PRELIMINARY REPORT OF VOTING ON **ISO/DIS 14687-2** *Hydrogen Fuel — Product Specification — Part 2: Proton exchange membrane (PEM) fuel cell applications for road vehicles*	
Closing date of voting **2011-06-05**	**ISO/TC 197 N 488**
Secretariat *SCC/BNQ*	

A report shall be returned to ISO/CS no later than 3 months after the closing date of voting on the DIS, whether or not comments have been reviewed and/or a new text has been prepared.

☒ **Preliminary report**

(submitted in those cases where comments are still to be considered and/or a decision has not yet been taken, or where it is decided that the nature of comments indicates a need for further consultation and/or reversion to a previous project development stage). To be followed by a 'Final report'. Any preliminary report is for ISO/CS for information, and is not circulated to member bodies)

☐ **Final report**

(submitted either immediately, when all comments have been reviewed and a decision can be taken, or following a 'Preliminary report'. The final report is circulated by ISO/CS to member bodies, and is distributed with any associated DIS or FDIS text)

1 Result of the voting

The above-mentioned document was circulated to member bodies with a request that the ISO Central Secretariat be informed whether or not member bodies were in favour of registration of the DIS as a Final Draft International Standard or for publication in the case of unanimous approval.

The vote closed on the date indicated above. The replies listed in annex A have been received.

2 Comments received

3 Observations of the secretariat See annex B

4 Decision of the Chairman

Preliminary report (no annexes required)

☒ The comments are under review and/or a decision on further procedure has not yet been taken

☐ The project is to revert to the Preparatory Stage (a new working draft will be developed)

☐ The project is to revert to the Committee Stage (a new committee draft will be developed)

Final report

☐ Having received 100% approval from the member bodies voting, the DIS is approved for direct publication without change other than editorial (no FDIS vote)
(*Option not applicable to projects progressing under the Vienna Agreement*)

☐ A revised text is to be submitted to ISO/CS for the approval procedure (FDIS vote)

☐ A revised text is to be submitted to ISO/CS for a further enquiry (DIS) vote

Remarks (e.g. observations on how comments were reviewed, date by which a decision is to be taken, date when a text is expected)

We are pleased to inform you that the ISO/DIS 14687-2 has been approved. You will find attached in Annexes 1 and 2 the results of voting and comments received. Please note that the comments received are to be returned to ISO/TC 197 WG 12 for consideration in preparation of the FDIS, which should be made available to the ISO/TC 197 Secretariat by October 2011

As you will see in the attached compilation of comments, some P-members have submitted comments on the lack of testing methods in ISO/DIS 14687-2. By way of background, it should be noted that prior to the DIS circulation, the WG 12 convener advised the leadership of ISO/TC 197 that test methods are not to be included in this international standard as the working group does not have the expertise to develop them. The WG convener recommended that another working group should be formed to look at these test methods.

These test methods will not only be used by ISO/TC 197 WG 12 but also ISO/TC 197 WG 14 for ISO 14687-3 and eventually for the revision of ISO 14687-1 when the work of the existing working groups is advanced enough to proceed with the consolidation of the various hydrogen fuel grades.

The formation of this new working group will be one of the topics that will be discussed at the next plenary meeting in order to seek the interest of the P-members. In the meantime, a column will be added in Table C.1 of ISO 14687-2 (see Annex 3) so that the WG can list the national test methods that could be used for measuring the contaminants. This should provide more information to the users of the standards until the ISO standards on test methods are made available.

Enclosures

- ☒ **Annex 1 - Voting results on DIS**
- ☒ **Annex 2 - Compilation of comments**
- ☒ **Annex 3 - Skeleton of Table C.1of ISO 14687-2**

Signature of the Secretary	Signature of the Chairman
	
Date 2011-07-18	Date 2011-07-18

Voting results on ISO/DIS 14687-2 *Hydrogen Fuel — Product Specification — Part 2: Proton exchange membrane (PEM) fuel cell applications for road vehicles*

Result of voting
P-Members voting: 12 in favour out of 14 = 86 % (requirement >= 66.66%) *(P-Members having abstained are not counted in this vote.)* **Member bodies voting: 2 negative votes out of 15 = 13 % (requirement <= 25%)** ***Approved***

Votes by members					
Country	**Member**	**Status**	**Approval**	**Disapproval**	**Abstention**
Argentina	**IRAM**	**P-Member**	X *		
Australia	**SA**	**O-Member**			X
Austria	**ASI**	**O-Member**			X
Brazil	**ABNT**	**P-Member**			X
Canada	**SCC**	**Secretariat**	X *		
China	**SAC**	**P-Member**			X
Denmark	**DS**	**P-Member**			X
Egypt	**EOS**	**P-Member**	X		
France	**AFNOR**	**P-Member**	X *		
Germany	**DIN**	**P-Member**	X *		
India	**BIS**	**P-Member**	X *		
Italy	**UNI**	**P-Member**			X *
Japan	**JISC**	**P-Member**	X *		
Korea, Republic of	**KATS**	**P-Member**	X		
Netherlands	**NEN**	**P-Member**	X		
Norway	**SN**	**P-Member**	X		
Pakistan	**PSQCA**		X		
Russian Federation	**GOST R**	**P-Member**	X		
Spain	**AENOR**	**P-Member**			X
Sweden	**SIS**	**P-Member**	X *		
Switzerland	**SNV**	**P-Member**			X
United Kingdom	**BSI**	**P-Member**		X *	
USA	**ANSI**	**P-Member**		X *	
P-Member TOTALS Total of P-Members voting: 14			12	2	6
TOTALS			13	2	8
(*) A comment file was submitted with this vote					

