ISO/TC 197
Hydrogen technologies

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ISO DIS 16111 (Ed 2) Collated Comments

Document type:	Other committee document
Date of document:	2017-08-30
Expected action:	INFO
Background:	Here are the collated comments from the DIS 16111 Ballot. See N 866 for the ballot results.
Committee URL:	http://isotc.iso.org/livelink/livelink/open/tc197

Template for comments and secretariat observations

Date:2017-08-30	Document: DIS 16111 (Ed. 2)	Project: WG 25

MB/ NC[1]	Line number	Clause/ Subclause	Paragraph/ Figure/Table	Type of comment[2]	Comments	Proposed change	Observations of the secretariat
US 001				ge	The flammability of the metal hydride should be considered	Please include text to address the flammability issues of metal hydrides and what safety steps should be considered to mitigate this concern	
US 002				ge	Explosion Severity of Dust Cloud test could be performed to evaluate the material	The standard should include the following test for the metal hydride material: Explosion Severity of Dust Cloud test could be performed according to ASTM E 1226	
GB 003		01	Scope	Te	The text says "25 MPa (250 bar)". ISO directives part 2 section 9.3 requires the use of SI units. Conversions from the SI unit pascals into bar adds clutter and is an insignificant benefit for a suitably qualified reader.	Replace "25 MPa (250 bar)" with "25 MPa". Replace "200 kPa (2 bar)" with "200 kPa".	
US 004		02			ISO 9809-2 referenced but not used	Delete	
US 005		02			ISO 11114-1, -2 used but not referenced	Add	
JP1 006	1 Page 2	02		ed	ISO 14687 consists of -1, -2 and -3 at the present time, and the applicable standard to MH is ISO 14687-2, although unification process of ISO 14687-1, -2 and -3 is going on.	"ISO 14682, …" shall be replaced by "ISO 14682-2, Hydrogen fuel – Product specification – Part 2: Proton exchange membrane (PEM) fuel cell applications for load vehicles".	
GB 007		03		Ge	Where possible use ISO/TC 58 gas cylinder terminology. For instance: Is there a reason "maximum developed pressure" is used in place of "developed pressure"? If so, consider indicating why this different term is needed….	Update terminology where possible.	
GB 008	8	03.01		Te	'…taken and held through the formation of bonding interactions within the bulk of the material'	Change to: '…taken and held through the formation of chemical bonds within the bulk of the material'.	

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US 009		03.04			Why call it a fuel cell cartridge and not a fuel cartridge? Why limit the cartridge use.	Delete cell from “fuel cell cartridge”.	
GB 010	26	03.06		Te	'material capable of combining directly with hydrogen gas to form a reversible metal hydride.'	Change to: 'material capable of incorporating hydrogen into their atomic structure to form a reversible metal hydride.' OR 'material capable of reacting with hydrogen to form a reversible metal hydride.'	
US 011		03.09		te	The proposed revision to the definition of MDP leaves ambiguity, whereas the previous definition was clear. Recommend using the definition as published previously. It is important the gas is at equilibrium.	maximum developed pressure **MDP** ~~highest gas gauge pressure developed internal to an MH assembly at rated capacity under normal service conditions or normal operating conditions, whichever is greater.~~ highest gas gauge pressure for a MH assembly at rated capacity and equilibrated at the maximum service temperature NOTE The MDP term was specifically selected for MH assemblies to avoid confusion with the MAWP and the service pressure used in other ISO International Standards.	
AR 012		03.10		Te	Metal hydride should be redefined to avoid to exclude elements that form hydrides like MgH2 for instance “solid material formed by reaction between hydrogen and hydrogen absorbing alloy”	Rephrase definition as follows: “solid material formed by reaction between hydrogen and hydrogen absorbing alloy or element”	
GB 013	26	04.02		Te	Should the manufacturer not also state the total weight or volume of the alloy material?	Change to: 'The manufacturer shall state the rated capacity, total weight or volume of the MH assembly by units	

