ISO/TC 197
Hydrogen technologies

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ISO DTR 15916 Vote Comments

Document type:	DTR ballot
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Background:	Here are the comments that were submitted with the DTR 15916 vote (see N644 for the vote results).
Committee URL:	http://isotc.iso.org/livelink/livelink/open/tc197

Template for comments and secretariat observations

Date: April 4, 2014	Document: ISO/PDTR 15916	Project:

MB/ NC[1]	Line number	Clause/ Subclause	Paragraph/ Figure/ Table/	Type of comment[2]	Comments	Proposed change	Observations of the secretariat
FR 1	Title		C.1	te	Title “Hydrogen embrittlement susceptibility of some commonly used metals (data from ISO 11114–4)”	Replace by: “Hydrogen embrittlement susceptibility of some commonly used metals (ISO 11114–4 describes test methods which allow to verify the exact sensibility of steel and metallic materials to hydrogen embrittlement)”	
FR 2	Line 5		C.2 Column GH_2	te	“S”	Delete “S” and replace by: “See C.1”	
FR 3	Line 5		C.2 Column LH_2	te	“S”	Add “*” after S and the following foot note: “Care shall be taken that when the liquid H2 tanks are more or less empty that the upper part could be warm. In this case, the column of GH_2 applies instead of LH_2.”	
FR 4	Line 6		C.2 Column GH_2	te	“E”	Delete “E” and replace by: “See C.1”	
US 1		E.5		Te	Combine E.5 and E.107 into a single definition as they are different names for the same physical phenomena and therefore should be discussed together.	Delete the current item E.107 and show the combined definition under E.5 as follows: *E.5. Spontaneous-Ignition, Auto-ignition, and Self-ignition* *The terms self-ignition, spontaneous-ignition, and auto-ignition are used synonymously.* Ignition of a mixture of gases, vapours, mists, dusts or sprays which occurs with no artificially provided ignition source (like a spark, flame, static discharge …) as the temperature, pressure, and mixture fraction is in the physical domain that supports combustion (see E.16).	

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						Note: If the entire mixture is in this physical domain for auto-ignition, then an explosion will occur simultaneously throughout the mixture without flame propagation. This behaviour can be seen in a Rapid Compression Machine where the pressure and temperature of premixed reactants at the correct mixture ratio are increased putting the entire mixture in the "explosive" domain. The entire mixture will simultaneously combust (no flame propagation).	

GB		2		Ed	An ISO/TR cannot contain requirements (i.e. It cannot say shall and so cannot contain Normative requirements). Clause 3.3.1 if the ISO/IEC Directives – Part 1, states .... The document shall be entirely informative in nature and shall not contain matter implying that it is normative. It shall clearly explain its relationship to normative aspects of the subject which are, or will be, dealt with in International Standards related to the subject...	Delete Clause 2 and move the information included in it into a Bibliography.	
GB		4.1.3.3	Paragraph 1	Te	Evaporation losses need to be better qualified. In the last sentence of paragraph 1 (As a result, liquid storage is advantageous in terms of energy density, but it is not suitable for long term storage) Is not true for large scale liquid H_2 storage. At present the technology of liquid hydrogen (LH_2) storage is state-of-the-art thanks to extensive applications in space propulsion. LH_2 tanks used for long term storage have double vacuum Perlit vacuum insulation. Commonly, stationary tanks have capacities ranging from 1 500 litres (approximately 1 100 Nm^3 or 100 kg H_2)	Delete the last sentence of paragraph 1 and add : Typical losses for a small liquid H_2 tank are 1 % per day, but for large scale storage tanks this loss drops considerably to under 0.03 % per day (i.e. 1 % per month).	