Template for comments and secretariat observations					Date:2011-06-18	Document:
1	2	(3)	4	5	(6)	(7)
MB[1]	**Clause No./ Subclause No./ Annex** (e.g. 3.1)	**Paragraph/ Figure/ Table/ Note** (e.g. Table 1)	**Type of comment**[2]	Comment (justification for change) by the MB	Proposed change by the MB	**Secretariat observations** on each comment submitted
1 CA			ge	Canada supports this DIS on the condition that ASTM methods are explicitly referenced in the informative Annex C. These methods are absolutely essential for consistency in H2 quality assurance as they were specifically developed for H2 fuel and low levels of contaminants.	See comment 10 below	
DE			te	Re-establish the limit for Max. Particulate Size. Fueling station operators cannot be taken out of the responsibility to provide clean hydrogen also with respect to particulates. We have experienced poorly manufactured fueling station parts (nozzles, break aways, hoses, tubing, ...) which could cause particulate contamination. It should be up to the station operator to ensure that only high quality parts are used, a sufficient filter system is installed, an appropriate practice is in place to clean the station internally and measures are taken to keep ambient stray particles out of the fuel stream. Also, the limit for the Particulate Concentration is too high.	We recommend to add another line to Table 1 stating the limit for Max Particulate Size to be 100micron and to reduce the limit for Particulate Concentration to 0.5mg/kg.	
FR1			Ge	AFNOR supports the initiation of a revision as soon as the FDIS is approved to specify further the analytical methods.		
IT		ge		Abstention due to lack of national interest		
2 CA	Contents	Page iii	ed	Section 5 and Subsections 5 titles do not correspond to the titles on pages 3 and 4	Correct as required	
**	General		ed	The document should refer to itself as "this part of ISO 14687" and not "this International Standard" everywhere except in the Foreword and Clauses 2 and 3 where "this document" is used in accordance with the ISO/IEC Directives Part 2.	Change "this International Standard" to "this part of ISO 14687" throughout the document.	
US 1	general		Ge	It is encouraging to see the significant progress made on this document since it was published in March 2008. Further refinements have been made as knowledge was gained from the necessary long-term testing of the effects of key constituents on fuel cell performance. Test methods have been developed by ASTM to make it possible to detect the levels of impurities specified. Unfortunately, the present document does not reference	Add appropriate references to published ASTM test methods as described in detail in subsequent US comments on Clauses 2, 6.2, 6.3, and 7.3-7.15.	

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				these ASTM documents. Since these documents have been published, we recommend that these test methods by normatively referenced (as we described in comments on relevant sections). Without such references, the value of this document is minimal. Additionally, this document is likely to become the basis for regulation in some countries and as such the specification must be complete with regards to particulates and clear with regards to sampling requirements.	See US comments relative to subclauses 5.2 & Annex A and 6.3.	
**	Introduction		ed	"Should", which denotes a recommendation, is not permitted in the Introduction which is considered informative.	Redraft the Introduction so that it does not contain "should". Sometimes this can be done by simply changing "should" into "can".	
FR2	Introduction		Ed	The abbreviation FCV is not clearly defined.	In the foreword add : Proton exchange membrane (PEM) fuel cells for road vehicles (FCV)	
JP 1	Introduction		ge	It is better to organize the sentences in the introduction.	Replace whole sentences with the followings; "This International Standard specifies two grades of hydrogen fuel, "Type I, Grade D" and “Type II, Grade D.” These grades are intended to apply to the interim stage of PEM FCV on a limited production scale. It is also noted that this International Standard has been prepared based on the research and development focusing on the following items • 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	

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					• Vehicle demonstration results Since the FCV and related technology are developing rapidly, this International Standard needs to be revised according to technological progress as necessary. Technical Committee ISO/TC 197, Hydrogen Technologies, will monitor this technology trend."	
GB	Introduction and whole of document	-	Ed	All abbreviations should be defined in full when first used (e.g. PEM, FCV, FID, etc…).	Define abbreviations in full when first used.	
**	Terms and definitions		ed	Definitions should not contain the verb "may", which denotes permission.	Redraft the definition in 3.10 so that it does not contain the verb "may".	
GB	Whole document	-	Ge	It is encouraging to see the significant progress made on this document since it was published in March 2008. Further refinements have been made as knowledge was gained from the necessary long-term testing of the effects of key constituents on fuel cell performance. Test methods have been developed to make it possible to detect the levels of impurities specified. Unfortunately, the present document is unable to reference many of the developing test methods due to timing issues with publication, among other things. As the need for published, internationally-accepted test methods was cited as a key reason that this work was pursued as a TS rather than an International Standar and ISO/TC 197 N 363 - Results of Voting on ISO DTS 14687-2, noted "the WG will have to pay a special attention to the test methods, which will need to be further refined before the publication of the International Standard". Therefore the UK cannot vote in favour of moving this document to the FDIS stage. We would prefer to see the work utilised instead to update the 2008 TS and allow the working group the time necessary to put into place the	Rather than moving to FDIS, consider revising the published TS or revising the DIS once the test methods have been published.	

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				required test methods before advancing the document to FDIS. One key activity that may contribute to developing the analytical methods is HyQ, which is currently scheduled to complete their work in 2014. Alternately, a new DIS could be developed once the development and publication of the test methods has been completed.		
GB	Whole document	-	Ge	The documents do not specify explicitly whether different testing methods are required based on the source of the hydrogen and/or the type of fuel cell being used. Is this covered by section 5.2?	Consider, and add text if required.	
GB	Whole document	-	Ge	No mention is given to the transportation of samples for analysis, and specifically whether this is allowed by current regulations. This is an important issue as there are currently very few labs worldwide who are able to carry out analysis to the specification required by this standard.	Add a clause discussing the issues regarding the transportation of hydrogen samples.	
GB	Whole document		Ge	No consideration has been given to ensuring that the analyses are carried out in a manner compliant with internationally–accepted best practice and using methods traceable to national standards. Should the measurement be accredited to, for example, ISO 17025?	Add a compliance statement to the text.	
GB	Table 1	'Water' row	Te	Is it the intention for water to be removed such that the hydrogen is non-condensing at the lowest expected ambient temperature and at a certain fuelling pressure or is 5ppm a specific value above which water content shall cause problems for use with a vehicle fuel cell? It is our understanding that 5ppm of water at 350 bar equates to a dew-point of ~ -14°C, whilst at 700 bar, this equates to a dewpoint of ~ -6°C. We wonder therefore if this value needs further consideration depending on the expected conditions for hydrogen use?	Consider, and add text / alter value if required.	

