ISO/TC 197 N 871

ISO/TC 197
Hydrogen technologies

Email of secretary: jim.ferrero@bnq.qc.ca
Secretariat: SCC (Canada)

CD 14687 Collated Comments WG27 revised 2017-08-31

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Template for comments and secretariat observations

Date: 2017-08-31	Document: CD 14687.2	Project: WG 27

MB/ NC[1]	Line number	Clause/ Subclause	Paragraph/ Figure/Table	Type of comment[2]	Comments	Proposed change	Observations of the secretariat
1 CA		Introduction	Second Last Line Last Paragraph	ge	Grammar error	"in the future" instead of "in future"	Agree
2 DE		Introduction	Pg. 6	Ge	The purpose of the standard is not to combine existing standards.	The purpose of this revision is to….	Agree
3 JP		Introduction		Ge.	This revision is intended to apply to the dissemination stage of PEM fuel cells for road vehicles and stationary appliances and is aiming the reliable hydrogen quality with lower cost	Add the following sentences before the last paragraph of Introduction section; reads; This international standard is intended to apply to the dissemination stage of PEM fuel cells for road vehicles and stationary appliances. This revision has been aiming the reliable hydrogen quality with lower cost for the hydrogen fuel supply. Since the hydrogen application ----	Agree
4 AR		1	Scope	Te	The scope as indicated below does not include specifications for hydrogen to be used in Fuel cells to power mobile applications like cellular phones, tablets, ultrabooks and other similar devices Even more the appliances indicated in Table 1 does not cover the above mentioned need Appliance is a device, machine, or piece of equipment, especially an electrical one that is used in the house, such as a cooker or washing machine 1 Scope This International Standard specifies the quality characteristics of hydrogen fuel in order to assure uniformity of the hydrogen product as produced and distributed for utilization in vehicular and stationary applications. It is applicable to hydrogen fuelling applications, which are listed in Table 1 of this International Standard.	If it is possible, the following text is suggested: 1 Scope This International Standard specifies the quality characteristics of hydrogen fuel in order to assure uniformity of the hydrogen product as produced and distributed for utilization in vehicular, mobile devices and stationary applications. It is applicable to hydrogen fuelling applications, which are listed in Table 1 of this International Standard. If modification of the text of the scope it is not possible, it will be discussed how to include such important mobile applications to be covered by this standard	Disagree This International Standard is able to be used for mobile device applications.

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MB/ NC[1]	Line number	Clause/ Subclause	Paragraph/ Figure/Table	Type of comment[2]	Comments	Proposed change	Observations of the secretariat
5 DE		1	Pg. 7	Ge	Uniformity of production not necessary. Only the product specification needs to be ensured at the fuelling interface.	This international standard specifies the minimum quality characteristics of hydrogen fuel as distributed for utilization in vehicular and stationary applications.	Agree
6 DE		1	Pg. 7	Ge	The scope of the document should be clearly pointed out.	The applicable hydrogen fuelling applications should be designated.	Disagree They are clarified in this whole document.
7 CN		2		ge	Any information about “ISO 21087” can not be got on ISO website or specialized libraries of China, please provide some way that we can purchase this important standard.		Agreed in principle Secretary is going to consult TC197 or ISO CS how to manage
8 CA		3		ge	Formatting	The first letters of all the terms should be capitalized. Example: 3.1 Boundary point Point between the hydrogen…	Disagree. The format is conformed the directives. Add following sentence. 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 http://www.iso.org/obp – IEC Electropedia: available at http://www.electropedia.org/ 3.1 boundary point Point between the hydrogen
9 AR		3		Ed	Notes in point 3 of Terms and definitions are not properly numbered (See 3.20)	It’s suggested to number correctly all notes within this clause	Agree

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10 DE		3.1	Pg. 7	Ge	Boundary point only applies to stationary applications.	3.1 boundary point (stationary appliances)	Agreed in principle Replace with "boundary point (PEM fuel cell for stationary applications)" to keep consistancy.
11 NZ		3.1 – 3.21	Pg 7-9	ed	Inconsistent use of full stops (notes & 3.17 only end with full stop).	Add full stop after every definition.	~~Disagree~~ Agreed in principle Edit as ISO/IEC Directives. Delete unnecessary periods
12 GB		3.3	Note	Ed	Editorial error	Change to: “Note 1 to entry: An adverse…..” (Also, the font size should be one size smaller for notes)	Agree Edit as ISO/IEC Directives Use 10 pt instead of 11 pt
13 CN		3.4		ed	The definition of "Customer" has obvious errors, it is same as "contaminant".	Change the definition	Agree **3.4** **customer** party responsible for sourcing hydrogen fuel in order to operate the fuel cell power system
14 DE		3.4	Pg. 7	Ge	Definition of customer	Please provide correct definition	See 13
15 GB		3.4	All	Ed	Incorrect definition has been copied into this draft document. See ISO 14687-3, clause 3.4	Replace with: “party responsible for sourcing hydrogen fuel in order to operate the fuel cell power system”	See 13
16 JP		3.4		Ed	Citation error	Replace the whole section of 3.4 with the following; **3.4** **customer** party responsible for sourcing hydrogen fuel in order to operate the fuel cell power system	See 13

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17 NZ		3.4	Pg7	ge	Incorrect definition of “customer”	A party that receives or consumes products (goods or services) and has the ability to choose between different products and suppliers.	See 13
18 SE		3.4	Page 7	te/ed	The definition of customer (3.4) does not make sense. It is a copy of the definition of contaminant (3.3).	Delete sub-clause 3.4.	See 13
19 US		3.4		ed	Please change definition for “customer”. It should be different that the one provide for “contaminant”	Typo – replace with definition from working draft “Party responsible for sourcing hydrogen fuel in order to operate the fuel cell power system”	See 13
20 GB		3.8	term	Ge	Term doesn’t match 3:20.	Modify to: “transportable proton exchange membrane (PEM) fuel cell power system” or “vehicular proton exchange membrane (PEM) fuel cell power system” Or make the definition more generic, not specifically for vehicle applications, and remove 3.20.	Agreed in principle Add following after the term. "(PEM fuel cell application for road vehicles)"
21 GB		3.8	Para 1	Ge	Definition doesn’t match 3:20 (for which it is the equivalent, although with the inclusion of fuel processing?)	Modify to: “self-contained assembly of integrated PEM fuel cell systems used for the generation of electricity which is used in a vehicular application, typically containing the following subsystems: fuel cell stack, air processing, fuel processing, thermal management, water management, and automatic control system” Or similar, but keep the two definitions consistent as far as is appropriate.	See 20
22 NZ		3.8	Pg8	te	“…thermal management, and water management.”	“… thermal management, water management, and automatic control system”	Disagree Not need to be clarified
23 FR		3.9	Pg 8	Te	Hydrogen that has been produced to gaseous form and brought essentially to ambient conditions... The state (gas or liquid) does not depend on the way it has been produced. It does not depend either of the ortho or para status of the molecules.	Gaseous hydrogen GH2: Hydrogen under gaseous form, purified to a minimum...	Agree

