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Hydrogen fuel quality — Product specification

Qualité du carburant hydrogène — Spécification de produit

FDIS stage

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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 document 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 ISO/TC 197, *Hydrogen technologies*.

This second edition cancels and replaces the first edition (ISO 14687:2019), which has been technically revised.

The main changes are as follows:

— ~~The~~a new Grade of hydrogen quality for internal combustion engine (Grade F) applications has been added in Informative ~~Annex F;~~Annex F;

— ~~The~~ rationale for each ~~of~~ Grade D ~~specifications~~specification has been moved from ISO19880-8 to this ~~standard~~document;

— ~~Each of the specifications~~each specification for each Grade ~~were~~has been modified reflecting ~~the~~ recent research ~~works~~work and ~~the~~ change in industrial needs.

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.

Field Code Changed

Introduction

In recent years, the ~~environment surrounding the use of~~landscape for using hydrogen as a fuel has changed significantly ~~from the perspective of contributing~~in response to its potential to contribute to the reduction of greenhouse gas emissions ~~because of issues~~. This shift is influenced by challenges on both the hydrogen supply side, ~~including hydrogen~~such as production ~~technology~~technologies and supply chain infrastructure, and ~~issues on~~also the hydrogen energy ~~use~~usage side, including advancements in fuel cell ~~technology~~ and combustion ~~use. In order to respond to~~technology. To address these ~~changes~~changing conditions, the hydrogen fuel specifications ~~given~~ in this document have been ~~revised~~updated.

The hydrogen fuel specifications for ~~the~~ proton exchange membrane (PEM) fuel cell applications in this document are ~~mainly~~primarily based on research, development and data on the following items ~~[2][3][4][5][6][7][8][9][10][11][12][13][14].~~[2][3][4][5][6][7][8][9][10][11][12][13][14]:

— ~~—~~PEM fuel cell catalyst and fuel cell tolerance to hydrogen fuel impurities;

— ~~—~~effects/mechanisms of impurities on fuel cell power systems and components;

— ~~—~~impurity detection and measurement techniques for laboratory, production and in-field operations;

— ~~—~~fuel cell vehicle demonstration and stationary fuel cell demonstration results.

Grade D and ~~the~~ grade E in this document are intended to apply to PEM fuel cells for road vehicles and stationary appliances, respectively. These aim to facilitate the provision of hydrogen of reliable quality balanced with acceptable lower cost for the hydrogen fuel supply.

In addition, Grades F-1 and F-2 ~~were~~are newly specified in this ~~revision~~edition to apply to hydrogen internal combustion engines for use in vehicular and stationary applications respectively. The new Grades were placed in an informative annex ~~(Annex F)~~(Annex F) to allow experience to be gained with this fuel quality prior to inclusion in the normative text.

~~This~~While this document reflects the state of the art at the date of its publication, ~~but since~~ the rapid development of quality requirements for hydrogen technology applications ~~are developing rapidly, this document~~ would ~~need to be further revised in the~~necessitate future ~~according~~revisions in response to technological progress.

Hydrogen fuel quality — Product specification

1 Scope

This document specifies the minimum quality characteristics of hydrogen fuel as distributed for utilization in residential, commercial, industrial, vehicular and stationary applications.

This document is applicable to hydrogen fuelling applications, which are listed in ~~Table 2.~~Table 2.

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 19880-8, *Gaseous hydrogen — Fuelling stations — Part 8: Fuel Quality Control*

ISO 19880-9, *Gaseous hydrogen — Fuelling stations — Part 9: Sampling ~~procedures and hardware for hydrogen~~for fuel quality analysis*

ISO 21087, *Gas analysis — Analytical methods for hydrogen fuel — Proton exchange membrane (PEM) fuel cell applications for road vehicles*

3 Terms ~~and,~~ definitions and abbreviations

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 http://www.iso.org/obp

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

~~3.1~~

3.1 Terms and definitions

3.1.1

boundary point

<proton exchange membrane *fuel cell* ~~(3.7)~~(3.1.7) for stationary applications> point between the *hydrogen fuel supply equipment* ~~(3.13)~~(3.1.13) and the PEM *fuel cell power system* ~~(3.9)~~(3.1.9) at which the quality characteristics of the hydrogen fuel are to be determined

~~3.1.1~~3.1.2 ~~3.2~~

constituent

component (or compound) found within a hydrogen fuel mixture

~~3.1.2~~3.1.3 ~~3.3~~

contaminant

impurity that adversely affects the components within the *fuel cell system* ~~(3.8),~~(3.1.8), the *fuel cell power system* ~~(3.9)~~(3.1.9) or the hydrogen storage system