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GB	Table 1	'Total hydrocarbons' row	Te	'C_1 basis' is not technically correct	Change reference to 'methane basis'	
GB	Table 1	'Nitrogen and argon' row	Te	The reference to footnote 'c' is incorrect.	Change reference to footnote 'b'.	
GB	Table 1	'Max. particulates conc.' row	Te	This is not stated as a concentration – mg/kg is a mass fraction	Change to 'maximum particulates mass fraction'. This also applies to Section 7.2.	
GB	Table 1	Footnote a	Ed	'non-hydrogen gaseous' should read 'non-hydrogen gases	Change text	
AR	2		Te	ISO 6145 parts 1 to 11 are referenced in Clause 7.2	Add **ISO 6145 Gas analysis -- Preparation of calibration gas mixtures using dynamic volumetric methods parts 1 to 11**	
JP 2	2		ge	The terms listed in the definition in Part 1 of ISO14687 are not used in Part 2. Those are not needed to be referred.	Delete whole clause of clause 2	
US 2	2		te	Reference ASTM standards for test methods as normative references as the only international standards. These have been referenced in SAE J2719, so including the ASTM standards in ISO 14687-2 will maintain harmonization.	Insert the following normative references in Clause 2 based on US comments on 6.2, 6.3, 7.3-7.15: "ASTM D1945-03, *Standard Test Method for Analysis of Natural Gas by Gas Chromatography* ASTM D7550-09, *Standard Test Method for Determination of Ammonium, Alkali and Alkaline Earth Metals in Hydrogen and Other Cell Feed Gases by Ion Chromatography* ASTM D7606-11, *Standard Practice for Sampling of High Pressure Hydrogen and Related Fuel Cell Feed Gases* ASTM D7634-10, *Standard Test Method for Visualizing Particulate Sizes and Morphology of Particles Contained in Hydrogen Fuel by Microscopy* ASTM D7649-10, *Standard Test Method for Determination of Trace Carbon Dioxide, Argon, Nitrogen, Oxygen and Water in Hydrogen Fuel by*	

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					Jet Pulse Injection and Gas Chromatography/Mass Spectrometer Analysis ASTM D7650-10, *Standard Test Method for Test Method for Sampling of Particulate Matter in High Pressure Hydrogen used as a Gaseous Fuel with an In-Stream Filter* ASTM D7651-10, *Standard Test Method for Gravimetric Measurement of Particulate Concentration of Hydrogen Fuel* ASTM D7652-11, *Standard Test Method for Determination of Trace Hydrogen Sulfide, Carbonyl Sulfide, Methyl Mercaptan, Carbon Disulfide and Total Sulfur in Hydrogen Fuel by Gas Chromatography and Sulfur Chemiluminescence Detection* ASTM D7653-10, *Standard Test Method for Determination of Trace Gaseous Contaminants in Hydrogen Fuel by Fourier Transform Infrared (FTIR) Spectroscopy* ASTM D7675-11, *Standard Test Method for Test Method for the Determination of Total Hydrocarbons in Hydrogen by FID Based Total Hydrocarbon (THC) Analyzer*"	
AR	3		Te	Several terms are cited but not defined	Add FTIR: Fourier Transform Infrared Spectroscopy GC/MS: Gas Chromatography–Mass Spectrometry GC/FID: Gas Chromatography–Flame Ionization Detector.	
JP 3	3	1st Para	ge	The terms listed in the definition in Part 1 of ISO14687 are not used in Part 2. Those are not needed to be referred.	Delete 1st Para.	
FR4	3.4	Determina-tion limit	Te	To avoid confusion between the determination limit and the maximum acceptable level of impurities the definition should be more accurate.	Replace : "the lowest quantity at a given minimum acceptable level of uncertainty" By: the lowest quantity which can be measured at a given minimum acceptable level of uncertainty	
GB	3.4, Annex C & Section 8	Definition	Te	'Determination limit' is defined in 3.4 as being 'the lowest quantity at a given minimum acceptable level of uncertainty'.	Resolve this apparent contradiction or specify what 'a given minimum acceptable level of uncertainty' is.	

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				The Determination limits in Annex C just seem to be the detection limits divided by three. Section 8 does not mention a 'minimum acceptable level of uncertainty'.		
JP 4	3.5 fuel cell system		ed	"Automatic control system" is ambiguous. Automatic control system should be included in the following subsystems: air processing, fuel processing, thermal management and water management.	Delete ", and automatic control system" and add "and" as follows; 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 (including storage system), thermal management~~,~~ and water management~~, and automatic control system~~.	
GB	3.9		Ed	"....site , receiving..." contains an extra space	Remove extra space	
GB	3.10	Definition	Te	Using the word 'particle' in the definition of 'particulate' seems somewhat circular	Redefine 'particulate'	
JP 5	3.10 particulate		te	There is no specific data for particulate specification. If "particulate " includes oil mist and aerosol, there is gap between analytical methods. The more clear clarification for potassium and sodium compounds is required. It needs further discussion for the next revision.		
JP 6	3.10 particulate		te	It need further investigation for the effect of filter size on the hydrogen dispensing pressure/flow rate and the filter pressure drop/ performance/ durability in case filter is installed in the system. It needs further discussion for the next revision.		
FR3	3.10 and B.11	Particulate	Te	Particulates are not clearly defined; no specification about the diameter or the high of the particulate is given. In annex B paragraph 11, concerning the sentence : "particulate sizes should be kept as small as possible" : -What does small mean? Interpretation can be different for each person. A numerical value will be more relevant.	A numerical value is required	
FR5	4.1 Limiting characteristics	Table 1	Te	For the line: Nitrogen (N_2), Argon (Ar)[c] : - the exponent (c) refers to total sulphur compound that is without any relation with N_2 or Ar.	Remove the exponent c or add a corresponding note. Replace the comma by *or* or *plus*	

