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

Carburant hydrogène — Spécification de produit —

*Partie 2: Applications pour piles à combustible de membrane pour
échange de protons (MEP) pour les véhicules routiers*

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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.

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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of document:

- an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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/TS 14687-2 was prepared by Technical Committee ISO/TC 197, *Hydrogen technologies*.

ISO/TS 14687 consists of the following parts, under the general title *Hydrogen fuel — Product specification*:

- *Part 1: All applications except proton exchange membrane (PEM) fuel cells for road vehicles*
- *Part 2: Proton exchange membrane (PEM) fuel cell applications for road vehicles*

Introduction

This Technical Specification provides an initial, albeit incomplete, basis for describing a common fuel to be used by Proton exchange membrane (PEM) fuel cell road vehicles (FCV) during demonstration programs presently being conducted or envisioned in the near term. A Technical Specification is a normative document that can be published in shorter timeframes than an amendment to a published standard, and it will provide guidance for those who may have to manage small fleets of FCV.

This Technical Specification is intended to consolidate the hydrogen fuel product specification needs anticipated by FCV manufacturers and hydrogen fuel suppliers as both industries proceed toward achieving commercial viability. In this consolidation process, methods to monitor the hydrogen quality that is delivered to these vehicles will also be addressed. Monitoring and controlling hydrogen quality are necessary because specific impurities will adversely affect the fuel cell system and/or on-board hydrogen storage system performance. In addition, there may be performance implications in the fuel cell system if certain non-hydrogen constituent levels are not controlled. A Technical Specification for hydrogen fuel quality can serve as a starting point for all of the participating entities to learn what technology improvements and developments are necessary as well as the impacts of such improvements and developments on commercial viability.

This Technical Specification defines two new grades of hydrogen fuel, "Type I, Grade D" and "Type II, Grade D." These new grades are intended to apply to the pre-commercial demonstration of PEM FCV on a limited scale. The purpose of this Technical Specification is to establish hydrogen fuel quality supplied at the above-mentioned scale so that the development of FCV as well as the infrastructure of hydrogen fuel can be implemented in a prompt and efficient manner toward the practical use of FCV. Quality verification requirements should be determined at the dispenser nozzle or other location by written agreement between the supplier and the customer. Because ISO 14687:1999 includes other grades of hydrogen fuel of lower quality, and in the absence of ISO standards for hydrogen fuelling stations and installation of hydrogen equipment, it is important to note that appropriate measures should be taken to prevent cross-contamination of these fuels.

Since the FCV and related technology are developing rapidly, this Technical Specification needs to be revised according to technological progress as necessary. Technical Committee ISO/TC 197, will monitor this technology trend. It is also noted that this Technical Specification has been prepared to assist in the development of FCV and related technologies.

Research and development are required to generate specific information so that a final consensus can be reached. These efforts should focus on, but not be limited to,

- PEM catalyst and fuel cell tolerance to hydrogen fuel impurities,
- effects/mechanisms of impurities on fuel cell systems and components,
- impurity detection and measurement techniques for laboratory, production, and in-field operations,
- onboard hydrogen storage technology, and
- vehicle demonstration results.

Because of the aforementioned rapid development, ISO/TC 197 will continue its work to prepare an International Standard in a manner that reflects technological advancements by incorporating the lessons learned from ongoing research, development, and demonstration activities. Any application of this Technical Specification should take technological progress into account.

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Hydrogen fuel — Product specification —

Part 2:

Proton exchange membrane (PEM) fuel cell applications for road vehicles

1 Scope

This Technical Specification specifies the quality characteristics of hydrogen fuel in order to assure uniformity of the hydrogen product as dispensed for utilization in PEM fuel cell road vehicle systems.

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 14687-1, *Hydrogen fuel — Product specification — Part 1: All applications except proton exchange membrane (PEM) fuel cells for road vehicles* (ISO/TS 14687-2:2008)

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14687-1 and the following apply.

3.1

constituent

component (or compound) found within a hydrogen fuel

3.2

contaminant

constituent that adversely affects the components within the fuel cell system or the hydrogen storage system

NOTE An adverse effect can be reversible or irreversible.

3.3

fuel cell system

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

3.4

hydrogen fuel index

measure of hydrogen fuel quality based on the presence of listed non-hydrogen constituents

3.5
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

3.6
non-hydrogen constituent

component (or compound) other than hydrogen found within a hydrogen fuel

3.7
particulate

solid or aerosol particle, including oil-mist, potassium and sodium compounds that may be entrained somewhere in the delivery, storage, or transfer of the hydrogen fuel

3.8
reversible effect

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

4 Requirements

4.1 Classification

Hydrogen fuel for PEM fuel cell applications for road vehicles shall be classified according to the following types and grade designations:

- Type I (grade D): Gaseous hydrogen
 - Type II (grade D): Liquid hydrogen
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4.2 Applications

The following information characterizes representative applications of each type and grade of hydrogen fuel. It is noted that suppliers commonly transport hydrogen of a higher quality than some users may require.

- | | |
|------------------|--|
| Type I, grade D | Gaseous hydrogen fuel for PEM fuel cell road vehicle systems |
| Type II, grade D | Liquid hydrogen fuel for PEM fuel cell road vehicle systems |

NOTE 1 Type I (grades A, B, and C), Type II (grade C) and Type III, which are applicable for all applications except PEM fuel cells for road vehicles, are defined in ISO 14687-1.

NOTE 2 There is no equivalent grade A and B for Type II fuels.

4.3 Limiting characteristics

The directory of limiting characteristics outlined in Table 1 specifies the requirements applicable to the aforementioned grades of hydrogen fuel.

5 Quality Verification

5.1 Hydrogen fuel qualification test

5.1.1 General requirements

Quality verification requirements shall be determined at the dispenser nozzle or other location by written agreement between the supplier and the customer.

5.1.2 Analytical requirements of the qualification tests

The analytical requirements for the qualification tests shall be determined by agreement between the supplier and the customer.

5.1.3 Report results

The detectable limits for analytical methods and instruments used shall be reported along with the results of each test. These detectable limits shall be below the threshold limit for each constituent. All limiting characteristics of the hydrogen fuel specified in Table 1 shall meet the requirements therein. When applicable, means should be provided to test for other contaminants not listed in Table 1, but identified as potentially harmful to the fuel cell system.

NOTE Annex A provides the rationale for the selection of the non-hydrogen constituents specified in Table 1.

5.2 Lot acceptance tests

Lot acceptance requirements shall be determined by agreement between the supplier and the customer.

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