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						of mass of hydrogen.'	
JP2 014	11 Page 5	04.06		ed	ISO 14687 consists of -1, -2 and -3 now, and the applicable standard to MH is ISO 14687-2.	"ISO 14682" shall be replaced by "ISO 14682-2".	
US 015		05.02.1		te	The proposed technical change deviates substantially from the language approved by the regulatory bodies. The new language limits a probation on dangerous materials to Type 2.1 flammable gases only, whereas the previous language matched the requirements in the UN Recommendations on the Transport of Dangerous Goods, for Type 1 Explosives (gaseous, liquids, and solids). Making this change in the text may cause a significant discrepancy between the requirements of this standard and the transport regulations, which take priority.	Revert to language in published standard for the second paragraph under section 5.2.1 General ~~Hydrogen absorbing alloys and/or metal hydride materials that are classified as class 2.1 flammable according to the UN Recommendations on the Transport of Dangerous Goods shall not be used in an MH assembly.~~ <u>Hydrogen absorbing alloys and/or metal hydride materials that are classified as Type I explosive materials according to the UN Recommendations on the Transport of Dangerous Goods shall not be used in a MH assembly.</u>	
JP3 016	27 Page 5	05.02.1		ed	This paragraph is described in order to exclude any explosive materials from hydrogen absorbing alloys and/or metal hydride materials for the MH assembly. "class 2,1 flammable" for flammable gas does not appropriate for the description of solid materials like hydrogen absorbing alloys.	"class 2,1 flammable" shall be replaced by "class 1 explosive" according to the UN Recommendations on the transport of Dangerous Goods.	
CA 017		05.02.1		te	There is an error concerning the UN recommendations in this clause.	The second paragraph of cl 5.2.1 should read: Hydrogen absorbing alloys and/or metal hydride materials that are classified as Type I explosive materials according to the UN Recommendations on the Transport of Dangerous Goods shall not be used in an MH assembly.	
GB 018	27-8	05.02.1	Para. 2	Te	Class 2.1 is specific of gases, whilst class 4 is for flammable solids? There has been a further change in this issue between the 2008 version of the standard and the current DIS, i.e. metal hydrides that should not be		

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					used in MH assemblies in the 2008 standard were classified as Type 1 explosive materials whereas in this DIS this has changed to an exclusion for 'flammable'. Could the reason for this be explained please?		
US 019		05.02.2			Do we need touch temperature limits and warnings?		
US 020		05.03.2b			Very confusing on system vs test pressure. In IEC 62282-3-100 we inserted a plot.	Insert a plot of system vs test pressure. See example below.	
GB 021	12-8	05.04	Note	Te	The manufacturer should have information or easily measure this. The lattice expansion by hydrogen inclusion and therefore the confined material expansion measurement should be provided as is important information to support the design of the shell.	Confined material expansion measurement should be provided.	
US 022		05.05.3		te	The proposed revision creates confusion. By reverting to the published definition of MDP as proposed previously, the text is clearer as published.	5.5.3 PRD activation temperature The temperature at which any thermally actuated PRD is set to activate shall be specified by the manufacturer and correspond to an equilibrium pressure inside the MH assembly of less than 1,25 times the MDP. In no case shall the temperature of actuation of a temperature-activated PRD result in an equilibrium pressure inside the MH assembly that exceeds the test pressure of the shell. The PRD shall have a pressure rating greater than the MDP at all temperatures less than or equal to 10 °C above the maximum service temperature. In no case shall the PRD activate at a temperature lower than the maximum service temperature. ~~The temperature at which any thermally activated PRD is set to activate shall be specified by the manufacturer and correspond to an equilibrium pressure inside the~~	

