches to administration of Japanese quality control guidelines	24
C.3	Hydrogen production methods, hydrogen purification methods and hydrogen transportation methods	24
C.3.1	Hydrogen production methods	24
C.3.2	Hydrogen purification methods	25
C.3.3	Hydrogen transportation methods	25
C.4	Constituents requiring analysis (potential sources of contaminants)	25
C.4.1	General	25
C.4.2	All hydrogen production methods	25
Table C.1— Constituents requiring an analysis for all production methods		25
C.4.3	Specific hydrogen production methods	26
Table C.2 — Constituents requiring an analysis for specific production methods		26

C.5	Constituents that do not require analysis	27
	Table C.3 — Constituents that do not require an analysis.....	27
C.6	Administration of quality control.....	27
C.6.1	Frequency of routine analysis	27
C.6.1.1	Routine analysis at a centralized production and distribution facility	27
C.6.1.2	Routine analysis at fuelling station.....	27
C.6.1.2.1	Off-site fuelling station	27
C.6.1.2.2	On-site fuelling station.....	27
C.6.2	Frequency of non-routine analysis	28
C.7	Administration of analysis and monitoring records	28
C.7.1	Forms for analysis and monitoring records and reports	28
C.7.2	Safekeeping and recording.....	28
C.8	Routine analysis work	28
C.9	Non-routine analysis work.....	28
C.10	Approaches to particulates requirements	28
	Table C.5 — Non-routine analysis work.....	32
	Annex D (informative) Typical hydrogen fuelling station supply chain	34
D.1	General	34
	Figure D.1 — Example of a typical fuelling station supply chain.....	34
D.2	Production.....	34
D.2.1	General.....	34
D.2.2	Reforming	34
	Table D.1 — Impurities potentially present in H ₂ produced by SMR.....	34
D.2.3	Alkaline electrolysis.....	35
	Table D.2— Impurities potentially present in H ₂ produced by alkaline electrolysis	35
D.2.4	Proton exchange membrane electrolysis	35
	Table D.3 — Impurities potentially present in H ₂ produced by PEM electrolysis	35
D.2.5	By-products	35
D.2.6	New production methods	35

D.3	Transportation	35
D.3.1	General	35
D.3.2	Pipeline	36
Table D.4 — Impurities potentially introduced during Pipeline Transportation		36
D.3.3	Filling center and tube trailer	36
Table D.5 — Impurities potentially introduced during centralized distribution and tube trailer transportation		36
D.4	Hydrogen fuelling station	37
Table D.6 — Impurities potentially introduced at fuelling station		37
D.5	Particulates	37
Annex E (informative) Routine hydrogen quality analysis		38
E.1	Off-site production	38
E.2	Transportation	38
E.2.1	Storage and transportation of compressed hydrogen	38
E.2.2	Storage and transportation of liquid hydrogen	38
E.2.3	Pipeline transport	38
E.3	Hydrogen fuelling station	38
E.3.1	Delivered hydrogen	38
E.3.2	On-site hydrogen generation	38
E.3.3	Hydrogen fuelling station contaminants	39
Bibliography		40

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).

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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 197, *Hydrogen technologies*.

A list of all parts in the ISO 19880 series can be found on the ISO website.

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.

Introduction

This document was developed to specify how the quality of gaseous hydrogen fuel for road vehicles which use PEM fuel cells can be assured. The document discusses hydrogen quality control approaches for routine and non-routine conditions, as well as quality assurance plans. It is based upon best practices and experience from the gaseous fuels and automotive industry. ISO 21087 describes the requirements for analytical methods to measure the level of contaminants found in the gaseous hydrogen fuel.

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Gaseous hydrogen — Fuelling stations — Part 8: Fuel quality control

1 Scope

This document specifies the protocol for ensuring the quality of the gaseous hydrogen at hydrogen distribution facilities and hydrogen fuelling stations for proton exchange membrane (PEM) fuel cells for road vehicles.

