Compilation of comments received on ISO/DTS 16111 *Transportable gas storage devices — Hydrogen absorbed in reversible metal hydride*

Date:2006-09-04	ISO/TC 197 doc. **N355 Annex 1**
	Reference : ISO/TC 197 doc. **N350** (ISO/DTS 16111)

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
UK TC58	General		ge	The editorial style of the document is not in line with other standards relating to gas cylinders making it difficult to implement and use. The document is written more as a discussion paper rather than a technical standard.	Structure document in similar manner to other ISO TC58 SC3 documents.	
AR TC58	General		Ge	As a general comment, the proposed TS is basically dedicated to the canister and not includes more detailed specifications to the hydride forming alloys.		
AR TC58	General		Te	Filter system for hydride particles, this means in the canister and before the first shut down valve, normally it is installed a metal or ceramic filter to avoid, in some hydride forming alloys, the transportation of particles into the hydrogen stream out of the canister, this particles, many times submicron in size, could affect or damage hydrogen circuit components like valves, and others.	Filter system for hydride particles should be considered within the TS.	
AR TC58	General		Te	Internals of the canister, tubes or whatever shape containing hydride forming alloys: for multiple function and protection reasons, most hydride storage devices contains accesories like separators, heat improving conductivity; which traps the powder of the hydride forming alloys, to avoid its concentration or densification at some extent of the canister and by this means avoids excesive expansion of the walls of the canister.		
UK TC58	General		ge	Document contains elements relating to the periodic inspection and testing of the canisters and their filling and use. These matters fall under the remit of ISO TC58 SC4 so it is important that the document is reviewed by that committee.		
UK TC58	Scope		te	There are currently no limits on the size of container which are covered by this standard. Whilst it is recognized that some of the design standards referred to do themselves have capacity limits, this document should also impose constraints.	Add constraints on container water capacity.	

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JP TC 197 and TC58	2 Normative references		ge & te	The transportable gas storage canisters, treated in this ISO/CD, are not simple "gas cylinders" for storage and transportation, but they work as "heat-exchangers" and " reactors" in service gas charging - discharging cycles. They cannot, therefore, be designed or certified by the standards for simple "seamless metallic gas cylinders" such as ISO 7866, ISO 9809-1, ISO 9809-3, nor by the standards for "wrapped fiber reinforced composite cylinders" such as ISO 11119-1, or 11119-2. It is to be noted that the design and certification of the canister is much more complicated than those of simple "gas cylinder". The conditions of the fabrication (temperature and stresses in sintering of alloy storage material, etc) and the service of the canister (heating and cooling for charging and discharging of gas, etc) should be carefully examined for the certification. Material characteristics should be assured in whole the service temperature range, -40 to 75 □.	ISO 7866:1999, ISO 9809-1:1999, ISO 9809-3:2000, ISO 11119-1:2002 and ISO 11119-2:2002 shall be delete.	
US	2		Te	Add reference to ISO 11119-3 for all-composite construction. Note that section 6.5.2 references all-composite (Type 4) tanks.	Add reference to ISO 11119-3.	
UK TC58	3.		te	The terms and definitions are not consistent with those typically used for gas cylinders.	Bring definitions in line with ISO TC58 SC3 documents where applicable	
US	3.3		Ed	Design stress is used two ways: meaning calculated design stress and allowable design stress.	Define both calculated design stress and allowable design stress.	
AT	3.6		te	"fully charged" is not defined. See also next line at 4.1.1.	…fully charged according to PCT-diagram characteristics equilibrated …..	
DE	3.8 and 3.9	Normal operating conditions / normal service conditions		Difference between "all use" and "normal operating conditions" is not clear enough.		