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						~~MH assembly of less than 1.25 times the MDP. In no case shall the temperature of actuation of a temperature-activated PRD result in an equilibrium pressure inside the MH assembly that exceeds the test pressure of the shell. The PRD shall have a pressure rating greater than the MDP at all temperatures less than or equal to 10 °C above the maximum service temperature or operating temperature (whichever is higher). In no case shall the PRD activate at a temperature lower than the maximum service or operating temperature. 3~~ ~~NOTE Due to the MDP definition, an equilibrium pressure less than 1.25 times the MDP is compliant with 4 4.1.1 and 5.4, which respectively refer to the MDP assessment and the shell design. As an immediate consequence, the pressure inside the MH assembly cannot exceed the test pressure of the shell at the temperature of actuation~~.	
US 023		05.06			What does this section mean? The manufacturer cannot insure this. The best that can be hoped for is that the manufacturers shall supply instructions.		
GB 024	12	05.09		Te	It is worth mentioning that metal hydride powders change size as they are cycled because the lattice expansion and compression can affect agglomerated small clusters. This could have an impact on the valve and any filter needed.	Add that metal hydride powders change size as they are cycled because the lattice expansion and compression can affect agglomerated small clusters.	
US 025		06.01.6.3		te	Cycling testing has been eliminated for this draft. Even for a MH Assembly designed to be used in a single orientation, the MH assembly has to be transported to its location. It may also be moved. Therefore, all MH assemblies should undergo	Restore vibration testing as a part of the cycle testing as follows: 6.1.6.3 Test method For MH assemblies designed to be transported and	

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					vibration testing to assure the integrity of the assembly.	used in a single orientation, at least five MH assemblies shall be tested in that orientation. For MH assembly designs that do not preclude use in more than one orientation, at least three MH assemblies shall be tested in two orientations perpendicular to each other, with the MH assembly axis horizontal and vertical. The MH assemblies shall be hydrogen charge cycled from not more than 5 % of rated capacity to not less than 95 % of rated capacity. The RCP shall be used for charging and the temperatures shall be held within the operating temperature range. The cycling shall be continued for at least 106 cycles and until the acceptable results defined in 6.1.6.4 are met. If the measured strain on consecutive cycles exceeds the design stress limit or plastic deformation of the shell material occurs, the testing shall be discontinued. As a minimum, a measurement from each strain gauge shall be recorded on every cycle while at the maximum charge condition. After the fifth complete cycle and then at intervals of not more than 50 cycles, with the MH assemblies charged to not more than 5 % of their rated capacity, each MH assembly shall be subjected to the following vibrational sequence while in the orientation for cycling: - A sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours for each MH assembly. The logarithmic frequency sweep shall be as follows: from 7 Hz a peak acceleration of 1 gn shall be maintained until 18 Hz is reached. The amplitude shall then be maintained at 0,8 mm (1,6 mm total excursion) and the frequency increased until a peak acceleration of 8 gn occurs (approximately at 50 Hz). A peak acceleration of 8 gn shall then be maintained until the frequency is increased to 200 Hz. For MH assemblies with a mass greater than 100 kg, the following vibration sequence may be used as an alternative to the above sequence.	