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					up to 75 000 litres (~ 60 000 Nm^3 or ~5 tonnes of H_2) with radii of 1.4 m to 3.8 m and heights from 3 m up to 14 m. Since the hydrogen liquefaction capacity in North America is ten times larger than in Europe (300 tons/day in 2004 in North America, including 224 tons/day in the USA, versus 20 tons/day in Europe) there are more large stationary tanks in the USA, the largest of which belongs to NASA and is located at Cape Canaveral. This tank, at ground level, has a storage volume of about 3 800 m^3 (~ 270 tons LH_2). With an outer spherical diameter of 20 m. Its evaporation rate is under 0.03 % per day, allowing for a storage period of several years. As compared with pressurized gas storage, this method offers more inexpensive storage costs when dealing with large quantities. The energy required for liquefaction may not be a barrier if the hydrogen is to be transported as a liquid or if the end-use application requires its fuel to be in liquid form. Link : http://www.ika.rwth-aachen.de/r2h/Large_Hydrogen_Underground_Storage		
GB		7.5.6		Ed	An ISO/TR cannot contain Normative requirements (i.e. it cannot say shall)	In the last line of the first paragraph delete ...shall... and add ...should...	

DIN / DE	2	6.1		te	The hazard in handling of hydrogen is mainly not to be influenced because it is induced by the material itself. Not the hazard itself should be avoided but the occurrence of a respective situation	… in order to avoid the realization of a hazard	
DIN / DE	1	6.6.2		Te	The temperature limit of 200 ℃ is rela tively low (but correct). In order to avoid misunderstandings (heat treatment to reduce hydrogen in a material is performed in the same temperature range) it is	“Already at temperatures …”	

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					proposed to start the sentence with “Already at temperatures …”		
DIN / DE	3	6.6.2		Te	Materials resistant to pressured hydrogen, which do not or only very limited show this behaviour also contain carbides (but another type). Therefore it is suggested to replace the term “carbide particles” by “carbon”	… caused by a chemical reaction between diffusing hydrogen and the carbon in the steel, …	
DIN / DE	2	7.2.2.3	Item 1	Te	Strength is not equal to hardness. The hardness of a material is often used as an indication of the strength. This is often due to the fact that a tensile specimen cannot be taken from a component. In these cases the transferability must be assured for the respective case. A general analogy between hardness and strength does not exist	Restricting the strength level of the material used to the necessary limit	
DIN / DE		Annex C	Table C1	Te	Diese Tabelle ist nicht dem letzten Stand der ISO 11114-4 entnommen. Anm.: Unsere Vermutung ist, dass diese Tabelle aufgrund von Prüfungen, die nach der ISO 11114-4 durchgeführt worden sind entstanden ist. Dabei bleibt aber offen welche der in der Norm vorgeschlagenen Prüfmethoden angewandt und bei welchen Temperaturen geprüft wurde. This table is not in agreement with the latest version of ISO 11114-5 Note: we assume that this table has been generated after test performed in accordance with ISO 1114-5. This leave open which of the test methods proposed in the standard were applied and at which temperature the tests were done.	**Steht noch aus/still to be proposed** Proposal of H. Barthelemy to change the table title as: Hydrogen embrittlement susceptibility of some commonly used metals (ISO 11114–4 describes test methods which allow to verify the exact sensibility of steel and metallic materials to hydrogen embrittlement)	
DIN / DE		Annex C	Table C2	Te	Die Aussagen zu den rostfreien austenitischen Stählen (austenitic stainless Steel) entsprechen zumindest für automobile Anwendungen nicht	**Steht noch aus/still to be formulated**	