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				- Does the comma mean : ►*plus* (the summation of N_2 and Ar needs to be under 100 ppm) ► *or* (N_2 and Ar can be at 100 ppm, the summation is 200 ppm)		
FR6	4.1 Limiting characteristics	Table 1	Te	For the line: Total halogenated compounds[d]: The unit of the limit is in µmol/mol. Does this unit refer to the number of mole of the compound or the number of halide that are contained in the compound? For example, does $CHCl_3$ count for 1 mole or 3 moles? The situation for the Total hydrocarbons is clearer because the unit is based one carbon (µmolC/mol) Perchloroethylene damages the cell even at 50 ppb.	Specify the unit :µmolCl/mol	
US 3	4.1-4.3 (and also Table 1 and 7.1)		te	Does a liquid grade with the impurities noted make sense? At liquid hydrogen temperatures, with the exception of helium, all other impurities are a solid and are removed. Thus, liquid hydrogen should meet the requirements of MIL-PRF-27201. This grade was extracted into ISO 14687-1 as Type II and CGA G-5.3 Type II A. This would eliminate confusion and help harmonize parts in the future.	In 4.1 and 4.2, delete Type II Grade D and replace with ISO 14687-1 type II for liquefied H2 vehicular applications. In the 2nd paragraph of 4.3, add the following to end of paragraph: "The directory of limiting characteristics for Type I Grade D is listed in Table 1. See ISO 146887-1 limiting characteristics for Type II liquid hydrogen." In Table 1, delete “Type II” from the 2nd column heading. Change 7.1 as follows: "Analytical methods suitable for measuring characteristics listed in Table 1 are described below for Type 1 Grade D gaseous hydrogen, and ISO 146887-1 shall be used for Type II liquid hydrogen. Alternatively, for either gaseous or liquid hydrogen, other industry-accepted test methods that have been mutually agreed upon by the supplier and customer may be substituted."	
3 CA	4.2	Note 3	ge	This is not consistent with page iv	Note 3 should either be removed or on page iv added as Part 3	
US 4	4.2	Note 3	te	Hydrogen fuel specifications applicable to stationary PEM fuel cell applications will be addressed in ISO 14687-3. This document does not currently exist and thus cannot be	Delete the entire note.	

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				referenced		
4 CA	4.3	Table 1	te	Particulate size should be listed in Table 1, subsequently B.11 should be revised accordingly, see B.11 below	Insert row for particulate size Limit particulate size to 50 micrometer	
JP 7	4.3		ge	The processes of hydrogen production may vary the impurities contents and concentrations. It needs to cover those concern.	Add the following sentences after the first sentence. The specifications in this standard are not varied depending on the hydrogen production process. Any constituents those are not listed in the table 1 in this standard are no guarantee of harmlessness.	
SE	4.3	Table 1	ge	The total concentration of non-hydrogen gases is stated as 300 mol/mol, which agrees with the min.mole fraction for the hydrogen fuel index of 99.97%. However, if the gases listed are summed they represent 415 mol/mol which is larger than the stated total. Is this a mistake or can the total be only 300 mol/mol with individual species separately restricted. If so this should be clarified.	Please correct or clarify the table in line with the comment.	
SE	4.3	Table 1, Note c	ge	Note c clarifies total sulphur compounds, however, in the main table it is also applied to nitrogen and argon.	Delete Note c from nitrogen and argon in the main table.	
US 5	4.3	Table 1	te	The size of particulates is not listed in Table 1	Add the following row, above the row that lists the concentration: "Particulate size 100 µm"	
FR7	4.3 Limiting characteristics	Table 1	Te	For the line: Total sulfur compounds[c]: The unit of the limit is in µmol/mol. Does this unit refer to the number of mole of the compound or the number of sulfur atoms that are contained in the compound? For example, does CS_2 count for 1 mole or 2 moles? The situation for the Total hydrocarbons is clearer because the unit is based one carbon (µmolC/mol)	Specify the unit :µmolS/mol	
FR8	4.3 Limiting characteristics	Table 1	Ed	Spelling of sulfur in “total sulphur compounds” in the comment *c.* Everywhere else, sulfur is written with “f” not with “ph”	“total sulfur compounds”	
AR	B5		Ed	In the second sentence CO2 should be written properly	Write as follows: “With CO_2 very much higher than the specification…”	
US 6	5.2 & Annex A		ge	ISO is not a regulatory body, why is it mandating quality assurance methods? This subclause and annex should be dropped.	Delete requirement and referenced Annex A	

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JP 8	5.2.1 On-site fuel supply		te	The description for on-site supply of other hydrogen production is not sufficient.	Replace the second sentence with "In other hydrogen production processes of on-site supply, the supplier should develop the analytical requirements for the qualification tests similarly to Annex A and prove it as equivalent to the sampling and analytical procedure given in Clauses 6, 7 and 8."	
JP 9	5.3 Report results	NOTE	ed	Note in this clause should be better to be in Sub-clause 4.3.	Delete Note and move to Sub-clause 4.3 after the last sentence.	
GB	6.1	-	Te	Sample volume is one of the main issues with performing all the analysis specified by this standard. We recommended that a statement (or note) is added stating that large sample volumes / pressures may be required if multiple analytical methods (particularly ion chromatography) are to be used.	Add statement or note stating this.	
GB	6.2	First paragraph	Ed	The text states 'using one of the following procedures', but only one procedure is then listed.	Revise text	
GB	6.2	Second paragraph	Te	Ensuring that the sampling vessel is free of impurities is absolutely essential to ensure that a meaningful analysis is carried out. Evacuating the vessel before sampling is a better way to do this than purging.	Revise the text so that it is recommended that the sampling vessel is evacuated. Where this is not possible, purging may be used as an alternative, but a minimum number of purges (10) should be specified.	
US 7	6.2	Paragraph 1	te	This language does not make this document actionable nor does it protect any of the parties involved.	Revise the first paragraph to read: "Gaseous samples shall be representative of the dispensed hydrogen. The sampling location shall be accordance with 5.1."	
US 8	6.2	Paragraph 2	GE	The gaseous sampling of hydrogen from the station nozzle is being published at ASTM under work item 5847. It includes design considerations and sampling techniques to safely collect reliable samples.	Replace the second paragraph with the following: "ASTM D7606-11 or other industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used to withdraw the sample."	