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 19880-1, *Gaseous hydrogen — Fuelling stations — Part 1: General requirements*

3 Terms and definitions

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

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 authority having jurisdiction

AHJ

organization, office or individual responsible for approving a facility along with an equipment, an installation, or a procedure

3.2 indicator species

one or more *constituents* (3.3) in the gas stream which can signal the presence of other chemical constituents because it has the highest probability of presence in a fuel produced by a given process

3.3 constituent

component (or compound) found within a hydrogen fuel mixture

3.4 contaminant

impurity (3.9) that adversely affects the components within the *fuel cell system* (3.6) or the hydrogen storage system

Note 1 to entry: An adverse effect can be reversible or irreversible.

3.5 filter

equipment to remove undesired particulates (3.15) from the hydrogen

3.6 fuel cell system

power system used for the generation of electricity on a *fuel cell vehicle* (3.7), typically containing the following subsystems: fuel cell stack, air processing, fuel processing, thermal management, and water management

3.7 fuel cell vehicle

FCV

vehicle which stores hydrogen on-board and uses a *fuel cell system* (3.6) to generate electricity for propulsion

3.8 fuelling station

facility for the dispensing of compressed hydrogen vehicle fuel, including the supply of hydrogen, and hydrogen compression, storage, and dispensing systems

Note 1 to entry: Fuelling station is often referred to as hydrogen fuelling station or hydrogen filling station.

3.9 impurity

non-hydrogen component in the gas stream

3.10 irreversible damage irreversible effect

effect, which results in a permanent degradation of the fuel cell power system performance that cannot be restored by practical changes of operational conditions and/or gas composition

3.11 monitoring

act of measuring the *constituents* (3.3) of a hydrogen stream or process controls of a hydrogen production system on a continuous or semi-continuous basis by on-site equipment

3.12 non-routine, adjective

not in accordance with established procedures

3.13 on-site supply

hydrogen fuel supplying system with a hydrogen production system in the same site

3.14 off-site supply

hydrogen fuel supplying system without a hydrogen production system in the same site, receiving hydrogen fuel which is produced out of the site

3.15 particulate

solid or liquid such as oil mist that can be entrained somewhere in the delivery, storage, or transfer of the hydrogen fuel entering a *fuel cell system* (3.6)

3.16 purifier

equipment to remove undesired *constituents* (3.3) from the hydrogen

Note 1 to entry: Hydrogen purifiers may comprise purification vessels, dryers, *filters* (3.5), and separators.

3.17**quality assurance**

part of quality management focused on providing confidence that quality requirements will be fulfilled

3.18**quality control**

part of quality management focused on fulfilling quality requirements

3.19**quality plan**

documentation of quality management

3.20**reversible damage****reversible effect**

effect, which results in a non-permanent degradation of the fuel cell power system performance that can be restored by practical changes of operational conditions and/or gas composition

3.21**risk**

combination of the probability of occurrence of harm and the severity (3.26) of that harm, encompassing both the uncertainty about and severity of the harm

3.22**risk assessment**

determination of quantitative or qualitative value of *risk* (3.21) related to a specific situation and a recognized threat also called a hazard

3.23**risk level**

assessed magnitude of the *risk* (3.21) [ISO 19880-8:2019](#)
[/catalog/standards/sist/db02d071-7152-4ca7-b046-b83b38ec08e0/iso-19880-8-2019](#)

3.24**routine**, adjective

in accordance with established procedures

3.25**sampling**

act of capturing a measured amount of hydrogen for chemical analysis by external equipment

3.26**severity**

measure of the possible consequences for fuel cell cars if filled with H₂ containing higher level of *impurities* (3.9) than the threshold value

4 Abbreviated terms

Abbreviated term	Definition
Halogens	total halogenated compounds
HDS	hydrodesulphurization
PEM	proton exchange membrane
PSA	pressure swing adsorption

SC	severity class
SMR	steam methane reforming
THC	total hydrocarbons
TS	total sulphur compounds
TSA	temperature swing adsorption

5 Hydrogen specifications

The quality requirements of hydrogen fuel dispensed to PEM fuel cells for road vehicles are listed in ISO 14687-2.

6 Quality control approaches

6.1 General

There are two common methods to control the quality of hydrogen at a fuelling station, by spot sampling and continuous monitoring. These methods can be used individually or together to ensure hydrogen quality levels.