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					dem Stand der Technik. Der dort Angegebene Nickelgehalt von >7% ist bei allen dort aufgeführten Stählen für eine dauerhafte Beständigkeit gegen Wasserstoffversprödung zu niedrig. Die Einstufung „s = suitable for use“ Können wir nicht teilen, zumal nicht hervorgeht auf welchen Prüfbedingungen (Temperatur, Druck) diese Aussage beruht. Der Stand der Technik für automobile Anwendungen wird hier von der SAE J 2579 (Ausgabe vom März 2013) repräsentiert. Dort ist auf Seite 52 in der Tabelle B2 eine Empfehlungsliste für zu verwendende Stähle angegeben. Für Wasserstoffbeständigkeit sind Stähle mit einem mindest Nickelgehalt von 13% erforderlich, oder Stähle mit einem mindest Nickelgehalt von 12,5% erforderlich, wobei Die in der Verwendung auftretende Kerbspannung 67% der Streckgrenze nicht überschreiten darf. Stähle mit einem niedrigeren Nickelgehalt können und werden grundsätzlich auch für diverse industrielle Wasserstoffanwendungen eingesetzt. Dafür ist der Nachweis der erforderlichen Lebensdauer unter den auftretenden Betriebsbedingungen (Spannungen, Druck, Temperatur, H2 Atmosphäre etc.) in der jeweiligen Anwendung in geeigneter Weise zu erbringen. The statements for the austenitic stainless steels do not, at least for the automotive industry, represent the state of technique. The Nickel content given as > 7% is to low for all steels indicated there to grant a lasting resistance for	Vorschlag H. Barthelemy für Zeilen 5 und 6 (Steel, austenitic ... und Steel, carbon ...): In Spalte 2 (GH2) wird S (suitable) ersetzt durch “See C.1”. Vorschlag für Zeile 5 (Steel, austenitic): In Spalte 3 (LH2) wird das S (suitable) ergänzt durch eine Fußnote: [1] Care shall be taken that when the liquid H2 tanks are more or less empty that the upper part could be warm. In this case, the column of GH_2 applies instead of LH_2. Proposal H. Bartehelmy for lines 5 and 6(stell, austenitic…and steel, carbon.): Replace s(suitable) by “see C.1” in column 2 (GH2). Proposal for line 5 (steel, austenitic…): amend s (suitable) in column 3 (LH2) by the following foot note: [1] Care shall be taken that when the liquid H2 tanks are more or less empty that the upper part could be warm. In this case, the column of GH_2 applies instead of LH_2.	

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					hydrogen induced embrittlement. We therefore cannot agree to the grading "s = suitable for use", in particular because no testing conditions (pressure, temperature) to underlay this statement are given. The state of technique for automotive applications is represented by SAE J 2579:2013-03. There, on page 52 in table B2 a recommendative list of steels to be used is given. For hydrogen resistance, steel with a minimum content of 13 % Nickel is required, or steel with a minimum Nickel content of 12,5 %, if the notch tension which may appear in use shall not extent 67 % of the yield point. Steel with a lower Nickel content can be and are used for different industrial hydrogen applications. To do so, proof of the required lifetime under operational conditions (tensions, pressure, temperature, H_2 atmosphere, etc.) in the respective applications shall be provided in a suitable manner.		
DIN / DE	3	Annex E	E.56	Te	In the note it is mentioned that hardness is also measured as yield strength or tensile strength. This is not correct. Hardness of a material is the resistance of a material to indentation (as mentioned above). For example a decarbonisation can reduce the hardness of a material significantly, since this is a phenomenon that only occurs in the outer area of the sample the strength of the material is completely unaffected	Erase the word "deformation" and the complete phrasing: "Note, ….". Composite property of a material involving resistance to indentation and / or abrasion.	
CA		General		ed	This DTR contains an amazing amount of info related to safety, and covers a wide range of considerations, but it should be edited for brevity and reformatted to make it more readable (and therefore more useful) to the audience. There	Re-edit.	

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					are many duplications of information, excessive technical descriptions, and motherhood statements. It should be reformatted in terms of "Compressed Hydrogen" and "Liquid Hydrogen" in many clauses.		
CA		1		te	Suggest a note to confirm that hydrogen covers deuterium and tritium		
CA		4.1		ed	Try to minimize superfluous wording in standards. For example, the 2nd para of 4.1.2 is speculative and not essential. The standard should not be for the purpose of educating persons about the hydrogen economy, but should rather stick to its safety purpose. Describing how hydrogen may be produced and transported is unnecessary. For example, 4.1.3.4 talks about the "....triple point pressure of some 7.2 kPa..." for slush. This is irrelevant to the Scope as it is not "... relevant to safety".	Delete this subclause in its entirety	
CA		4.2		ed	This clause jumps around from describing a variety of technologies, to stating safety requirements such as large volumes of hydrogen should be stored outdoors, and pressure relief should be used, etc. These safety items are referenced elsewhere in this standard and do not need to be repeated here.	Delete this subclause in its entirety	
CA		4.2.2		ed	"Vessel construction should consider the start of the technology" is unclear	Revise/clarify	
CA		4.2.5		te		Replace "This device is usually used in parallel with a pressure-relief valve as a fail safe path for over pressurization." With "This device is usually used in parallel with a pressure-relief valve as a fail safe path for over-pressurization or in series (upstream) when subsequent ingress of air is unacceptable."	
CA		4.2.7		ge	"For example, the proton exchange membrane (PEM) stacks used in electrolysis and fuel cells require pristine water that is carefully filtered and deionized" is inappropriate.	"For example, palladium membranes can be used to produce ultra-pure hydrogen for applications such as fuel-cells."	
CA		4.3		ed	Remove "of course"		