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US 9	6.2	Paragraph 3	te	This does not ensure a safely drawn sample.	Replace the third paragraph with the following: "See Clause 9 for guidance relative to managing hazards associated with withdrawing samples from the high pressure hydrogen system."	
JP 10	6.2 Gaseous samples 3rd para.		te	Safety issue for the sampling needs to be covered more carefully.	Add the following sentence after the last sentence in this clause 6.2; "These procedures for sampling shall conform to the domestic or regional safety regulation if applicable. "	
IN	6.3		Ed	Insert “of”	Modify clause 6.3 as follows: To avoid trapping **of** particles or contaminating the sample, no regulator shall be used between the dispenser nozzle and the particulate filter.	
GB	6.3	Title	Ed	The title to Section 6.3 does not read correctly	Change to, for example: ‘Sampling particulates in a gaseous hydrogen supply.’	
US 10	6.3		te	Particulates in hydrogen should be sampled from a dispenser nozzle. Samples shall be collected in a manner that does not compromise safety. Appropriate measures should be taken for the sample gas not to be contaminated by particulates coming from the connection device and/or the ambient air. For example when using a filter, samples should be collected if possible under the same conditions (pressure and flow rate) as employed in the actual refuelling operation. To avoid trapping particles or contaminating the sample, no regulator shall be used between the dispenser nozzle and the particulate filter.	Add the following as a new first paragraph: "Particulates in hydrogen should be sampled as defined in Clause 5.1 in accordance with ASTM D7650-10, ASTM D7651-10 and ASTM D7634-10, as applicable, or other industry-accepted test methods that have been mutually agreed upon by the supplier and customer." Add the following as a new second paragraph: "Samples shall be collected in a manner that does not compromise safety in accordance with Clause 9."	
IN	6.4 (a)		Te	Vaporising temperature to be specified for sampling liquid hydrogen	Modify clause 6.4 (a) as follows: Vaporizing, in the sampling line, liquid hydrogen from the supply container **at temperature specified by the supplier**	
JP 11	7		ed	There should be consistency in description of the analytical methodologies.	Use consistent way to describe. e.g. GC or Gas Chromatograph.	

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1	2	(3)	4	5	(6)	(7)
MB[1]	**Clause No./ Subclause No./ Annex** (e.g. 3.1)	**Paragraph/ Figure/ Table/ Note** (e.g. Table 1)	**Type of comment**[2]	Comment (justification for change) by the MB	Proposed change by the MB	**Secretariat observations** on each comment submitted
AR	7.2		Te	The standard ISO 6145 in its 11 parts specifies the calibration methods involved in the preparation of gas mixtures by dynamic volumetric techniques. It also gives a brief presentation of a non-exhaustive list of examples of dynamic volumetric techniques which are described in more detail in other parts of the document. The reference to ISO 6145 within the bibliography is missing	The reference to ISO 6145 should be added within the Bibliography chapter as follows: ISO 6145. Parts 1 to 11. Gas analysis -- Preparation of calibration gas mixtures using dynamic volumetric methods	
GB	7.2	(a) and (b)	Te	- micromoles per mole is also a unit of amount fraction - milligrams per kilogram is a unit of mass fraction	Change test to: (a) mole fraction, expressed as a percentage (% mol/mol) or micromoles per mole (umol/mol) (b) mass fraction expressed as milligrams per kilogram (mg/kg) [particulate concentration only].	
GB	7.2	Third paragraph (starting 'calibration')	Te	The use of traceable calibration gas standards that are accredited to ISO 17025 or ISO Guide 34 would be beneficial.	Update the text to reflect this comment.	
GB	7.2	Fourth paragraph	Te	The text states that calibration should be traceable to a primary standard *if possible*. What should the user do if this is not possible?	Update the text to reflect this comment.	
AR	7.3		Te	FTIR is a well known instrumental technique, but it should be defined within the document to avoid confusion or misunderstandings	Add the definition of the acronym FTIR as (Fourier Transform Infrared Spectroscopy) and any other of the analytical techniques the first time that they appear within the text	
AR	7.3		Te	The technique of Gas Chromatography–Mass Spectrometry (GC-MS) combines gas-liquid chromatography with mass spectrometry to identify different substances within a test sample However the acronym is not defined within the document	Define the acronym GC/MS as (Gas Chromatography–Mass Spectrometry). Avoid the use of different forms of expression for this technique like GCMS instead of GC/MS. Define any other of the analytical techniques the first time that they appear within the document.	
GB	7.3	-	Te	A hygrometer (which may or may not be an 'electrostatic capacity type moisture meter') can be used for the measurement of water content.	Add 'a hygrometer' to the list	
US	7.3-7.15		te	These sections are not actionable unless an industry	Add the following as the first sentence in 7.3:	

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MB[1]	**Clause No./ Subclause No./ Annex** (e.g. 3.1)	**Paragraph/ Figure/ Table/ Note** (e.g. Table 1)	**Type of comment**[2]	Comment (justification for change) by the MB	Proposed change by the MB	**Secretariat observations** on each comment submitted
11				accepted, commercial test method is referenced. The industrially accepted methods should be used unless the buyer and seller mutually agree on an alternate test method.	"ASTM D7649-10, ASTM D7653-10, or other industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used." Add the following as the first sentence in 7.4: "ASTM D7675-11 or other industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used." Add the following as the first sentence in 7.5: "ASTM D7649-10 or other industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used." Add the following as the first sentence in 7.6: "ASTM D1945-03 or other industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used." Add the following as the first sentence in 7.7: "ASTM D7649-10 or other industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used. Add the following as the first sentence in 7.8: "ASTM D7649-10, ASTM D7653-10, or other industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used." Add the following as the first sentence in 7.9: "ASTM D7653-10 or other industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used." Add the following as the first sentence in 7.10: "ASTM D7652-11 or other industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used." Add the following as the first sentence in 7.11: "ASTM D7653-10 or other industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used."	

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1	2	(3)	4	5	(6)	(7)
MB[1]	**Clause No./ Subclause No./ Annex** (e.g. 3.1)	**Paragraph/ Figure/ Table/ Note** (e.g. Table 1)	**Type of comment**[2]	Comment (justification for change) by the MB	Proposed change by the MB	**Secretariat observations** on each comment submitted
					Add the following as the first sentence in 7.12: "ASTM D7550-09, ASTM D7653-10, or other industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used." Add the following as the first sentence in 7.13: "ASTM D7653-10 or other industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used." Add the following as the first sentence in 7.14: "An industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used." Add a new 7.15 that reads as follows: "7.15 Particulate size ASTM D7634-10 or other industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used." Change the current 7.15 to 7.16 and add the following as the first sentence: "ASTM D7650-10, ASTM D7651-10, or other industry-accepted test method that has been mutually agreed upon by the supplier and customer shall be used."	
AR	7.4		Te	In GC/FID, the FID or flame ionization detector detects analytes by measuring an electrical current generated by electrons from burning carbon particles in the sample. However FID and GC/FID are not defined within the first two points of this subclause.	Define the acronym GC/FID as (Gas Chromatography–Flame Ionization Detector). Define any other of the analytical techniques the first time that they appear within the document.	
GB	7.5	-	Te	Recent work in the UK has developed a methods to measure oxygen using a GC-PDHID.	Add GC-PDHID information to the text.	
GB	7.10	-	Te	Recent work in the UK has developed a method to allow total sulphur species to be measured using GC-SCD without a pre-concentration device.	Add GC-SCD (without pre-concentration) to the text	
6 CA	7.14	Page 7	ed	Consistency within section 7	Insert "**content**" after "Total halogenated compounds..."	