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24 GB		3.9	Para 1	Ed	Spelling	Change 'quilibrium' to 'equilibrium'	See 23 Deleted
25 GB		3.9	Note	Ed	Editorial error	Change to: "Note 1 to entry: The gaseous….." (Also, the font size should be one size smaller for notes)	Agree Edit as ISO/IEC Directives
26 NZ		3.9	Pg8	ed	Incorrect spelling "quilibrium" and "98 %"	"equilibrium" and "98%"	Agree
27 SE		3.9	Page 8	ed	Under term/definition of gaseous hydrogen. Is "… ambient conditions as an quilibrium mixture of …", should be "… ambient conditions as an equilibrium mixture of …" (missing an "e" in equilibrium).	See our comment.	Agree See 23 Deleted
28 GB		3.9 & 3.10	All	Ge	Decide whether it needs to be 98 % or 50 % as a minimum mole fraction for it to be classed as (gaseous) hydrogen fuel. Consider combining 3.9 with 3.10	Address as appropriate.	TG2 Change the term to hydrogen based fuel (PEM fuel cell for stationary applications)
29 GB		3.10	Term	Ge	Hydrogen fuel is used for numerous applications in this document – the term and definition should be generic if they remain separate from the term "gaseous hydrogen"	Address as appropriate.	TG2 hydrogen based fuel (PEM fuel cell for stationary applications)
30 NZ		3.10	Pg8	ed	"50 %"	"50%"	Agree
31 FR		3.14	Pg9	Te	Liquid Hydrogen state is not related to the status of the molecule	Delete "para"	Agree
32 GB		3.17	Para 1	Ge	Include generation as a source of particulates	Change to "…..somewhere in the generation, delivery, storage, or transfer of the hydrogen fuel…."	Disagree This IS covers the PM after generation of H2. No need to specify whole processes.

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33 GB		3.17	Para 1	Ge	Clarification on definition of aerosol particle	Change to “Aerosol particles, solid or liquid such as oil mist, that can be entrained…”	Agreed in principal Change Particles, solid or liquid such as oil mist, that can be entrained....
34 NZ		3.17	Pg9	ed	“entering a fuel cell systems.”	“entering a fuel cell system.”	Agree
35 AR		3.20	Note	Ed	In the Note 2 is there a mention to a part of this standard and that should be changed because there will not be parts any more for ISO 14687 “Note 2: For the purposes of this part of ISO 14687, the PEM fuel cell power system does not contain a fuel processing system due to the location of the boundary point.”	Change the note 2 as follows: Note 2: For the purposes of this standard, the PEM fuel cell power system does not contain a fuel processing system due to the location of the boundary point.	Agree
36 GB		3.20	Note	Ed	Editorial errors	Change to: “Note 1 to entry: For the purposes of ISO 14687, the…..” (Also, the font size should be one size smaller for notes)	agree Edit as ISO/IEC Directives
37 AR		4	Table 1	Te	Table 1 — Hydrogen classification by application The text is not prepared to properly include mobile applications because they are not appliances “Internal combustion engines for transportation; Residential/commercial appliances except PEM fuel cell stationary appliances”	Include mobile applications if needed, depending of the result of the previous point discussion	Disagree This international standard is able to use for mobile applications.
38 AR		4		Te	It is suggested that we include a point within the classification of all the different types of hydrogen related to the origin of the product as well as other undergoing standards as it could be useful to work on a new specific document devoted to this topic. This proposal is supported by the increasing global environmental awareness and as an example of regional initiative, we mention the European program: CertifHy (www.certifhy.eu)	Add a new sub clause 4.1 that consider the aforementioned suggestion and then renumber the subsequent points.	Disagree Out of scope

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39 GB		4.2	Para 1 Sentence 2	Ge	Is this a requirement for suppliers? "It is noted that suppliers shall take measures not to contaminate the each grade of hydrogen with the other grade(s) of hydrogen." If so it should be clearer. It begs the question why this cannot happen if Grade D hydrogen is provided for a Grade E application however – other than the particulate diameter, it still meets the Grade E specification.	Modify to: "Suppliers shall take measures to avoid contamination of the different grades of hydrogen by other grades of hydrogen." However, it should be noted that some grades of hydrogen exceed the specifications of other applications. If it is felt reasonable, an alternative could be: "Suppliers shall take measures to avoid contamination of the different grades of hydrogen by inferior grades of hydrogen."	Disagree This Clause is indicating only the description on hydrogen grade. It is a matter of quality control.
40 GB		4.2	Table 1	Ge	Internal combustion engines for transportation; Residential/commercial appliances except PEM fuel cell stationary appliances;	Clarify what this grade is for – for example: "Internal combustion engines for transportation; Residential/commercial combustion appliances (e.g. boilers, cookers and similar applications)" or "Non PEM fuel cell residential and commercial applications, for instance; Internal combustion engines for transportation; Residential/commercial combustion appliances (e.g. static combustion engines, water heaters (boilers), cookers and similar applications); or XXXX fuel cells" (if other types of fuel cells need this quality of hydrogen rather than Grade D or E) Please note: It is unclear if this grade is suitable for hydrogen internal combustion engines for transportation – please see comment on Chap 7	Agree change the sentence as follows; Internal combustion engines for transportation; Residential/commercial combustion appliances (e.g. boilers, cookers and similar applications)"
41 GB		4.2	Table 1	Ge	Industrial fuel for power generation and heat generation	Clarify what this grade is for – for example: "Non PEM fuel cell industrial applications, for instance; ???"	Agreed in principle add except PEM fuel cell applications