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CA		4.3		ed	A clause describing hydrogen quality and impurity effects is not necessary in this standard.	Delete this sub clause in its entirety	
CA		4.4		te	Add comment that catalytic oxidation of hydrogen can avoid NOx	"If appropriate, low-temperature catalytic oxidation can eliminate NOx production entirely"	
CA		4.4		te	"As hydrogen is transported to the upper atmosphere, it will escape into space. This is why there is so little hydrogen free in the atmosphere" Please check this. I suspect most hydrogen will oxidize to water or react with pollutants before it rises very far.		
CA		4.4		ed		Change "The exception is air-breathing…" to "One notable exception is air-breathing…"	
CA		4.4		ed	A clause describing possible environmental considerations is not relevant to a safety standard.	Delete this sub clause in its entirety	
CA		4.4		ed	"evoking after treatment technologies"	"requiring after-treatment technologies"	
CA		5.1.1		te	Clarify radioactivity of tritium	Replace "(β, 12.3 years halftime)" with "(decay by β emission, with 12.3 year half-life)"	
CA		5.1.1		te		Replace "and tritium is produced only by irradiation in nuclear reactors" with "and tritium is produced mainly by irradiation of materials in nuclear reactors"	
CA		5.1.1		ed	A standard is not for the purpose of being an educational textbook. The descriptions provided in this sub clause are not necessary for safety.	Delete this sub clause in its entirety	
CA		5.1.3		ed	The descriptions provided in this sub clause are not necessary for safety	Delete this sub clause in its entirety	
CA		5.2.2		ge	Suggest an additional section describing the compressibility (Z) of hydrogen.		
CA		5.2.2.2		te	Viscosity description is inaccurate	Remove "…an effect of the small size of the molecule…"	
CA		5.2.2.2		te	Inaccurate statement	Remove "an effect of the small size of the molecule,"	
CA		5.2.3.4		ge	Add example of a paramagnetic catalyst		
CA		5.3.1		ed	The clause reads like a technical paper on combustion, and includes terms like "...we are most often concerned....".	Rewrite, and shorten.	
CA		5.3.2		ed	Unnecessary descriptions of properties provided.	Rewrite, and delete excessive descriptions such as the explanation of deflagration vs detonation.	