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MB[1]	**Clause No./ Subclause No./ Annex** (e.g. 3.1)	**Paragraph/ Figure/ Table/ Note** (e.g. Table 1)	**Type of comment**[2]	Comment (justification for change) by the MB	Proposed change by the MB	**Secretariat observations** on each comment submitted
IN	7.15		Ed	Replace “Flowed” by ” Flowing”	Modify clause 7.15 as follows: The concentration of particulates is calculated from the weight and the total volume of sample hydrogen **flowing** through the filter.	
IN	9	1st para	Te	Adequate safety equipment needs to be used in sampling Hydrogen	Modify clause 9 as follows: Users of hydrogen shall be familiar with its physical and chemical properties as well as specific hazards associated with the use of gaseous hydrogen (GH2) and liquid hydrogen (LH2) as applicable, and shall use **appropriate safety equipment** and develop appropriate risk management measures.	
US 12	9		ge	Discussion of hazards associated with gas sampling need to be improved.	Change the first paragraph as follows: "The sampling and testing of hydrogen may be hazardous. For example, a) hydrogen is flammable and can be an asphyxiant, b) exposure to liquid hydrogen can cause severe injury, and c) sampling is typically performed from pressurized system so there is a risk of burst if the sampling equipment and containers are not capable of withstanding the pressure. Users of hydrogen shall be familiar with its physical and chemical properties as well as specific hazards associated with the use of gaseous hydrogen (GH_2) and liquid hydrogen (LH_2), as applicable, and shall develop appropriate risk management measures." Add this paragraph to the end of the clause: "The sample container and sampling system shall have a rated service pressure at least equal to the maximum allowable working pressure of the system from which the sample is taken or utilize pressure relief devices (PRDs) or other suitable counter-measures to prevent over-pressure of the sampling system."	

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MB[1]	**Clause No./ Subclause No./ Annex** (e.g. 3.1)	**Paragraph/ Figure/ Table/ Note** (e.g. Table 1)	**Type of comment**[2]	Comment (justification for change) by the MB	Proposed change by the MB	**Secretariat observations** on each comment submitted
JP 12	9 Safety	1st para.	ed	"Users" is ambiguous. It should not be drivers of FCV.	Replace "Users" with "Suppliers ". Hydrogen is flammable and can be an asphyxiant. The sampling and testing of hydrogen may be hazardous. ~~Users~~ Suppliers of hydrogen shall be familiar with its physical and chemical properties as well as specific hazards associated with the use of gaseous hydrogen (GH2) and liquid hydrogen (LH2) as applicable, and shall develop appropriate risk management measures.	
JP 15	B.1 Water content		te	It is also helpful to indicate the ice formation problem in the H2 dispensing system.	Add "as well as hydrogen dispensing system" after the end of the last sentence.	
JP 16	B.6 Carbon monoxide content		te	It does not need to emphasize "the long term effects".	Replace the second sentence with; "Although its effect can be reversed through mitigating strategies, such as material selection of MEA, system design and operation, the ~~long-term~~ effects of CO on ~~system durability~~ performance is a strong concern."	
JP 17	B.9 Ammonia content		te	This section does not need to include testing methods.	Delete the second and third sentences; Ammonia (NH_3) causes some irreversible fuel cell performance degradation by contaminating the proton exchange membrane/ionomer and reacting with protons in the membrane/ionomer to form NH_4^+ ions. ~~Test data for ammonia tolerance should include ion exchange capacities of membrane and/or electrodes.~~ ~~Lower catalyst loadings imply lower ion exchange capacities within the electrode.~~	
JP 18	B.11 Particulates		te	There is no need to emphasize the potassium and sodium influence in this section.	Delete the second sentence. A maximum particulate concentration is specified to ensure that filters are not clogged and/or particulates do not enter the fuel system and affect operation of valves and fuel cell stacks. ~~Potassium and sodium ions present in aerosols cause irreversible performance degradation by~~	

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					~~contaminating the proton exchange membrane/ionomer.~~ A maximum particulate size diameter is not specified but should be addressed in fuelling station and/or component standards. Particulate sizes should be kept as small as possible.	
GB	Annexes A, B & C	-	Ge	Ensure that Annexes A, B & C in this Part of the Standards is identical to those in Part 3 of the Standard	Ensure consistency	
7 CA	Annex A		ge	This does not belong here	Remove Annex A and reference in bibliography as a published document	
US 13	Annex A		te	This does not belong in any fuel standard.	Remove Annex A from ISO/DIS 14687-2 and publish it as a separate technical report.	
JP 13	Annex A and Annex B		ed	It should be better to change in the order of Annex A and Annex B in consideration of comprehension of this standard.	Change in the order of Annex A and Annex B.	
5 CA	Annex B	B.11	ge	In reference to comment # 4 above, the last sentence of B.11 should be revised to reflect the particulate size requirement	Revise paragraph, i.e. delete last sentence	
8 CA	Annex B	B.1	ed	Water in the fuel needs to remain gaseous throughout the ambient storage/operating conditions	Remove “most”	
9 CA	Annex B	B.7	ed	Sulphur containing compounds are severe causing catalyst poisons that at even very low levels can cause some irreversible degradation	Remove “causing” and “some”, i.e. Sulphur containing compounds are severe catalyst poisons that at even very low levels can cause irreversible degradation	
FR10	Annex B	Section B7 2nd and 3rd sentence	Te	2) Section B7 2nd and 3rd sentence - Te: Comment: This section deals with the rationale for selecting the impurities for which limits are to be specified. It should not prescribe when and how to do the analysis. Furthermore, there is no scientific basis for identifying hydrogen reformed from natural gas as a being particularly prone to contamination by sulfur compounds. This should be deleted.	Substitute: The minimum specific sulfur compounds that need to be included in the testing are: hydrogen sulfide (H2S), carbonyl sulfide (COS), carbon disulfide (CS2), methyl mercaptan (CH3SH), which may be found in hydrogen reformed from natural gas. It is recommended that total sulfur compounds be monitored. with The specific sulfur compounds that are addressed are in particular: hydrogen sulfide (H2S), carbonyl sulfide (COS), carbon disulfide (CS2), methyl	