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42 GB		4.2	Table 1	Ge	Aircraft and space-vehicle ground support systems	Clarify what this grade is for – for example: “Non PEM fuel cell aircraft and space-vehicle ground support system applications, for instance; ???”	Agreed in principle add except PEM fuel cell applications
43 JP		4.2 6.1		te	The applications for each Category 1,2,3 should be clarified.	Add description of applications for each categories in the Table 1 of Clause 4.2 and the category description in Clause 6.1 as follows; 4.2 a part of Table 1 ... PEM Fuel cells for stationary appliances 1 E 1 High efficiency/low power; minimum hydrogen fuel index of 50% 1 E 2 High power; minimum hydrogen fuel index of 50% 1 E 3 Hydrogen applications; minimum hydrogen fuel index of 99.9% 6.1 Fuel quality specification Bulleting • Type I, Grade E, Category 1 (High efficiency/low power; minimum hydrogen fuel index of 50%) • Type I, Grade E, Category 2 (High power; minimum hydrogen fuel index of 50%) • Type I, Grade E, Category 3 (Hydrogen applications; minimum hydrogen fuel index of 99.9%)	TG2 Agree As for the language for describing those categories in Subclause 6.1 change to "Type I, grade E hydrogen fuel for PEM fuel cell applications for stationary appliances specifies the following subcategories in order to meet the needs of different stationary applications, depending on the requirements specified by the manufacturer:" and delete the last sentence.
44 JP		4.2	Table 1, Note	Te	There is need to use grade D for PEM fuel cell application for stationary appliances in the market.	Add a foot note as follows; 4.2 Table-1 Note NOTE 3: Grade D may be used for PEM fuel cell stationary appliances alternative to Grade-E category-3	TG2 Agree

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45 GB		5	Title	Ed	Improve language	Simplify language: “Requirements for hydrogen for PEM fuel cell road vehicle applications”	Agree d in priciple Hydrogen quality requirements for PEM fuel cell road vehicle application Change other titles of the related Clause.
46 CA		Section 5, 6, 7	Table 2, 3, 4	ge	The font, size, and word choice should be kept consistent for Table 2, 3, and 4. Example: The font and size of “Maximum concentration of individual contaminants” are vastly different between Table 2 and 3. Furthermore, Table 4 uses “Impurities (maximum content”) instead.	Make the table consistent.	agree
47 CA		Section 5	Table 2	te	It is clear that the limits of constituents highlighted in yellow should be revised given the fact that, compared to the typical fuel cell anode loading used in 2012 (when 14687-2 was released), the typical anode loading in 2017 is significantly lower, is there any new preliminary threshold that can be proposed at this time? For example, it is not reasonable to maintain the 0.2 ppm CO limit when it is unlikely to work for the projected anode loading going forward.		See 48 and 49
48 CN		5.1	Table 2	te	As per HYCORA results, the Formaldehyde is confirmed as having a similar effect as CO on the Fuel Cells as presented during our previous WG27 meetings. According to our understanding, most of the participants of WG27 prefer as follow: CO < 0,2ppm HCOOH< 0,2 ppm HCHO<0,2 ppm CO+HCOOH+HCHO < 0,2 ppm		Tentatively agreed. Final decision may be modified based upon technical data at the next WG27 meeting. See attached table indicating each stakeholder's position at this meeting on 2017-05-30.

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49 DE | | 5.1 | Table 2 Te

CO value should be decreased from 0,2 ppm to 0,05 ppm to reduce additional recovery measures which lead to irreversible stack degradation. Proposal to implement new “Total Carbon Monoxide, Formaldehyde and Formic Acid” value at 0,1 ppm to meet OEM needs.

Latest discussions during last WG27 meeting:

06.12.2016

Revision of CO, HCHO, HCOOH specification

	CO	HCHO	HCOOH	Sum
	ppm	ppm	ppm	ppm
EIGA	0,2	0,2	0,2	0,2
JPN Infra	0,2	0,2	0,2	N/A
EuroeanOEM	N/A	N/A	N/A	0,1
JPN OEM	0,1	--?	--?	--?
Current Spec.	0,2	0,01	0,2	N/A

To reach the optimum in hydrogen cost (production, analysis) and fuel cell system cost the EIGA proposal would be a good next step for the current revision.

Proposal for new table 2 – Fuel quality specification for the PEM fuel cell application for road vehicles (changes marked yellow)

Constituent (assay)	**Type I, Type II Grade D**
Hydrogen fuel index (minimum mole fraction)[a]	99,97 %
Total non-hydrogen gases[b]	300 µmol/mol
Maximum concentration of individual contaminants	
Water (H_2O)	5 µmol/mol
Total hydrocarbons except methane[b, c] (C1 equivalent)	2 µmol/mol
Methane (CH_4)	100 µmol/mol
Oxygen (O_2)	5 µmol/mol
Helium (He)	300 µmol/mol
Nitrogen (N_2)	300 µmol/mol
Argon (Ar)	300 µmol/mol
Carbon dioxide (CO_2)	2 µmol/mol
Carbon monoxide[b] (CO)	0,2 µmol/mol
Formaldehyde[b] (HCHO)	0,2 µmol/mol
Formic acid[b] (HCOOH)	0,2 µmol/mol
Total carbon monoxide, formaldehyde, formic	0,2 µmol/mol

Constituent (assay)	**Type I, Type II Grade D**
Hydrogen fuel index (minimum mole fraction)[a]	99,97 %
Total non-hydrogen gases [b]	300 µmol/mol
Maximum concentration of individual contaminants	
Water (H_2O)	5 µmol/mol
Total hydrocarbons except methane [b, c] (C1 equivalent)	2 µmol/mol
Methane (CH_4)	100 µmol/mol
Oxygen (O_2)	5 µmol/mol
Helium (He)	300 µmol/mol
Nitrogen (N_2)	300 µmol/mol
Argon (Ar)	300 µmol/mol
Carbon dioxide (CO_2)	2 µmol/mol
Carbon monoxide [g] (CO)	0,2 µmol/mol
Formaldehyde[g] (HCHO)	0,2 µmol/mol
Formic acid[g] (HCOOH)	0,2 µmol/mol

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acid[b]	
Total sulfur compounds[d] (S1 equivalent)	0,004 µmol/mol
Ammonia (NH_3)	0,1 µmol/mol
Total halogenated compounds[e] (Halogen ion equivalent)	0,05 µmol/mol
Maximum particulates concentration[f]	1 mg/kg

[a] The hydrogen fuel index is determined by subtracting the “total non-hydrogen gases” in this table, expressed in mole percent, from 100 mole percent.