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AT	4.1.1.		te	The maximum developed pressure is dependent upon filling ration of metal hydride within the canister. Does it mean the MDP can be taken out of the PCT-diagram. Is there a ISO-standard of how th set up a PCT-diagram ?		
US	4.1.2		Ed	Design stress is used two ways: meaning calculated design stress and allowable design stress.	Change “design stress” to “allowable design stress”	
AT	4.1.2.			the temperature of the canister and alloy inside when starting the filling is missing	Starting the filling at room temperature	
US	4.1.3		Ed	Design stress is used two ways: meaning calculated design stress and allowable design stress.	Change “design stress” to “calculated design stress” in two places	
FR	4.1.4		te	There is no requirement preventing the pressure of actuation to be set at a value greater than the actual burst pressure. Note : simply verifying on new cylinders that a pressure-actuated PRD will prevent burst in the fire test does not ensure that the PRD effectively prevents bursting of canisters in service. The lower value of the range of actual bursting pressure of canisters that have been in service some time, may be smaller than the actuation pressure of PRD that will prevent bursting of new canisters in the fire test.	Add at end of first sentence : ,but less than twice the MDP.	
US	4.1.4		Te	There is no specific factor above the MDP for the PRD activation pressure. It seems that just indicating greater than the MDP is a bit vague. It may be that a maximum limit should be indicated.	Indicate a reasonable limit above the MDP for the activation pressure of the PRD.	
AT	4.2.		te	No standards, which conditions?	“	

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US	4.3.2		Te	Increase the upper temperature limit to +85C. These devices may be transported in an automobile, and auto manufacturers use +85C as the upper limit temperature. These temperatures could occur in the passenger compartment and in the trunk space. These temperatures might also be reached inside of a transport vehicle.	At a minimum this range shall be of at least from -40C to ~~+75C~~ <u>+85C</u> and shall include the entire operating temperature range.	
AT	4.3.2.			Range -40℃ to +75℃ , It has to be checked if the +75℃ is according to regulations of closing and safety valves	-40℃ – + 65℃	
DE	4.3.3	PRD retaining MDP at all temperatures		If MDP is defined as highest possible pressure (i.e. equilibrium pressure at maximum service temperature and full capacity of the hydride), below maximum temperatures pressures are <u>always</u> lower than MDP (typical hydrdie properties) and the stated requirement on PRD is not necessary.		
FR	4.3.3		te	There is no requirement preventing the temperature of actuation to be set such that the corresponding pressure will exceed the actual burst pressure. Note : simply checking that a temperature-actuated PRD will prevent burst in the fire test provides absolutely no guarantee that this PRD effectively prevents bursting in any elevated temperature conditions. For instance, in the fire test the PRD may be exposed in such a way that it will relieve pressure prior to significant elevation of temperature inside the canister, despite an actuation temperature that would not avoid bursting in the case where the canister temperature is slowly and uniformly elevated to this actuation temperature.	Add at end of first sentence ,but less than the temperature that would result in a pressure equal to twice the MDP.	
US	4.3.3		Ed	Reword the last sentence of 4.3.3 to clearly state that the PRD shall have a pressure rating greater than or equal to the MDP	"The PRD pressure rating shall not be less than the MDP for the canister within the service temperature range."	
UK TC58	4.6		te	This is not appropriate for a design/manufacturing standard.	Remove.	