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1	2	(3)	4	5	(6)	(7)
MB[1]	**Clause No./ Subclause No./ Annex** (e.g. 3.1)	**Paragraph/ Figure/ Table/ Note** (e.g. Table 1)	**Type of comment**[2]	Comment (justification for change) by the MB	Proposed change by the MB	**Secretariat observations** on each comment submitted
					mercaptan (CH3SH).	
FR11	Annex B	B.8 Formaldehy-de and formic acid.	Te	Formaldehyde has shown less impact than CO on the PEMFC performance.		
FR9	Annex B	B.5	Ed	In “With CO2, at levels very much higher”, the “2” should be in subscript	“CO_2”	
GB	Annex B	B.2	Te	To comply with IUPAC terminology, change ‘paraffinic hydrocarbons’ to ‘alkenes’ (if this is what is meant here).	Revise text.	
GB	Annex B	B.2	Ed	‘…inert since’ should read ‘…inert gas since’	Revise text.	
GB	Annex B	B.5	Ed	‘CO2‘ should read …‘CO_2‘	Revise text.	
JP 14	Annex B		ed	The title of Annex B may mislead the contents of this annex.	Delete "to be measured" from the title of Annex B.	
10 CA	Annex C	Table C.1	te	This section must reference ASTM standards which are recognized internationally as standard analytical methodologies, not techniques that can meet the low detection limits but do not have a standardized sampling technique/methodology. Without listing ASTM methods this ISO standard has low practical impact. Listing ASTM methods will demonstrate that there are reliable standard test methodologies that can measure to these low contaminant levels.	Replace analytical methods listed in the 2nd column with ASTM test methods as follows and include their detection limits: Water –ASTM D7653-10 & D7649-10 Oxygen – ASTM D7675-11 Helium – ASTM D1945-03 Nitrogen/Argon – ASTM D7649-10 Carbon Dioxide – ASTM D7649-10 & D7653-10 Carbon Monoxide – ASTM D7653-10 Total Sulfur – ASTM d7652-11 Formaldehyde - ASTM D7653-10 Formic Acid – ASTM D7653-10 Ammonia – ASTM D7550-09 & D7653-10 Particulate Size – ASTM D7634-10 Particulate Concentration – ASTM D7650-10 & D7651-10	
FR12	Annex C	Table C.1	Ed	Spelling of sulfur in “Total sulphur compounds” in the column Impurities Everywhere else, sulfur is written with “f” not with “ph”	“Total sulfur compounds”	
FR13	Annex C	Table C.1	Ed	In the entire document, the decimal mark should be the same. In 4.3, Table 1, it is a comma ; whereas in the annex C Table C.1, they are some dots/periods in the rows: Nitrogen (N_2), Argon (Ar) | GC/MS	Replace dot/period by comma when it is used as a decimal mark	

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1	2	(3)	4	5	(6)	(7)
MB[1]	**Clause No./ Subclause No./ Annex** (e.g. 3.1)	**Paragraph/ Figure/ Table/ Note** (e.g. Table 1)	**Type of comment**[2]	Comment (justification for change) by the MB	Proposed change by the MB	**Secretariat observations** on each comment submitted
				Ammonia (NH_3) | IC with concentrator		
GB	Annex C	Last sentence	Ed	Change 'numbers' to values'	Revise text.	
GB	Annex C	Table C1 – water row	Te	Recent work in the UK has developed a method to measure water using GC-MS with a detection limit of 0.2 ppm and a determination limit of 0.8 ppm.	Add this information to the table.	
GB	Annex C	Table C1 – oxygen row	Te	Recent work in the UK has developed a methods to measure oxygen using: (a) GC-TCD with a detection limit of 1 ppm and a determination limit of 3 ppm. (b) GC-PDHID with a detection limit of 0.006 ppm and a determination limit of 0.02 ppm.	Add this information to the table.	
GB	Annex C	Table C1 – total sulphur compounds row	Te	Recent work in the UK has developed a method to measure total sulphur compounds using GC-SCD (with no pre-concentration) with a detection limit of 0.001 ppm and a determination limit of 0.003 ppm.	Add this information to the table.	
GB	Annex C	Table C1 – total sulphur compounds row	Te	Can IC really measure total sulphur compounds down to 0.1ppb? What sample volume is needed for this?	Respond to question and, if required, amend text.	
JP 19	Annex C Detection and determination limits of the analytical methods for determination of the limiting characteristics of hydrogen	Table C1 List of detection and determination limits of the analytical methods	ed	Some of the arithmetic points are periods. They need to be comma.	Replace the periods with comma for the. arithmetic points. Nitrogen (N_2), Argon (Ar) GC/MS Detection limit µmol/mol (unless otherwise noted) : 0,03 Determination limit µmol/mol (unless otherwise noted) : 0,1 Total sulphur compounds IC with concentrator Determination limit µmol/mol (unless otherwise noted)	

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MB[1]	**Clause No./ Subclause No./ Annex** (e.g. 3.1)	**Paragraph/ Figure/ Table/ Note** (e.g. Table 1)	**Type of comment**[2]	Comment (justification for change) by the MB	Proposed change by the MB	**Secretariat observations** on each comment submitted
					: 0,0003 -- Ammonia Detection limit µmol/mol (unless otherwise noted) : -- 0,01 Determination limit µmol/mol (unless otherwise noted) : -- 0,03	
JP 20	Annex C	Table C1 Maximum particulate concentration	te	It is estimated that detection limit of particulate is 0,0005 mg/kg, which number is calculated from the sample more than 2 kg using a precision balance with 1 µg accuracy. Further discussion will be needed on those numbers of detection limits and determination limits as well as sampling methodologies for the next revision of this standard.		
US 14	Annex C		ge	Rather than using these typical values, we believe that it would be preferable to list the minimum detection limits based on the published ASTMs.	Change title of Annex C to: "Justification of ability to measure limits" Delete text above existing title in Annex C Replace Table C.1 with the table below:	