[b] For the constituents that are additive, such as total hydrocarbons and total sulfur compounds, the sum of the constituents are to be less than or equal to the acceptable limit.

[c] Total hydrocarbons include oxygenated organic species. Total hydrocarbons shall be measured on a C1 equivalent (µmolC/mol).

[d] As a minimum, total sulphur compounds include H2S, COS, CS2 and mercaptans, which are typically found in natural gas.

[e] Total halogenated compounds include, for example, hydrogen bromide (HBr), hydrogen chloride (HCl), chlorine (Cl2), and organic halides (R-X). Total halogenated compounds shall be measured on a halogen ion equivalent.

[f] Particulates include solid and aerosol particles.

Total sulfur compounds [d] (S1 equivalent)	0,004 µmol/mol
Ammonia (NH_3)	0,1 µmol/mol
~~Total~~ halogenated compounds [e] (Halogen ion equivalent)	0,05 µmol/mol
Maximum particulates concentration[f]	1 mg/kg

[a] The hydrogen fuel index is determined by subtracting the “total non-hydrogen gases” in this table, expressed in mole percent, from 100 mole percent.

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[c] Total hydrocarbons include oxygenated organic species. Total hydrocarbons shall be measured on a C1 equivalent (µmolC/mol).

[d] As a minimum, total sulphur compounds include H2S, COS, CS2 and mercaptans, which are typically found in natural gas.

[e] Total halogenated compounds include, for example, ~~hydrogen bromide (HBr),~~ hydrogen chloride (HCl), ~~chlorine (Cl2),~~ and organic halides (R-X). Total halogenated compounds shall be measured on a halogen ion equivalent.

[f] Particulate includes aerosol such as oil mist. No visible oil shall be found in fuel at a nozzle.~~Particulates include solid and aerosol particles.~~

[g] Sum of CO, HCHO, HCOOH shall not exceed 0.2 µmol/mol.

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50 FR		5.1	Pg11 Table 2	TE	As per HYCORA results, the Formaldehyde is confirmed as having a similar effect as CO on the Fuel Cells as presented during our previous WG27 meetings. According to our understanding, most of the participants of WG27 including EIGA, the European OEMs, HySUT would be now ready to compromise for the following: CO < 0,2ppm HCOOH< 0,2 ppm HCHO<0,2 ppm CO+HCOOH+HCHO < 0,2 ppm.	Change threshold of Formaldehyde HCHO to 0,2 µmol/mol Add a note to specify Total CO + HCHO + HCOOH <0,2 µmol/mol	See 48 and 49
51 NL	Pg. 11	5.1	Table 2	Te	As per HyCORa results and as also presented at earlier WG27 meetings, formaldehyde has been confirmed as having a similar effect as CO on the fuel cells. The current formaldehyde threshold is at 0.01ppm (10ppb) which leads to considerable unnecessary control costs. At the last WG27 meeting (June 2016) the stakeholders seemed to converge on a relaxation of the threshold to 200ppb, in addition to capping the total (CO + HCHO + HCOOH) threshold also at 200ppb. EIGA, the European OEMs and HySUT agree on this combined small modifications to the totals definition (see proposed changes, right). To achieve an optimum of both hydrogen cost (production, analysis) and fuel cell system cost, this proposal would be a good next step for the current revision.	Proposal for new table 2 – Fuel quality specification for the PEM fuel cell application for road vehicles (changes marked yellow):	See 48 and 49
52 NO	P11	5.1	T2 L15-16	te	Consensus on HCHO, HCOOH, CO at 0.2 µmol/mol was expected from last WG27 meeting. This has not been updated in the CD	Set individual tolerances for HCHO, HCOOH and CO at Consensus on HCHO, HCOOH, CO at 0.2 µmol/mol, but limiting their sum to be 0.2 µmol/mol	See 48 and 49

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53 GB		5.1	Para 1	Ed	The fuel quality requirements at the dispenser nozzle applicable to the aforementioned grades of hydrogen fuel for PEM fuel cells in road vehicles shall meet the requirements of Table 2.	Simplify language: “The quality of hydrogen dispensed to PEM fuel cell electric vehicles shall meet the requirements of Table 2.”	Agree in principle Change to; The quality of hydrogen at dispenser nozzle for PEM fuel cell road vehicles shall meet the requirements of Table 2.
54 GB		5.1	Para 1	Ge	There are additional impurities that could potentially cause problems for fuel cell vehicles but are not specified in Table 2. For example, hydrogen produced by biogas may contain siloxanes. It is not clear how this should be addressed and who is responsible.	Clarify action needed for hydrogen production processes where additional impurities may be present.	Agree in principle GDR. AM and SQ will prepare the language for this comment in a month. Secretary took #89 GB comment tentatively until secretariat receive the input from GDR. AM and SQ.
117 Secretary		5.1	Para 1	ed	The fuel specifications are not process or feed stock specific.	Change to The fuel specifications are not depended on process or feed stock specific.	Modified based on NH's suggestion. “The fuel specifications are not process dependent, or feed stock specific.”
55 GB		5.1	Table 2 - title	Ed	Fuel quality specification for the PEM fuel cell application for road vehicles	Simplify language: “Fuel quality specification for PEM fuel cell road vehicle applications”	Agree
56 GB		5.1	Table 2	Te	ISO TC 197 WG27 delegates have shown evidence to show that the total for carbon monoxide, formaldehyde and formic acid should be 0.2 ppm, this has not been included.	Increase limits of carbon monoxide, formaldehyde and formic acid to 0.2 µmol mol^{-1} with a note that this is for the combined total of these compounds	See 48 and 49
57 GB		5.1	Table 2 – note a	Ed	Why is “is” underlined?	Remove underline	agree
58 GB		5.1	Table 2 – note d	Te	Specifying examples of compounds included in total halogenated is too vague, as with the other compounds in this table it should be clearly defined. As with the other compounds if there is little evidence showing that it will present in hydrogen, why is it included in the specifications. This measurement is currently not required, but simply pushes up the price of hydrogen as it is not	Remove total halogenated compounds or replace with the individual compounds that would actually be present.	Agreed in principle Delete "Total " Leave "Halogenated compounds (Halogen ion equivalent)" The foot note d is also

