



ISO/TC 197
Hydrogen technologies

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WG 18 Treated CD 19881 Comments

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Background: Here is the compilation of comments from the CD 19881 ballot and their treatment by WG 18.

This information was previously sent to the WG 18 experts as document N 5.

Committee URL: <http://isotc.iso.org/livelink/livelink/open/tc197>

Template for comments and secretariat observations

Date:2015-10-01

Document: ISO 19881

Project:

MB/ NC ¹	Line number	Clause/ Subclause	Paragraph/ Figure/Table	Type of comment ²	Comments	Proposed change	Observations of the secretariat
SE	1.	General		ge	The title includes "Land Vehicle", the scope does not indicate which vehicles are covered referring only to "vehicle", while detailed requirements apply to "land vehicles", "UN GTR for fuel cell vehicles" and "industrial trucks". Are the service requirements for Category A appropriate to all other land vehicle applications, e.g. trains, construction equipment, farming equipment, forestry equipment, mining equipment.	Consider extending the scope and service requirements for unspecified "land vehicle" types so that they can be set appropriately for each application, with the values currently indicated adopted as a minimum. Possibly with a simple formula for calculating key figures such as number of filling cycles.	Reject. These applications could be addressed in future annexes as the need arises. Safe use will be predicated on close adherence to performance criteria herein.
SE	2.	General		te	Leak test gas/mixtures must be defined for hydrogen service.	Use a gas or gas mixture which has leak characteristics equivalent to hydrogen	Accept. Add leak test gas definition: gas for testing leaks that consists of dry hydrogen, or dry helium, or blends of a minimum 10 % of hydrogen or helium with nitrogen. Use leak test gas in Clause 12.3. Add definition for dry hydrogen: hydrogen which meets or exceeds the quality level in ISO 14687-2
SE	3.	General		GE	Define "manufacturer"	Vehicle or Container	Accept. Specify container manufacturer where appropriate
SE	4.	General		TE	-	Use either MPa or KPa throughout	Accept. ISO Secretariat to decide where appropriate.
GB	5.	Introduction		te	This is missing and needs to be added	Add Introduction	Accept. Refer to NWIP document for language.
GB	6.	1		te	This needs to be amended to define what is included/excluded and give the limits on operating conditions. As drafted it is unclear.	Expand to include different cylinder types covered, temperature limits etc.	Reject. This information is provided in the definition and service condition clauses (3 and 5,

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							respectively).
GB	7.	1	3 rd para.	ed	“reasonable” does not give sufficient weight to the statement and is unverifiable	Change to “..with acceptable levels of ...”	
GB	8.	1	a)	te	It is stated that cylinders are to be permanently mounted. Can they be removed or substituted?	Clarify.	Containers are permanently mounted between inspection intervals. Some jurisdictions will require removal for inspection, or in the event of a collision, a container may be replaced.
GB	9.	1	Last 4 paras.	te	This text is not necessary.	Remove.	Accept. ISO Secretariat to decide on suitability of these paras.
SE	10.	2	United Nations	ed	Reference document more accurately		Agree
SE	11.	3		ed	Pressure definitions scattered around	Focus all pressure definitions under 3.20	
GB	12.	3.01		te	This is not in keeping with ISO rules. Standards should specify technical requirements.	Remove.	Reject. The standard does specify technical requirements, ISO Secretariat to advise on language.
IT	13. -	3.05		Te	“Container Category”: it would be very useful, at this document development stage, to include an explanation of this categorization	It is recommended to include an explanatory note or an Informative Annex giving the rationale of the different categories. This is important because the required tests are partially different for the 3 categories	Reject. The definitions are clear. Although the 3 categories are defined differently, they provide equivalent level of safety.
GB	14.	3.05		te	Why do we need 3 different categories of container?	Add clarification.	Reject. Categories are required to cover different needs of industry, e.g. fuel cell buses (Category A), light duty vehicles (Category B), forklifts (Category C).

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SE	15.	3.05 & 5.1.2		ed	-	Remove duplicated text	
GB	16.	3.06		te	These definitions are not in keeping with those typically found in the TC58 standards. e.g. ISO 10439, ISO 10286	Amend to bring in line with usual definitions.	Accept. Type 1 Metal Type 2 Metal liner reinforced with resin impregnated continuous filament (hoop wrapped) Type 3 Metal liner reinforced with resin impregnated continuous filament (fully wrapped) Type 4 Resin impregnated continuous filament with a non-metallic liner (all composite)
GB	17.	3.06	c) d)	ed	Unnecessary text.	Remove “and”	
SE	18.	3.07		ed	Incorrect Table reference		
GB	19.	3.08		te	There are standard methods for describing how cylinders are to be rendered unserviceable in TC58 standards.	Amend in line with method given in ISO 10439.	Accept.
SE	20.	3.14 & 3.20.02		ed	Use either fuelling or fill consistently	Use either fuelling or fill consistently	
GB	21.	3.15		ed	Poor English	Change to “...temperature which the container will be subjected to in ...”	
GB	22.	3.23		te	ISO 19078 applies to CNG cylinders, the pressures and stresses in these containers will be different to those in the containers described here. Are these rejection criteria still applicable?	Verify criteria are appropriate.	Reject. Stress ratios are the same; thicker walls for higher pressure hydrogen designs suggests flaw criteria in ISO 19078 are conservative
GB	23.	4		ed	Blank clause.	Remove and renumber subsequent clauses.	
SE	24.	5.01.1		ge	-	Add reference to UN GTR	Accept. Use UN GTR #13