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CA		5.3.3		ed	Includes terms like "...we can define ....".	Rewrite.	
CA		5.3.3		ed		Replace "dilatation" with "expansion"	
CA		5.3.4		ed	Excessive details not directly related to safety. Many if these details, if considered useful background info, should be added as an annex.	Rewrite	
CA		5.3.4		te	Sentence" The process that a flame relies on chemical reactions associated with complex heat and mass-transfer mechanisms that propagates subsonically into regions of unburnt mixtures is known as a deflagration." Is unclear	revise	
CA		5.3.5		ed	Unnecessary technical information that does not assist in safety measures.	Rewrite by deleting unnecessary details.	
CA		5.3.5.3		ed	Solid oxidizers? Sounds like a rocket motor handbook, and of little use to safety when it says there is a lack of information characterizing this process.	Delete sub clause in its entirety.	
CA		5.3.6		ed	Excessive details. Simply listing the flammability limits would be sufficient.	Rewrite.	
CA		5.3.4		te	Sentence" The process that a flame relies on chemical reactions associated with complex heat and mass-transfer mechanisms that propagates subsonically into regions of unburnt mixtures is known as a deflagration." Is unclear	revise	
CA		5.3.7		te	Add catalysts as a source of ignition		
CA		5.3.7		ge	Spark-free tools are mentioned here. They could be discussed a bit more in the later part of this doc		
CA		6.1		ed	There are statements within the paragraphs that need to be drawn out and highlighted – perhaps even collected under different headings. For example, the last para has the sentence "Care needs to be taken not to assume that rapid diffusion of hydrogen will dilute the mixture". This should be explained in more detail as an issue that a designer or operator should consider in designing outdoor systems.	Rewrite/reformat.	
CA		6.1		ge	Remove "low viscosity" which is not really a function of molecular size.		
CA		6.3.3.4	Last para	ed	This liquid-phase info is not relevant as it even says that this situation is "...typically not found in	Delete last para.	

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					standard equipment" (whatever "standard equipment" means). The description of deflagration effects propagating faster that relief systems can handle is not relevant, since safety measures should specify how to prevent air-hydrogen explosions within closed pressure systems.		
CA		6.6.1		ed	Excessive theoretical descriptions about how hydrogen embrittlement might manifest itself in metals	Rewrite by limiting text to warning about embrittlement effects, and directing the reader to consult materials selection list such as CSA CHMC-1.	
CA		7.1.2		ed	First sentence of 1st para unnecessary. In fact whole section could be simply reduced to a table listing the percentages associated with each cause.		
CA		7.1.2		ed	Consistent use of "attributed to" and "responsible for"	See mark-up	
CA		7.1.4		te	This clause suggests that people handling hydrogen should consider "the use of personal protective equipment". I do not believe the automotive OEMs would agree when it comes to fueling their FCEVs. This might be applicable under certain industrial applications, but not for general public.	Rewrite	
CA		7.2.2		ed	Suitable construction materials have already been addressed under 6.6 for hydrogen embrittlement. Also, it is probably not necessary to address suitability of materials for temperature effects, corrosion, low temp effects, etc. This standard is not a building code, and doesn't specify allowable stresses or loads. Stick to hydrogen !	Delete this subsection in its entirety.	
CA		7.2.3		ed	Considerations for pressure vessels should be limited to a simple statement like, "use only pressure vessels made to xxxx standard".	Rewrite	
CA		7.2.7.1		ed	This sub clause is simply a motherhood statement, ie useless. Instead of saying "...components....should be.....compatible.....with operating conditions...", list the standards components shall comply with!	Delete this sub clause in its entirety.	

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CA		7.2.7.2	1st sentence of 1st para		This statement basically repeated in 1st sentence of 2nd para.	Delete	
CA		7.2.7.2		ed	Unclear statement “Shutoff valves should not be installed between a relief device and the volume that it is protecting and locked in a safe position.”	revise	
CA		7.3.3.3		ed	Catalysts could be a separate section (not thermal), adding they can be guaranteed sources of ignition, not just potential	Make 7.3.3.4 section on catalysts as source of ignition and describe them.	
CA		7.4.1		te	Add “zero drift” as another consideration		
CA		7.5.2		ed	Could also refer to the use of NFPA 2 and NFPA 55 when discussing separation and location.	Rewrite	
CA		7.5.6		te	Expand the explanations to include: venting wet hydrogen may need to consider freeze-protection. recommend addition of inert gas to a vent to limit ingress of air when hydrogen is not flowing	CA17	
CA		7.6.3		te	Flame-retardant aramid-fibre clothing is commonly used in industry.	Add note on aramid fibre cloth	
CA		7.6.6		ed	Should separate many parts of the document (including this subsection) into Compressed Hydrogen and Liquid Hydrogen sections. If I want to know about compressed hydrogen, then I don’t want to have to read all kinds of liquid hydrogen info to find the compressed hydrogen info.	Rewrite	
CA		7.6.7		ed	Divide into liquid and compressed sections.	Rewrite	

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