6.2 Sampling

Spot sampling at a fuelling station involves capturing a measured amount for chemical analysis. Sampling is used to perform an accurate and comprehensive analysis of impurities which is done externally, typically at a laboratory. Since the sampling process involves drawing a sample of gas, it is typically done on a periodic basis and requires specialized sampling equipment and personnel to operate it. Sampling procedures shall conform to ISO 19880-1. The advantage of spot sampling is that a more detailed laboratory analysis can be conducted on the sample. The disadvantage of spot sampling is that it is not continuous and results in a detail analysis of a single point in time.

6.3 Monitoring

A fuelling station can have real time monitoring of the hydrogen gas stream for one or more impurities on a continuous or semi-continuous basis. A critical impurity can be monitored to ensure it does not exceed a critical level, or monitoring of indicator species are used to alert of potential issues with the hydrogen production or purification process. Monitoring equipment is installed in line with the hydrogen gas stream and shall meet the process requirements of the fuelling station, as well as be calibrated on a periodic basis. Continuous monitoring compliments spot sampling by offsetting the disadvantages.

7 Potential sources of impurities

For a given fuelling station, the contaminants listed in the hydrogen specification referred to in Clause 5 may or may not be potentially present. There are several parts of the supply chain where impurities can be introduced. The potential impurities in each step of the supply chain are described in Annex D.

When a contaminant is classified as potentially present, it shall be taken into account in the quality assurance methodology (risk assessment or prescriptive approach) described in Clause 8.

8 Hydrogen quality assurance methodology

8.1 General

A quality assurance plan for the entire supply chain shall be created to ensure that the hydrogen quality will meet the requirements listed in Clause 5. The methodology used to develop the quality assurance

plan can vary but shall include one of the two approaches described in this document. The general description of these two approaches are described in 8.2 and 8.3. Examples of these approaches 1) prescriptive approach and 2) risk assessment for hydrogen quality, are presented in Annexes A, B and C, respectively. The quality assurance plan for the fuelling station shall include the following to ensure hydrogen quality is properly maintained:

- identification of potential impurities;
- methods to control and remove these impurities;
- sampling impurities and frequency;
- monitoring of impurities or process controls;
- description of solid and liquid particulate filters;
- cleanliness and maintenance procedures.

It is important to understand that quality should be maintained throughout the complete supply chain of the product (from production source to fuelling station nozzle), such that the impurities that are given in the specification remain below the threshold values.

Each component of the supply chain shall be investigated taking into account the already existing barriers for a given contaminant.

NOTE An effective quality control approach can further ensure the quality of the hydrogen by providing a proactive means to identify and control potential quality issues which can include sampling and monitoring. Additionally, use of quality assurance can improve the decision making if a quality problem arises.

8.2 Prescriptive methodology

The prescriptive approach to hydrogen quality assurance considers potential sources of contaminants and establishes a fixed protocol for analysing and addressing potential contaminants. The prescriptive approach can be applied for the clearly identified supply chain.

The prescriptive quality assurance plan shall be determined taking into account all hydrogen production methods, hydrogen transportation methods and non-routine procedures which exists in the area where the assurance plan is applicable.

NOTE Annex C presents Japanese hydrogen quality guidelines which is an example of a prescriptive quality assurance plan.

8.3 Risk assessment methodology

The risk assessment approach determines the probability to have each impurity above the threshold values of specifications given in Clause 5 and evaluates severity of each impurity for the fuel cell vehicle (see Annex A). As an aid to clearly defining the risk(s) for risk assessment purposes, three fundamental questions are often helpful:

- What can go wrong: which event can cause the impurities to be above the threshold value?
- What is the likelihood (probability of occurrence expressed relative to the number of fuelling events) that impurities can be above the threshold value?
- What are the consequences (severity) for the fuel cell vehicle?

In doing an effective risk assessment, the robustness of the data set is important because it determines the quality of the output. Revealing assumptions and reasonable sources of uncertainty will enhance confidence in this output and/or help identify its limitations. The output of the risk assessment is a