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

3.1.33.1.4 3.4
customer
<-proton exchange membrane *fuel cell* (3.7)(3.1.7) for stationary applications> party responsible for sourcing hydrogen fuel in order to operate the *fuel cell power system* (3.9)(3.1.9)

3.1.43.1.5 3.5
detection limit
lowest quantity of a substance that can be distinguished from the absence of that substance with a stated confidence limit

3.1.53.1.6 3.6
determination limit
lowest quantity which can be measured at a given acceptable level of uncertainty

3.1.63.1.7 3.7
fuel cell
electrochemical device that converts the chemical energy of a fuel and an oxidant to electrical energy (DC power), heat and other reaction products

3.1.73.1.8 3.8
fuel cell system
<-proton exchange membrane *fuel cell* (3.7)(3.1.7) for road vehicle applications> power system used for the generation of electricity on a fuel cell vehicle

Note 1 to entry: The fuel cell system typically contains the following subsystems: fuel cell stack, air processing, fuel processing, thermal management and water management.

3.1.83.1.9 3.9
fuel cell power system
<–proton exchange membrane –*fuel cell* (3.7)(3.1.7) for stationary applications> self-contained fuel cell assembly used for the generation of electricity which is fixed in a place in a specific location

Note 1 to entry: The fuel cell power system typically contains the following subsystems: fuel cell stack, air processing, thermal management, water management and automatic control system. It is used in applications such as: distributed power generation, back-up power generation, remote power generation, electricity and heat co-generation for residential and commercial applications.

Note 2 to entry: For the purposes of the applications, the fuel cell power system does not contain a fuel processing system due to the location of the *boundary point* (3.1).(3.1.1).

3.1.93.1.10 3.10
gaseous hydrogen
hydrogen under gaseous form

3.1.103.1.11 3.11
hydrogen-based fuel
<-proton exchange membrane *fuel cell* (3.7)(3.1.7) for stationary applications> gas containing a specified concentration of hydrogen as specified in tables in this document used forin PEM fuel cellcells for stationary applications

3.12
Note 1 to entry: The concentration of hydrogen in the gas is specified in tables in this document (ISO 14687).

3.1.12
hydrogen fuel index
mole fraction of a fuel mixture that is hydrogen

~~3.1.11~~3.1.13 ~~3.13~~
hydrogen fuel supply equipment
equipment used for the transportation or on-site generation of hydrogen fuel, and subsequently for the delivery to the *fuel cell power system* ~~(3.9)~~(3.1.9), including additional storage, vaporization and pressure regulation as appropriate

~~3.1.12~~3.1.14 ~~3.14~~
irreversible effect
effect, which results in a permanent degradation of the *fuel cell system* ~~(3.8)~~(3.1.8) or the *fuel cell power system* ~~(3.9)~~(3.1.9) performance that cannot be restored by practical changes of operational conditions and/or gas composition

~~3.1.13~~3.1.15 ~~3.15~~
liquid hydrogen
hydrogen that has been liquefied, i.e. brought to a liquid state

~~3.1.14~~3.1.16 ~~3.16~~
particulate
solid or liquid such as oil mist that can be entrained somewhere in the production, delivery, storage or transfer of the hydrogen fuel to a *fuel cell system* ~~(3.8)~~(3.1.8) or a *fuel cell power system* ~~(3.9)~~(3.1.9)

~~3.1.15~~3.1.17 ~~3.17~~
reversible effect
effect, which results in a temporary degradation of *the fuel cell system* ~~(3.8)~~(3.1.8) or the *fuel cell power system* ~~(3.9)~~(3.1.9) performance that can be restored by practical changes of operational conditions and/or gas composition

~~3.1.16~~3.1.18 ~~3.18~~
slush hydrogen
hydrogen that is a mixture of solid and liquid at the eutectic (triple-point) temperature

~~3.1.17~~3.1.19 ~~3.19~~
system integrator
<proton exchange membrane *fuel cell* ~~(3.7)~~(3.1.7) for stationary applications> integrator of equipment between the PEM *fuel cell power system* ~~(3.9)~~(3.1.9) and the hydrogen supply

3.2 ~~3.20~~ Abbreviated terms

Table 1 — Abbreviated terms

Abbreviated term	Definition
PEM	proton exchange membrane
FCEV	fuel cell electric vehicle

4 Classification and application

4.1 Classification

Hydrogen fuel shall be classified according to the following types and grade designations:

a) ~~a)~~ Type I (grades A, B, C, D, E and F): gaseous hydrogen and hydrogen-based fuel;

b) ~~b)~~ Type II (grades C and D): liquid hydrogen;

c) ~~c)~~ Type III: slush hydrogen.