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DE	4.7	Hydrogen quality		Hydrogen quality could be a critical issue depending on the metal hydride. If the metal hydride is also able to absorb gases which are contained in lower quality hydrogen as impurities the loading capacity of the hydride could be diminished after a sufficient number of loading cycles.		
US	4.7		Te	There seems to be a lot of controversy regarding the appropriateness of referencing ISO 14687 as a H2 quality standard if the end product use is intended to be fuel cells.	Delete this reference and just indicate “The quality of the hydrogen gas that shall be used to fill a canister shall be specified by the manufacturer”.	
JP TC 197 and TC58	5.1 Shell Requirements		ge & te	The transportable gas storage canisters, treated in this ISO/CD, are not simple “gas cylinders” for storage and transportation, but they work as “heat-exchangers” and “ reactors” in service gas charging - discharging cycles. They cannot, therefore, be designed or certified by the standards for simple “seamless metallic gas cylinders” such as ISO 7866, ISO 9809-1, ISO 9809-3, nor by the standards for “wrapped fiber reinforced composite cylinders” such as ISO 11119-1, or 11119-2. It is to be noted that the design and certification of the canister is much more complicated than those of simple “gas cylinder”. The conditions of the fabrication (temperature and stresses in sintering of alloy storage material, etc) and the service of the canister (heating and cooling for charging and discharging of gas, etc) should be carefully examined for the certification. Material characteristics should be assured in whole the service temperature range, -40 to 75 □.	The shell should be designed and certified according to standards registered in accordance with ISO 16528 , as applicable , …	
US	5.1		Ed	Design stress is used two ways: meaning calculated design stress and allowable design stress.	Change “design stress allowed by” to “allowable design stress according to”	
US	5.1		Te	I believe there should be a safety factor applied to the total stress loading so that it is always less than the design stress of the shell. The current specification allows them to be equal.	“the total stress loading exerted on the shell at MDP, which are defined by 5.2, shall be <u>not more than 75%</u> the design stress allowed by the specification to which the shell is designed. Withdrawn	

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US	5.1		Te	Add reference to ISO 11119-3 for all-composite construction. Note that section 6.5.2 references all-composite (Type 4) tanks.	Add reference to ISO 11119-3	
US	5.1	2	Ge	It is unclear to me the meaning of “may not be appropriate” and “the shell may be deemed” in this paragraph. Why are they not appropriate? Use “shall” terms if there are requirements involved.	Clarify requirements.	
DE	5.3.1	Definition of "normal service"		Definition of "normal service" is not clear from chapter 3.9 (see item No. 1)		
US	5.3.3		Te	ISO 11114-4 is intended for steel materials. Other materials and test methods should be allowed.	Recognized test methods, such as those specified in ISO 11114-4, shall be used to select metallic materials resistant to hydrogen embrittlement where required for pressure structural integrity. Alternatively, materials known be to resistant to hydrogen embrittlement may be used.	
DE	5.3.4	Consideration of temperature		Either a stronger requirement on material selection concerning extreme operating temperatures should be mentioned here or the item should be deleted.		
DE	5.4	Approved PRD		Metal hydrides like complex catalyzed aluminium hydrides can show drastic releases of hydrogen above their melting point. For these materials a PRD approving a standard may not be sufficient to fulfill the fire test. Possible technical solutions should not be restricetd by requirement for "approval to a standard".		
US	5.4		Te	The specification does not require the PRD to be of the same type and limits as specified for the shell requirements.	“The PRD type shall be in accordance with, and the activation limits shall not be greater than the limits specified by the canister specification.” Withdrawn	
US	5.4	2	Ed	Improve readability/correctness	…Canisters that us an alternative means of ~~PRD~~ relieving pressure shall …	
US	5.5.1		Te	Shutoff valves used on the canister should meet minimum specification.	“The shutoff valve shall conform to EN849-1997 “Transportable Gas Cylinders – Cylinder Valves – Specifications and Type Testing” or equivalent.”	