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						- Simple harmonic motion with a vertical amplitude of 0,8 mm with a 1,6 mm maximum total excursion. The frequency shall be varied at a rate of 1 Hz/min between the limits of 10 Hz to 55 Hz. The entire range of frequencies and return shall be traversed in 95 min □ 5 min.	
CA 026		06.02.2		te	The fire test requirements are wholly inadequate. Not only is the test temperature condition undefined, but there is no consideration for a localized fire. Temperature and pressure readings are required, but there is no point measuring these values as there is no specification as to what is acceptable. What exactly does it mean to say “engulfing” fire? This term must be defined, otherwise a repeatable fire condition is not possible.	More closely define fire conditions such that a repeatable fire can be performed by different test laboratories. Factors to consider include the temperature of the fire, and the heat flux. Use the UN GTR 13 fire test requirements as guidance but adapt wording to consider irregular shapes.	
JP4 027	14-15 Page 11	06.02.2.3		ed	The monitoring interval is described as “ ≦ 15s ” in ISO16111 (2008), not a fixed value such as “ at 15s ” in this draft. Interval shorter than 15s is considered to be acceptable for the fire test.	“ at intervals of 15s ” should be replaced by “ at intervals not more than 15s ”.	
US 028		06.02.2.4	Paragraph	te	The statement “Any fuel may be used for the fire source, provided it supplies uniform heat sufficient to maintain the specified test conditions for a minimum of 20 min” does not fully establish the test requirements. It is possible to establish test conditions that are biased for successful performance. For example, if hydrogen is used as the exposing flame the low luminosity of the flame will limit heat transfer to the hydride container. If the test is then conducted in a location with limited thermal radiation reflection (e.g., unheated room in winter, cooled furnace walls, open environment on a cold night), the thermal radiation from the vessel to the environment will significantly reduce the thermal demand on the container.	Add a test provision that states: “The fire exposure shall produce and maintain a wall temperature in excess of 1000°C or a heat flux exposure of 120 kW/m^2 for the duration of the required fire exposure. (Note: The values are consistent with the SFPE Guide for Fire Exposures to Structural Elements, page 68; and the SFPE Engineering Standard on Calculation Fire Exposures to Structures, paragraph 6.5.2.3.2.) If sacrificial cooling protection is provided (e.g., absorption of energy by conversion of bound water to steam) that lowers the exterior wall temperature, it shall be acceptable to demonstrate that the fire test exposure meets the wall temperature or heat flux criteria if the protective method were not present.	

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CA 029		06.02.3		te	6.2.3 Initial burst tests for MH assemblies with an internal volume of 120 ml or less – the requirement does not define a rate of pressurization. The rate of pressurization is essential to ensure consistent results between test labs. A fast rate of pressurization results in artificially high burst results.	Limit rate of pressurization to not more than 3.45 bar/second, a value consistent with cylinder standards.	
AR 030		06.02.4.3		Te	As it is explained, the steel apex of the drop test obviously should be steel, but if not defining steel type, thickness, etc., the use of a thin sheet of ordinary steel is not excluded. Therefore, to avoid this, it is necessary to add some characteristics of the material used in the test	It is proposed to add the minimum thickness of the material as proposed by GB38, and/or to include a phrase that explains that the steel apex must maintain its structural integrity during and after the test, thus making it clear that it must be robust enough	
US 031		06.02.4.5		ed	The text is confusing.	Revise as follows: 6.2.4.5 Blunt impact test for MH Assembly with mass greater than 25kg 19 The MH assembly designed and tested according to ISO 7866, ISO 9809-1, ISO 9809-3, ISO 11119-1, 20 ISO 11119-2, ISO 11119-3 having mass higher that 25kg shall be subjected to blunt impact testing in 21 accordance with 6.2.4.6. The MH assembly designed with proof of performance in accordance to IS016528 shall be tested in accordance to the procedure ~~of Type 1 and Type 2 following procedure~~ described in ~~6.2.4.6 the~~ <u>6.2.4.6. The</u> blunt impact test must be performed at the lowest shell thickness location.	
US 032		06.02.4.X		te	The new DIS differentiates some requirements for “Type 1 MH Assemblies” and “Type 2 MH Assemblies”; yet these are not well-defined.	Add definitions for the various Types of MH assemblies referred to in the document.	
CA 033		06.02.5		ed	For 6.2.5 Leak test, subclause 6.2.5.2.1 MH assemblies with internal volume greater than 120 ml, the statement “*The value of K is defined by the following equation: K should be the greater value*	Clarify, or at least reword the sentence	