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MB/ NC[1]	Line number	Clause/ Subclause	Paragraph/ Figure/Table	Type of comment[2]	Comments	Proposed change	Observations of the secretariat
					a routine measurement.		modified Remove "Total" in two sentences. WG27 understands those phenomena and analysis methods need to be investigated.
59 GB		5.1	Table 2 – note d	Ed	The total halogen ion equivalent is expressed with units in carbon	Remove 'µmolC/mol' and replace with the correct units	agree
60 JP		5.1	foot note d inTable 2	ED	(µmolC/mol)	(µmol/mol)	See 59
61 JP		5.1	Table 2	Te.	HCHO : JARI in Japan is testing the influence of HCHO. The specification of HCHO should be revised based on those data.	Determined based on the technical data. Discuss at the WG27 meeting in Seoul.	See 48 and 49
62 JP		5.1	Table 2	Te.	Total halogenated compounds : - It is difficult and tremendously expensive to analyse all of the halogenated compounds for both organic and inorganic. - In Japan, it is very rare to be contaminated with Br or F compounds. - In Japan, CCl3F as organic solvent is not used.	JPN Infrastructure team will check the analysis methods. need to be discussed for further revision based on the technical data.	See 58
63 JP		5.1	Table.2	TE	The specification for liquid phase constituents is needed. Especially, liquid of lower vapour pressure is concern for FCV operation. E.g. Lubricants, Ionic liquid Those definitions need to be specified more clearly. (Oil is now specified in aerosol as a part of particulate in Clause 3.17.) If a liquid substance is found visually on a sampling filter for analysis, it should be categorized as out of specification.	J-OEM will present comments and proposals at WG27 Seoul meeting	Add new footnote to Table 2 g Particulate includes oil mist. No visible oil shall be found in fuel at a nozzle.

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64 JP		5.1	Teble2	TE	Is "Halogen ion equivalent" applicable for organic halides? If not, the definition needs to be modified.	Need consultation of experts.	See 58
65 US		5.1	Table 2	Te	Total non-hydrogen gases is 300.	Differs from SAE value of 100. Definitions of this category may explain the difference.	This is the consensus in ISO/TC197/WG27 meeting.
66 US		5.1	Table 2	Te	Previous version of Table 2 addressed Total sulphur compounds as (H2S basis). Well understood. In this CD version it was changed as (S1 equivalent). What was the basis of this change?	Please provide an explanation of the change.	It is the same way with a suitable expression to indicate. One sulfur equivalent (= basis) ~~From best our knowledge in ISO/TC197/WG27.~~
67 US		5.1	Table 2	Te	The U.S. recommends that Table 2 be revised with respect to CO, Formaldehyde (HCHO), and Formic Acid (HCOOH) based on ISO discussions during the December 6th meeting and previous input provided to European regulatory body CEN. Please consider revising the table to reflect that the Sum of: Carbon Monoxide + Formaldehyde + Formic acid = 0.2ppm Also, please leave individual constituents for: Carbon Monoxide (CO) = 0.2 ppm Formaldehyde (HCHO) = 0.2 ppm Formic Acid (HCOOH) = 0.2 ppm	The U.S. requests that data be provided that supports the increases in CO and HCHO and also on the use of a summation.	See 48 and 49
68 CN		5.1, 6.1	Table 2, Table 3	te and ed	The requirement on "Total sulfur compounds" may be too strict. For hydrogen producer, it will cost much to control and analysis the total sulfur compounds under 4ppb. And in Table 2 it is "Total sulfur compounds", in Table 3 it is "Total sulphur compounds", they should be unified.	Provide the reason for setting the index of " Total sulfur compounds" as 0.004μmol/mol, or change it to a higher value, like 0.01μmol/mol.	As for sulfur content, disagree This threshold has been determined based on the technical data and analytical capability. WG27 does not change at this time. The latter part of this comment on the consistency of wording was agreed. As for spelling, WG27 takes "Sulfur"

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69 GB		5.2	All	Ed	Simplify language. No need to include referenced standard title.	Modify to: "Analytical methods for measuring constituents in hydrogen for PEM fuel cell road vehicle applications, as listed in Table 2, are specified in ISO 21087.	Agree
70 GB		5.2	Para 1	Ge	No mention of how often the tests should be performed – even as a guide.	Provide guidance on when purity analysis is required, or a link to ISO 19880-8 if this is the intention / make it clear in 5.3.	Disagree It should be covered by WG28.
71 US		5.2	Table 2 Last row	te	Although specifying a particulate size is challenging, liquid and large particulates can cause significant issues. The proposed footnote highlights this concern and aligns it with the 00 µm requirement in SAE J2719	Maximum particulate~~s~~ concentration [e] Add footnote e Includes solid and aerosol particulates. Large particulates can cause issues with vehicle components and should be limited to less than 5 µm in diameter using the procedures listed in ISO 19880-1, *Gaseous hydrogen -- Fueling stations -- Part 1: General requirements* and ISO 19880-8, *Gaseous hydrogen -- Fueling stations -- Part 8: Hydrogen quality control*.	Agreed in principle Add footnote; f Includes solid and liquid particulates. Large particulates can cause issues with vehicle components and should be limited by using filter as specified in ISO19880-1 and ISO19880-8,
72 GB		5.3	All	Ed	No need to include referenced standard title.	"…… ISO 19880-8."	agree
73 GB		5.4	All	Ge	It isn't certain that there will be a specification for sampling – currently this is only guidance. Also, this sampling takes place at the hydrogen fuelling station, not from the vehicle. No need to include referenced standard title.	Modify to: "Guidance on hydrogen sampling methods for hydrogen fuelling stations is available in ISO 19880-1."	Agreed in principle (Reflecting the next US74 comment) Modify to: "Guidance on hydrogen sampling methods for hydrogen fuelling stations is available in Clause 9 of ISO 19880-1."
74 US		5.4		te	Why was sampling changed from "at the nozzle"? If not, how can it be referenced? Add a reference to Clause 9 to assist the reader in locating the requirements mentioned in this subclause.	Insert the following "See Clause 9 of ISO 19880-1 for these requirements."	See 73