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FR	6		te	Certain hydrogen absorbing alloys are known to react violently in case of high velocity impact such as that resulting from gunfire. It needs to be demonstrated that the shell will either prevent or contain the effects of this reaction in such circumstances. This is included in other standards on transportable gas vessels.	Add a “gunfire test”, as defined in ISO/WD 11119-2.	
US	6.1	2	Ed	What material is being referenced in “Any change in material”…. Does this mean the absorbing material, the canister material, both, or what?	Clarify reference to “material”	
AT	6.2			It is questionable why metal hydride canisters have to pass a fire test, as it is sure that without an overpressure relief valve they will fail this test. If then every canister is equipped with an overpressure protection, it is questionable why this safety device should be tested by MH-canister manufacturer and not by the manufacturer of the safety devices.	Take out 6.2, 5.4. taking out the sentences related to 6.2	
US	6.2.1		ge	The parenthetical defining "not considered significant" should be modified. It might be misinterpreted to permit the reduction in piping diameter, where such a change could increase the potential for pluggage.	Change parenthetical in second paragraph to "(e.g., reduction in canister diameter, reduction in length, or increase in PRD flow capacity)".	
US	6.2.1	2	Ed	“Exceptionally” doesn’t seem to be the proper wording here. Perhaps, “as an exception”?	Replace “Exceptionally” with different wording.	
US	6.2.1	2	Ed	Clarify the “i.e.”	…(i.e. reduction in canister diameter, reduction in canister length,…)	
DE	6.2.4	Fire test set-up		Why the fire source should be located on the opposite side of the PRD location? Put the whole tank into the fire analogous to UN ECE Draft LH2 at 590℃		
UK TC58	6.2.4		ed	mm would be more appropriate units to use.	Change (m) units to (mm)	

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US	6.2.4		ge	What is the intent of the wording "The fire tests shall be conducted on at least three canisters in each orientation of intended use"? If there are three orientations does that mean 9 tests? Was the statement intended to require a test is the three basic orientations and additional orientations unique to a design? The present wording proposes testing in the orientation of intended use. It does not address testing in a rollover configuration. The proposed change addresses potential accident configurations.	Replace the paragraph with "The fire test shall be conducted on at least three canisters. For small containers (< 4 meters in greatest dimension) three basic orientations shall be tested (e.g., upright, on-side, on-end). In addition, other orientations (e.g., upside down) shall be tested, unless an analytical justification based on symmetry is provided. For large containers (> 4 meters in greatest dimension) test orientations associated with the greatest dimension held in the vertical plane are not required, unless that is an orientation that may occur in normal use."	
US	6.2.4		Te	The fire test procedure does not indicate the filling limits of the samples. For pressure activated PRDs the fire test should include a canister which is only 25% filled to ensure the PRD can still prevent rupture of the canister when the canister is only partially filled with hydrogen	Samples tested shall be pressurized with hydrogen gas and tested in the orientations noted above at (a) rated capacity and (b) 25 percent of rated capacity (not required if a thermally activated device is used).	
UK TC58	6.2.5		ed	"mins." should be "minutes."	Amend	
US	6.2.5		Ed	Language should be inserted into the text which warns about the dangers of using hydride materials which are capable of rapid disassociation or explosion due to prolonged heating.	A statement to the effect that "hydride material which is capable of disassociation or explosion when exposed to prolonging heating may not be used as a hydride absorbing material in a hydride container."	
US	6.3.3		Te	Add a requirement to cycle some number of times before conducting the burst test.	d) Cycle each dropped canister 500 times from near zero pressure to service pressure.	
UK TC58	6.3.3 (c)		te	The requirement to use the centre of gravity adds further unnecessary complication. It is only necessary to specify the orientation of the cylinder for the test.	Review.	
UK TC58	6.3.3 (b)		te	Requires clarification to ensure repeatability and consistancy.	Review	