Annex C — Justification of ability to measure limits
(INFORMATIVE)

Table C.1 — Detection limits for recommended test methods

- Units are µmol/mol unless otherwise specified
- Limits are upper limits
- Gaseous sampling uses procedures in ASTM D7606-11

Constituent	Chemical Formula	Laboratory Test Methods to Consider and Under Development [e]	Minimum Analytical Detection Limit
Water [a]	H_20	**ASTM D7653-10, ASTM D7649-10**	0.012
Total hydrocarbons [b]			0.1

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(C_1 basis)		**ASTM D7675-11**	
Oxygen	O_2	**ASTM D7649-10**	1
Helium		**ASTM D1945-03**	10
Nitrogen, Argon	N_2, Ar	**ASTM D7649-10**	5
Carbon dioxide	CO_2	**ASTM D7649-10, ASTM D7653-10**	0.1
Carbon monoxide	CO	**ASTM D7653-10**	0.01
Total sulfur [c]		**ASTM D7652-11**	0.00002
Formaldehyde	HCHO	**ASTM D7653-10**	0.01
Formic acid	HCOOH	**ASTM D7550-09**, **ASTM D7653-10**	0.2
Ammonia	NH_3	**ASTM D7653-10**	0.02
Total halogenates [d]			0.01
Particulates			
Particulate Size		**ASTM D7634-10**	10 µm
Particulate Concentration		**ASTM D7650-10, ASTM D7651-10**	0,005 mg/kg

[a] Due to water threshold level, the following constituents should not be found, however they should be tested for if there is a question on water content:
Sodium (Na+) @ < 0.05 µmole/mole H_2 or < 0.05 µg/liter
Potassium (K+) @ < 0.05 µmole/mole H_2 or < 0.08 µg/liter
or Potassium hydroxide (KOH) @ < 0.05 µmole/mole H_2 or < 0.12 µg/liter

[b] Includes, for example, ethylene, propylene, acetylene, benzene, phenol (paraffins, olefins, aromatic compounds, alcohols, aldehydes). THC may exceed 2 micromoles per mole due only to the presence of methane, in which case the summation of methane, nitrogen and argon is not to exceed 100 ppm.

[c] Includes, for example, hydrogen sulfide (H_2S), carbonyl sulfide (COS), carbon disulfide (CS_2) and mercaptans.

[d] Includes, for example, hydrogen bromide (HBr), hydrogen chloride (HCl), chlorine (Cl_2) and organic halides (R-X).

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MB[1]	**Clause No./ Subclause No./ Annex** (e.g. 3.1)	**Paragraph/ Figure/ Table/ Note** (e.g. Table 1)	**Type of comment**[2]	Comment (justification for change) by the MB	Proposed change by the MB	**Secretariat observations** on each comment submitted
**	Bibliography		ed	ISO 14687-3 and ISO 6145 Parts 1-11 are cited in the document but are not listed in the Bibliography.	Add ISO 14687-3 and ISO 6145 Parts 1-11 to the Bibliography. Note that ISO 14687-3 is still under preparation and so a footnote should be added stating this. Additionally, Note 3 in 4.2 should be redrafted to state something like "...will be addressed in the future ISO 14687-3".	
11 CA	Bibliography		te	Both, ISO 26142 and IEC 60079-29-2: 2007 are not referenced within the body of the document	Include a reference within the body of the document of published documents listed in bibliography	
US 15	Bibliography			Include SAE J2719 as an informative reference	"SAE J2719, *Information Report on the Development of a Hydrogen Quality Guideline for Fuel Cell Vehicles*"	

Annex C of ISO/DIS 14687-2 (informative) Detection and determination limits of the analytical methods for determination of the limiting characteristics of hydrogen

This Annex, as informative, is intended to provide a list of detection and determination limits of the analytical methods to verify compliance with the specifications listed in Table 1. Detection limits should be at least three times lower than the specifications listed in Table 1, and the uncertainty of measurements must meet threshold confidence levels agreed upon by suppliers and customers. Table C.1 provides a list of detection and determination limits of the analytical methods listed in this International Standard. These numbers may change as analysis technology and analytical equipment will develop.

Table A. — List of detection and determination limits of the analytical methods

Impurities	Analytical methods	Detection limit µmol/mol (unless otherwise noted)	Determination limit µmol/mol (unless otherwise noted)	Example of test methods that could be used
Water (H_2O)	Dewpoint analyzer	0,5	1,7	
	GCMS/ jet pulse injection	1	3	
	Vibrating quartz analyzer	0,02	0,07	
Total hydrocarbons (C1 basis)	GC/FID	0,01 – 0,1	0,03 – 1,0	
Oxygen (O_2)	Galvanic cell O_2 meter	0,01	0,03	
Helium (He)	GC/TCD	3 – 5	10 – 15	
Nitrogen (N_2), Argon (Ar)	GC/MS	0.03	0,1	
	GC/TCD	1 – 3	3 – 10	
	GC/PDHID	0,001	0,01	
Carbon dioxide (CO_2)	GC/MS	0,01	0,03	
	GC/FID with methanizer	0,01	0,03	
	GC/PDHID	0,001	0,01	
Carbon monoxide (CO)	GC-FID with methanizer	0,01	0,03	
	FTIR	0,1	0,3	
	GC/PDHID	0,001	0,01	
Total sulphur compounds	IC with concentrator	0,0001 – 0,001	0,0003 – 0,004	
	GC/SCD (Sulfur Chemiluminescence Detector) with concentrator	0,001	0,003	
Formaldehyde (HCHO)	DNPH/HPLC	0,002 – 0,01	0,006 – 0,03	
	GC/HIPD	0,01	0,03	
Formic acid (HCOOH)	IC	0,002 – 0,01	0,006 – 0,03	
Ammonia (NH_3)	IC with concentrator	0,001 – 0.01	0,003 – 0.03	
Total halogenated compounds	IC with concentrator	0,05	0,17	
Maximum particulate concentration	Gravimetric	0,005 mg/kg	0,015 mg/kg	
Examples of sampling methods to be used:				