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GB	25.	5.01.1	note	te	Is this appropriate for a technical standard? Is it feasible for a manufacturer to be able to certify against "all" regulation?	Remove note.	Accept. Add "for the jurisdiction of use" to the note
GB	26.	5.01.2	4 th para	te	Text confusing, what is meant by "but type". Also, regulatory compliance is not appropriate for standards.	Amend text.	Accept. Delete "type" Regulatory compliance refers to UN GTR #13 requirements.
SE	27.	5.02.1	note	ge	Why allow other pressures as this defeats one purpose of a standard, and has safety implications linked to the refilling interface requirements	Delete "Note"	Accept.
GB	28.	5.03	b)	te	What is the rationale for the three values? What determines which is to be used?	Clarify.	Reject. The three values correspond to the filling requirements for each container category, representing for example, buses (Cat A), light duty FCVs (Cat B), forklifts (Cat C)
GB	29.	5.04.1		te	These are ranges. It is unlikely that a settled temperature would be at 85°C. If the permitted temperature range is -40°C to 85°C it is unreasonable to assume that settled temperatures at extremes are achievable.	Clarify.	Reject. Settled low temperatures occur in cold climates for example. Similar language to ISO 11439 is used.
GB	30.	5.04.3		te	The clause suggests that temperatures can go above 85°C. Specific limits of time and temperature need to be defined.	Define limits.	Reject. Similar language to ISO 11439 is used.
AR	31.	5.05		Te	Gas composition subclause can be read as follows: "Containers made to this International Standard are designed to be used with hydrogen fuel complying with ISO 14687-2, or SAE J2719" However, the containers covered by this standard can also be used for road transportation vehicles other than FCV using (Type I Grade A) hydrogen	Add an appropriated text paragraph under subclause 5.5 and the reference indicated below within the normative references. "Containers made to this International Standard can also be used for hydrogen road vehicles with hydrogen fuel (Type I Grade A) complying with ISO 14687-1"	Accept.

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					gas for example ICE road vehicles with hydrogen fuel. If this is true, the following normative document should be cited and referenced: ISO 14687-1, Hydrogen fuel — Product specification — Part 1: All applications except proton exchange membrane (PEM) fuel cell for road vehicles	ISO 14687-1, Hydrogen fuel — Product specification — Part 1: All applications except proton exchange membrane (PEM) fuel cell for road vehicles	
SE	32.	5.07		ge	-	Add reference to UN GTR	Accept.
GB	33. 2	5.07	2 nd para	te	Is it appropriate to include regulations?	Change to “The vehicle manufacturer or system integrator shall be responsible for the protection of the container valves, pressure relief devices and connections. If this.....”	Reject. Yes, UN GTR #13 regulation is being considered as a regulation to UN signatories.
AR	34.	7.02		Te	Material suitability for hydrogen service and proper material selection criteria can be found in ANNEX C of ISO/TR 15916 However, there’s not any reference to ISO/TR 15916.	Add the following paragraph to the existing note: “Material suitability for hydrogen service and proper material selection criteria can be found in ANNEX C of ISO/TR 15916”	Reject. ISO/TR 15916:2004 is an antiquated document compared to what we know now about HE in stainless steel and high strength low alloy steels. CHMC 1 is a state of the art document.
AR	35.	7.02		Te	Guidance for the safe use of hydrogen in its gaseous and liquid forms can be found in ISO/TR 15916. However, there’s not any reference to the safety ISO document: ISO/TR 15916	Add a second Note with the following text: “Guidance for the safe use of hydrogen in its gaseous and liquid forms can be found in ISO/TR 15916.”	Reject. See above.
GB	36.	7.02		te	This is a performance based standard, therefore appropriate criteria and test methods need to be specified.	Add test methods and required criteria	Accept Test methods and criteria are provided in ANSI/CSA CHMC 1 as indicated in the note.
FR1	37.	7.03.1		Te	At the meeting in summer 2014, France asked for an explicit reference to justify the choice of disposal of material 6082. Without explicit scientific reference, I propose to replace the sentence:	By the sentence "Excess silicon 6xxx series aluminum alloys with yield strengths above 250 MPa (e.g. 6351	Accept. Need to search for supporting literature re excess silicon alloys