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75 US		5.5	1	ed	The last phrase is an opinion and does not belong in the document	The protocol for ensuring the quality of the gaseous hydrogen ~~quality~~at ~~hydrogen~~distribution bases and hydrogen fueling stations is given in ISO 19880-8 ~~which provides reasonable and affordable methods and procedure~~ to comply with hydrogen quality required by this standard.	Agree
76 CN		6.1	Table 3	te	Categories I and II of Type I, Grade E	Description or definition of Categories I and II should be given.	TG2 Agree See 43
77 FR		6.1	Pg13 Table 3	Te	Thresholds of contaminants for category 3 should be higher or equal to the spec of 5.1 in order to allow using FCEV (Grade D) infrastructure to supply stationary FC	Change formaldehyde to 0,2 µmol/mol. Introduce Methane spec<100 µmol/mol	TG2 Agree
78 GB		6.1	Para 1	Ed	The fuel quality at the boundary point set between the hydrogen fuel supply equipment and the PEM fuel cell power system, as applicable to the aforementioned grades of hydrogen fuel for stationary appliances, shall meet the requirements of Table 3.	Simplify language: "The quality of hydrogen supplied to stationary PEM fuel cell appliances shall meet the requirements of Table 2 at the boundary point set between the hydrogen fuel supply equipment and the PEM fuel cell power system."	TG2 Agree with correction of the table number (Table 2 --> 3) "The quality of hydrogen, and hydrogen based fuels, supplied to stationary PEM fuel cell appliances shall meet the requirements of Table 3 at the boundary point set between the hydrogen fuel supply equipment and the PEM fuel cell power system." (Based on a NH's suggestion)
79 GB		6.1	Table 3 - title	Ed	These are specific to PEM Fuel Cell appliances?	"Fuel quality specification for PEM fuel cell stationary applications"	TG2 Agreed in principle Change to ~~Hydrogen quality requirements for PEM fuel cell stationary applications~~

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							NH recommended new language. "Hydrogen, and hydrogen based fuels, quality requirements for PEM fuel cell stationary applications"
80 GB		6.1	Table 3	Ed	Table 3 has not been updated to match the structure of table 2	Include row for Methane (as per Table 2) and remove from the note c. Separate nitrogen, argon and helium into separate rows (or combine in Table 2)	TG2 Agree for Methane Disagree for nitrogen, argon and helium. The threshold number is too big to indicate individually. Change to "Sum of nitrogen, argon and helium"
81 GB		6.1	Table 3, note c		Should note e be the same as note b of Table 2?	Correct if applicable	TG2 Agree Use the same expression in footnote in table 2
82 GB		6.1	Table 3, note e		Should note e be the same as note d of Table 2?	Correct if applicable	TG2 Agree Use the same expression in footnote in table 2
83 SE		6.1	Page 13 Table 3	ed	Please clarify; Is the specification of “Total sulphur compounds” given, as in Table 2, as S1 equivalent?	See our comment.	TG2 Agree
84 SE		6.1	Page 13 Table 3	ed	Please clarify; Is the specification of “Total halogenated compounds” given, as in Table 2, as halogen ion equivalent?	See our comment.	TG2 agree
85 US		6.1	1	te	Remove term hydrogen. Category 1 & 2 are not hydrogen, they are reformate.	The fuel quality at the boundary point set between the ~~hydrogen~~ fuel supply equipment and the PEM fuel cell power system, as applicable to the aforementioned grades of ~~hydrogen~~ fuel for stationary appliances, shall meet the requirements	TG2 Agreed in principle Change "hydrogen fuel " to "hydrogen based fuel"

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MB/ NC[1]	Line number	Clause/ Subclause	Paragraph/ Figure/Table	Type of comment[2]	Comments	Proposed change	Observations of the secretariat
						of Table 3.	Modified by the secretary based on NH suggestion. Change to "hydrogen, and hydrogen based fuels,"
86 US		6.1	2	te	Remove term hydrogen. Category 1 & 2 are not hydrogen, they are reformate.	Type I, grade E ~~hydrogen~~ fuel for PEM fuel cell applications for stationary appliances specifies the following subcategories for the convenience of both PEM fuel cell manufacturers and ~~hydrogen~~ fuel suppliers:	TG2 Agreed in principle Change "hydrogen fuel " to "hydrogen based fuel" Modified by the secretary based on NH's suggestion. Change to "hydrogen, and hydrogen based fuels," Also, see the #43 comment. This sentence was modified.
87 US		6.1	Table 3	te	In this table, the Total sulphur compounds do not have a “basis”. Is there a reason not to be included here?	Keep Table 2 and Table 3 titles for the constituents the same and reformat tables so they are laid the same.	TG2 Agree Change to " Total sulfur compounds (S1 equivalent)"
88 CN		6.2		ed	"the electrolysis of pure water and alkaline water" is a little bit confused	"the electrolysis of pure water and alkaline water" changed to "the electrolysis of pure water or alkaline water"	TG2 Agree
89 GB		6.2	All	Ge	This text, other than the note, appears to be applicable to all grades of hydrogen, not just E. This could be moved to Chapter 4.	Move to Chapter 4. Modify note to: “NOTE It should be recognized that biological sources of hydrogen can contain additional constituents (e.g. siloxanes or mercury) that can affect the performance of the various applications, particularly PEM fuel cells, however these are not included in all of the following specifications due to insufficient information.”	TG2 Agree in principle. It is covered with comment 54. Secretary took this comment tentatively until new input from GDR. AM and SQ as listed in #54 comment.