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UK TC58	6.3.4		te	Other cylinder standards which require a drop test, also require the cylinder to be subjected to a cycle (fatigue) test following the drop. This specification should also have such a requirement.	Include a requirement for the cylinders to be subjected to a cycle test following the drop test.	
US	6.4		Te	The test method indicates that gas other than hydrogen can be used if the leak rate is converted into an equivalent hydrogen leak rate. However, there is no guidance for this.	Provide some formula, etc., for determining the equivalent hydrogen leak rate.	
US	6.4		Te	The “acceptable results” are unclear. I can interpret this to say that the leaked material should be compressed to 101,325 kPa and 0C at which time it should be less than 10 cm/hr. Is this what you meant? Also, why are you saying 101,325 kPa when the manufacturer specifies the service pressure? Why specify 0 C when you have temperature addressed in Table 1?	Reword to clearly state leakage rate to be given as gas at standard conditions of 0°C and 101,325 kPa.	
AT	6.4.			A test set-up and working description is missing		
CA	6.4 and 7			Clause 6.4 and Clause 7, regarding leak test allowable leak rates, may need to be re-examined in the future as more extensive and widespread production data becomes available. For now (for the purpose of the TS), these clauses are acceptable.		
UK TC58	6.5		te	Description of testing is complex and difficult to understand.	Review and simplify to ensure consistency of approach around the world.	
US	6.5		te	Include requirements for the development of a stress/strain curve for each design during type/qualification testing. Periodically test one canister from those selected for batch testing to measure stress and strain in order to demonstrate that the manufactured canisters produce results consistent with the stress strain curve.	“Require that a stress/strain curve be developed as part of the qualification of a canister design. Periodically test one canister from those selected for batch testing to measure stress and strain in order to demonstrate that the manufactured canisters produce results consistent with the qualification stress strain curve.”	
US	6.5.1		Ed	Design stress is used two ways: meaning calculated design stress and allowable design stress.	Change “design stress limits” to “allowable design stress”	

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US	6.5.2		Ed	Design stress is used two ways: meaning calculated design stress and allowable design stress.	Change “design stress” to “calculated design stress in two places	
AT	6.5.3			Ref not to 6.5.3.	6.5.4	
US	6.5.3		Ed	Design stress is used two ways: meaning calculated design stress and allowable design stress.	Change “design stress” to “allowable design stress”	
US	6.5.3		Ed	The first paragraph of 6.5.3 contains a reference to 6.5.3. Is this intended to reference 6.5.4?	Clarify reference.	
UK TC58	6.5.4		te	Criteria are unclear.	Provide further clarification of acceptance criteria.	
US	6.5.4		Ed	Design stress is used two ways: meaning calculated design stress and allowable design stress.	Change “design stress” to “calculated design stress in four places	
UK TC58	6.6.3	1st para.	te	The hardness value requires a tolerance.	Add suitable tolerance.	
UK TC58	6.6.3	table 2	ed	Text refers to table 1	Amend as required.	
UK TC58	6.6.3		te	Specifying energy values can cause confusion.	Replace with mass and drop height or provide sample calculation.	
US	6.6.3		Te	There are no recommended dimensions for the impact ball, which may affect the test results.	Include dimensions of the impact ball to be used.	
AT	6.6.4.			Ref not to 8.2.3	Ref to 8.2.3.	

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US	6.7 New – Renumber current 6.7 to 6.8		Te	Elastomeric materials used in the canister constructions that are exposed to hydrogen should be compatible with hydrogen. Currently there is no test to determine compatibility. Add a test specification to the set of requirements	**6.7 Accelerated Hydrogen-Pressure Aging Test** 6.7.1 An elastomeric part is to be subjected to hydrogen gas as described in 6.7.2. After conditioning, the part shall not crack, blister, or show visible deterioration. 6.7.2 An elastomeric part is to be exposed for 14 days to hydrogen gas at a pressure of 300 ±15 psig (2068 ±103 kPa) and at a temperature of 80 ±1℃ (168 ±1.8℉) in accordance with the Standard Test Method for Rubber – Deterioration by Heat and Oxygen, ASTM D572, except that hydrogen gas is substituted for oxygen gas in the description.	
AT	7			1,5x service too long	1,2 x service life	
UK TC58	7		te	This section is not relevant to a design and manufacturing document. It should be part of a periodic inspection and testing document	Remove	
UK TC58	8.2		te	Labelling is a regulatory matter and varies depending upon the country of use. It should not be part of a design and manufacturing standard.	Remove.	
UK TC58	9		te	This should not be part of a design and manufacturing standard.	Remove.	
US	9.2.2.1	2	Ed	Clarify intent	… and that the shell and valve are not damaged~~,~~ and have not been tampered with ~~nor~~ or abused.	
UK TC58	Annex A		te	If Hydrogen compatibility is important, then this should be normative.	Make annex normative.	