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					of 6 or 15 times the internal volume of the shell (in litres/150)" is not at all clear English		
CA 034		06.02.5.2.1		ed/te	Acceptance criteria for MH assemblies >120ml leak testing, is unclear relating to their definition of "K", and potentially allows for a very high leak rate if interpreted incorrectly (whereas if it is interpreted the way I think it is intended, it is probably fairly reasonable). The total hydrogen leak rate shall be less than K standard cm3/h (standard conditions of 0 °C and 19 101,325 kPa absolute). If hydrogen gas is not used, the leak rate shall be converted into an equivalent hydrogen leakrate. The value of K is defined by the following equation: K should be the greater value of **6 or 15 times the internal volume of the shell (in litres/150)** I believe this is supposed to mean either K should be 6 cm3/h, or 15x shell volume in litres? However, this would mean that a shell of just 1 litre internal volume would have an allowable leak rate of 15cm3/h, which seems quite high. That being said, the "(in litres/150)" in parentheses at the end of the definition could alternately imply that the allowable leak rate of a 1 litre shell would be 15x1/150 = 0.1cm3/h, defaulting the leak rate to 6cm3/h for any shell smaller than 60 litres, which I am guessing was supposed to be the intent? This would make the allowable leak rate for a 90litre shell to be 9cm3/h... IF this is the intent, then technically the statement is probably fine, but definition should be reworded for clarity.	Reward the definition of K for clarity.	

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GB 035		07.02.4		Te	There should be a link or a mention made associating the temperatures and the equilibrium pressure intrinsic of the material. This should also address the Max operation pressures and maximum safety pressures mentioned in the standard. 6.2.5.1 Test procedure covers this for example. A metal hydride alloy heat of formation Kj/mol H2 is enough for the trained eye to understand if is suitable for a car application. Material equilibrium pressures at -40C, 20C and 150 C should also be provided by manufacturer.	Mention the association of temperature and the equilibrium pressure intrinsic of the material. Also address the Max operation pressures and maximum safety pressures mentioned in the standard. 6.2.5.1 Test procedure covers this for example. A metal hydride alloy heat of formation Kj/mol H2 is enough for the trained eye to understand if is suitable for a car application. Material equilibrium pressures at -40C, 20C and 150 C should also be provided by manufacturer.	
GB 036		08.02.2.2		Te	The material will heat up during charging as covalent hydrogen bonds are made during the absorption process. This will depend on the absorption kinetics of the material, the amount of it and thermodynamic nature of the bonds. This could make a considerable temperature rise in some alloys.	Note that the material will heat up during charging as covalent hydrogen bonds are made during the absorption process. This will depend on the absorption kinetics of the material, the amount of it and thermodynamic nature of the bonds. This could make a considerable temperature rise in some alloys.	
** 037		1 Scope		Ed (conformity assessment issue)	The last sentence in the Scope is not allowed.	Delete the last sentence in the Scope. It is in conflict with the conformity assessment rules here: https://www.iso.org/foreword-supplementary-information.html	
** 038		6 Inspection and Testing 6.01 General		Ed (conformity assessment issue)	1) 6.1 first sentence: Standards cannot mention that there is a need to comply with regulation as this is given when a regulation exists 2) 6.1, 2nd paragraph, 2nd sentence: If it is required by regulation in a country then it has to be done	1) Delete 6.1 first sentence 2) Delete 6.1, 2nd paragraph, 2nd sentence 3) Delete 6.1, NOTE	

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					3) 6.1, NOTE: the NOTE contradicts the requirements		
AR 039		All		Ed	Decimal point and comma are used not consistently in different parts of the document as decimal signs	Homogenize the use of one decimal mark only throughout the document	
US 040		Bibliography		ge	Include 19881	Please include ISO/DIS 19881: “Gaseous hydrogen – Land vehicle fuel containers”	
GB 041	5	Introduction	Para. 1	Te	'One of these techniques employs the absorption of hydrogen into specially formulated alloys.'	Change to: 'One of these techniques employs the chemical absorption of hydrogen into specially formulated alloys.'	
GB 042	9	Introduction and throughout	Para. 1	Ge	Why 'MH assemblies' not MHA?	Change to: '…referred to as “metal hydride assemblies” (MHA)'. Change 'MH assemblies' to 'MHA' throughout.	

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