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90 US		6.2			Remove term hydrogen. Category 1 & 2 are not hydrogen, they are reformate.	~~Hydrogen~~ fuel may be produced in a number of ways, including reformation of fossil fuels or other hydrocarbons, the electrolysis of pure water and alkaline water, and numerous biological methods. ~~Hydrogen~~ fuel can be generated on-site, generally in relatively small quantities, or in a larger scale production system off-site, then transported under pressure or as a liquid to the point of use.	TG2 See 85, 86 Agreed in principle Change "hydrogen fuel " to "hydrogen based fuel" Modified by the secretary based on NH suggestion. Change to "hydrogen, and hydrogen based fuels,"
91 GB		7	Title	Ed	Improve language	Simplify language: “Requirements (or recommendations?) for hydrogen for non PEM fuel cell applications”	Disagree "Non PEM fuel cell application" indicates the fuel cell application other than PEM fuel cell. Based on the recent NH's suggestion and the consistency of the titles in this document, the title of Clause 7 was modified by the secretary as follows; 7. Hydrogen quality requirements for applications other than PEM fuel cell road vehicles and stationary applications
92 CN		7.1	Table 4	ge	The unit in table 4 is hard to find and understand.	Use the same unit form as Table 2 and Table 3.	Agreed in principle. Delete top of the table "Dimensions in micromoles per mole unless otherwise stated" and put units beside each specification number.

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93 NZ			Pg16 Table 4	ed	"g" in notes is not included in table 4	Remove "g The …. percent."	Disagree. This is a footnote mark. The order of foot note is changed depending on the order of the list.
94 FR		7.1	Pg 15	Te	A blank indicates no maximum limiting characteristic. The absence of a maximum limiting characteristic in a listed quality level does not imply that the component is or is not present but merely indicates that the test need not to be performed for compliance with this International Standard	A blank indicates no maximum limiting characteristic. The absence of a maximum limiting characteristic in a listed quality level does not imply that the component is or is not present but merely indicates that there is no limitation regarding this component for compliance with this international standard	Agree
95 GB		7.1	Para 1	Ge	Type I, Grade A is understood to be a legacy specification which was supposed to cover fuel cells when written (published 1999) and appears unchanged since the PEM FC applications (transportation and stationary) have been removed from its scope. There is believed to be no need for the current, reasonably stringent, limitations on hydrogen for all combustion applications - in vehicles, or for cooking or boilers. The UK proposes that WG27 should either (a) clarify the requirements in Type I, Grades A and B are examples of hydrogen qualities required for certain applications, or (b) increase the effort on ascertaining what the minimum should be for a specification of hydrogen as a fuel for combustion engines and other combustion appliances, so that this specification is a valid minimum requirement for hydrogen as a fuel for combustion in non PEM fuel cell residential, commercial and transportation applications. Does this part of the standard require some discussion with ISO TC 193 Natural Gas, as these committee members may have some experience	Modify to: "The quality of hydrogen supplied to the example specifications for non PEM fuel cell applications shall meet the requirements of Table 4. NOTE Other specifications may be equally suitable for these applications." If Grade C is to remain as a specific requirement for aircraft and space applications, and ground support systems, then consider removing these into a separate chapter.	~~Disagree;~~ ~~Defer until the certain needs for revise.~~ After discussion with NH, Secretariat took this comment as agreed with modification. Needs to be confirmed by the member of WG27. Modify to; "The quality of hydrogen supplied to the example specifications for applications other than PEM fuel cell road vehicles and stationary applications shall meet the requirements of Table 4. NOTE: Other specifications may be equally suitable for these applications."

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					with using hydrogen for the non-fuel cell applications? (e.g. boiler / cooker manufacturers)		
96 GB		7.1	Table 4	Ge	Is there no limit for helium and CO2 in Grade A (and B) hydrogen? Is this included in the hydrogen fuel index or not? For example, could 30% H2, 69% helium/CO2 and 1% nitrogen be classed as Grade A hydrogen? Or is helium and CO2 included by default as maximum 2%, additive to the other contaminants listed, to achieve a hydrogen fuel index of 98%? Presumably this would affect the application if such a gas was supplied?	Please clarify.	Agreed in principle Delete "in this Table" from the footnote g to
97 GB		7.1	Table 4	Te	There is a concern that 2 ppm sulphur is not low enough to avoid contamination of the three-way catalytic convertors used in dual fuel combustion vehicles.	Please seek advice and clarify the permissible level of sulphur for ICE as appropriate.	Disagree If there is any change needed, please input specifically.
98 JP		7.1	Table 4		Some of the specifications were referred from the following documents. It is better check the latest version of those. ・California Code of Regulations Titles 13 Section 2292-7-1995 for the California Air Resources Board ・MIL-PRF-27201C (referred: www.fuelcellstandards.com/H2Quality.ppt)	Check the latest version of those. ・California Code of Regulations Titles 13 Section 2292-7-1995 for the California Air Resources Board ・MIL-PRF-27201C	Disagree If there is any change needed, please input specifically.
99 GB		7.2 & 7.3	all	Ge	Consider how much of this information is still relevant, how much is generic and can be combined with other text into Chapter 4	Please clarify.	Disagree If there is any change needed, please input specifically.
100 AR		7.2.1		Ed	The following paragraph should be corrected: “The sampling and control procedures described in Subclause 7.2.3.1 and 7.2.3.2 and in Subclause 7.3.”	Correct the paragraph as follows: “The sampling and control procedures are described in Subclauses 7.2.3.1 and 7.2.3.2 and in Subclause 7.3.”	agree
101 JP		7.2.1	Heading	ED	Title of Clause 7.2.1 is not correct	Replace title of Clause 7.2.1 with “General requirements”	agree

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102 NZ		7.2.3.2	Pg17	ge	"Lot acceptance tests are analyses that shall be performed on the hydrogen in the delivery container, or a sample thereof, which is representative of the lot."	"Lot acceptance tests shall be performed on the hydrogen in accordance with one of the following:"	Agree
103 GB		7.3.2	b	Te	Use of a regulator is prohibited for gaseous samples here, however, is standard practice for sampling from HRS – which is correct?	Please clarify.	Agree. Delete the second sentence of bullet b) of Subclause 7.3.2 reads; No regulator shall be used between the supply and the sample containers (a suitable purge valve may be used).
104 CA		Annex		te	Annex B of 14687-2:2012 did not get carried over to this CD. That Annex was very informative and an updated version should be carried over.	Update and carry over Annex B from 14687-2:2012.	Disagree Thank you for your comments but those are listed in ISO 21087
105 GB		A.3	All	Te	It is understood that the oxygen content above 5ppm is actually a concern to fuel cells? (not just where hydride storage is used) Please could this be updated if so?	Please clarify.	Disagree Nothing changed in this content at this time. Whole annex been deleted
106 JP		Annex A	A10, A11	Te	HCHO HCOOH： JARI in Japan is testing the influence of HCHO. The specification of HCHO and HCOOH should be revised based on those data.	Should be determined those specification based on the technical data.	Thank you for your effort!!! Whole annex A has been deleted
107 DE	Pg. 19-20	Annex A		Ge	The rational for the impurity selection is given in Annex A "Impact of impurities on fuel cell powertrains" of ISO 19880-8. Therefore Annex "Rational for the selection of hydrogen impurities to be measured for PEM fuel cell application for road vehicles" should be deleted.	Please delete Annex A Rational for the selection of hydrogen impurities to be measured for PEM fuel cell application for road vehicles.	AGREE Modify the sentence of the note at the top of Table 2 reads; NOTE Annex A of ISO19880-8 provides the rationale for the selection of the impurities specified in

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							Table 2.
108 NZ		Annex A, Annex C	Pg19-20, 24-25	ge	There is a 99% replication between Annex A and Annex C	Combine Annex A and Annex C into one Annex.	TG2 Annex A was deleted
109 US		A.5		te	With CO2, at levels very much higher than the specification a reverse water gas shift reaction can occur under certain conditions in fuel cell systems to create carbon monoxide.	Please delete third sentence	Whole annex A has been deleted
110 US		C.5		te	A high CO2 content in hydrogen fuel (> 1000ppm) will result in the formation of CO via a reverse water gas shift reaction which, depending on the material selection and/or system design and operation, could further impact fuel cell performance.	Please delete second sentence	TG2 Disagree. Useful information Delete "(> 1000 ppm)"
111 NZ		Annex D1	Pg 27	ed	"…CO can serve as a canary species for the presence of other impurities listed in Table 3. Canary species can serve as an indicator of the presence of other chemical constituents because it has the highest probability…"	"…CO can serve as an indicator for the presence of other chemical impurities listed in Table 3 because it has the highest probability…"	Agree Change all " canary species" to "indicator" as far as appropriate.
112 GB		Bibliography			Has this been accidentally removed?	Please include.	Secretary brings back Bibliography section,
113 GB		All	All	Ge	Further work is needed on combining the 3 parts of the original document into 1 coherent document.	Reconsider the decision to not have the third task force to put together the document into something that flows a little better, and that addresses the issues inherited from the original part 1 that don't fall into either TF1 or TF 2 (both PEM Fuel Cell applications)	Disagree We are not able to change our project.
114 GB		All	All, particularly Table 1	Ge	It is unclear if hydrogen for gas burner appliances are within the scope of this standard. Text in '1 Scope' and 'Table 1 Grade A' must reflect this clearly. The minimum gas quality specification for residential/commercial gas burner appliances has not yet been established. Table 1 must therefore not imply that this may be so.	Clarification required in text in '1. Scope' whether this standard covers hydrogen quality for fuel cell applications only, or if hydrogen combustion engine and gas burner applications are included. Clarification required in text in 'Table 1; Grade A' whether residential/commercial appliances refers to gas burner as well as 'fuel cell other than PEM'	Disagree Not need to be specified each application.

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						applications, or just 'fuel cell applications other than PEM'. If gas burner appliances are included within Grade A applications Table 1 must clearly state that the minimum gas specification is not yet known for this technology.	
115 GB		All	All, particularly Table 1	Ge	In the UK, there is no indication that Grades A-C for hydrogen fuel grades as specified in ISO 14687 part 1 are being used (as opposed to the standard industrial designations of 3, 4, 5 * 9s etc). Those grades as specified in ISO 14687 parts 1-3 of most importance currently are considered to be D & E. We therefore agree with the order of this document starting with Grade D (Chap 5), followed by Grade E (Chap 6) followed by Grades A-C (Chap 7) However, this seems a slightly strange ordering in the letters given to the different grades with this document structure. Is there a benefit in maintaining the proposed document structure, but relettering the grades? This would also facilitate a wider number of specifications for combustion and other applications (currently grades A & B, depending on the type of use) in the future should these become necessary? Also, is it sensible to mix combustion engines for vehicles (which have catalytic convertors if dual fuel vehicles which could be subjected to sulphur poisoning) with other combustion processes, where the specific sulphur requirement is likely to be less of a concern? Finally, is "off-road" vehicles using liquid hydrogen (but presumably not using PEM fuel cells?) a real application? These applications appear to need some further thought.	Consider, for example: Grade A: PEM fuel cells for road vehicles Grade B: PEM fuel cells for stationary appliances Grade C Aircraft and space vehicle applications; (also off-road non-PEM fuel cell vehicle applications?) Grade D:Internal combustion engines for transportation; Residential / Commercial non-PEM fuel cell appliances (i.e. cookers, boilers etc) Grade E: Industrial fuel for power or heat generation Please note: It is unclear if the above grade D is suitable for hydrogen internal combustion engines for transportation – please see comment on Chap 7. Also, other comments below may affect the descriptions in the Table 1.	Disagree Can not be changed the Grade and and original order of this document.

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116 JP		Whole section		ED	Is “PEM fuel cell” appropriate to use? IEC is unifying to use PEFC.	If it is appropriate, replace “PEM fuel cell” with PEFC (Polymer Electrolyte Fuel Cell).	Disagree PEM FC is now used in many relevant standard and documents. Too difficult to change. It is not essential issue.
117 Secretary					Moved next to 54		See above next to54

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5/30/2017

Revision of CO, HCHO, HCOOH specification

	CO	HCHO	HCOOH	Sum
	ppm	ppm	ppm	ppm
EIGA	0.2	0.2	0.2	0.2
EN standard as of today	0.2	0.2	0.2	0.2
JPN Infra	0.2	Has not determined	0.2	To be discussed
European OEM + Ford (compromised)	0.2	0.2	0.2	0.2
-European OEM need				0.1
Korean OEM	Korean OEM is investigating and discuss with K Infra			
JPN OEM (compromised)	0.2	Has not determined	0.2	Has not determined
-JOEM For next revision	0.1			To be discussed
GM	Would like to discuss CO levels			
Current Spec.	0.2	0.01	0.2	N/A

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