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					"Excess silicon 6xxx series aluminum alloys with yield strengths above 250 MPa (e.g. 6351 and 6082) shall not be used in fuel containers or liners."	and 6082) should not be used in fuel containers or liners."	suitability.
JP6	38.	7.03.1		te	On chrome-molybdenum steel which have a maximum tensile strength beyond 900MPa, the acceleration limits of fatigue crack growth don't exist. In this case, it is impossible to apply design by analysis to cylinder design. In case of less than 900MPa, the acceleration limits exist. and it is possible to apply design by analysis. The above is spreading among the material specialists globally.	The sentence shall be changed as below. 'Steels shall have a maximum tensile strength of 900MPa for chrome-molybdenum steel.' instead of 'Steels shall have a maximum tensile strength of 950MPa for chrome-molybdenum steel.'	950 MPa is the accepted maximum value per ISO 9809-1 Add information as a note after the table.
GB	39. 2	7.03.1	3 rd para.	te	The recognised limits for lead and bismuth in other cylinder standards and regulations is 0.003%.	Change "0.010" to "0.003".	Accept
GB	40. 3	7.03.1	3 rd para.	te	The restricted alloys are not clear.	Change to "Aluminium alloys 6351 and 6082 shall not be used."	Reject. See change above.
SE	41.	7.03.1	Last para	ed	There are various Aluminium Associations	Correctly reference "The Aluminium Association"	
GB	42.	7.03.2		te	Ensure requirements are in line with those of ISO 9809.	Bring in line with ISO 9809.	Accept.
GB	43.	7.03.4	title	ed	Further clarification	Change to "...for aluminium alloys."	
GB	44.	7.03.5	title	ed	Further clarification	Change to "...for aluminium alloys."	
SE	45.	7.05		te	-	Define grades of fibre that are or are not permitted.	Reject. This is up to the container manufacturer to qualify based on the performance requirements in this standard.
GB	46. 2	7.06	2 nd para.	te	What is the justification of having a glass transition	Add explanation/justification.	Accept.

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					temperature of at least 20°C above the maximum container temperature. Why 20°C?		Add note: There is safe container operation experience at T _g at least 20C above the maximum container temperature. At temperatures less than this value, viscous flow phenomena can have an effect, resulting in stress concentration and damage accumulation in the laminate.
SE	47.	7.07	3 rd para	te	Vague definition of temperature requirement	Clarify, e.g. change to at -50 C, or at x degree steps down to and including -50 C, or at -50 C or colder	Accept. Add "at temperatures to -50°C"
GB	48. 2	7.08		te	Why is the limit on lead and bismuth content removed? It is assumed that this applies to aluminium alloy bosses, therefore the same limits should apply to both the boss and the container.	Delete "(with the exception that the lead and bismuth restriction does not apply)".	Accept.
GB	49.	8.03.1	1 st para.	te	Why is B not included?	Change to "The stress analysis is applicable to all categories."	Reject. Stress analysis is not a requirement in UN GTR #13 containers (Cat B).
GB	50. 2	8.03.1	2 nd para.	te	To whom have the analyses been demonstrated?	Clarify who verifies and validates the accuracy of the analysis.	Accept. Delete: "that have been demonstrated"
GB	51.	8.03.2		te	What is the rationale for the values of stress ratio's used?	Add explanation/justification.	Reject: Same rationale as ISO 11439 and other vehicle container documents; safe history of use.
GB	52.	8.03.3		te	Further explanation is required.	Add explanation/justification.	Reject. This is an alternative test method to performing the stress analysis.

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GB	53. 5	8.03.3	1 st para.	te	Why/how are these alternatives equivalent?	Add explanation/justification.	The intent is that the one minute hold at 2.5 times operating pressure is equivalent to a ten second hold at 2.65 times the operating pressure as a means of verifying the compliance with the 2.65 stress ratio requirement. The reduced composite thickness test allows the container manufacturer to generate experimental results to validate material properties and process controls.
GB	54.	8.03.4	a) & b)	te	This is unclear and needs further clarification.	Add examples, such as in case b) non-load sharing protective layer.	Accept. Add "for example, such as in the case of a non-load sharing protective layer" to b).
GB	55. 2	9		ed	Better English.	Move 2 nd line to become 1 st line. Begin the clause "All threads shall..."	
GB	56. 3	9		te	Unclear text. Does this mean that steel containers can only have tapered threads or aluminium alloy containers cannot have taper threads?	Clarify requirement.	Reject. Only steel containers can have tapered threads – aluminium containers cannot have tapered threads.
US 1	57.	9.03.8		te	The fire test was developed based on temperature levels and durations for passenger cars per scope of GTR#13. While the fire test in 9.3.8 may serve as a minimum, the temperature duration (and possibly the level) of the localized exposure may, in fact, be longer (or higher) for a heavy duty vehicles, particularly vehicles with loads or	<i>Recommendation:</i> 1) In the near-term, add an advisory to the fire test that the application should be considered and adjustments to increase the temperature level or duration should be considered. 2) In the long-term, consider the situation further as part of the DIS document development.	Reject. Fire test criteria were based on actual light duty vehicle fire test data, but it is agreed that the specific application should be considered, e.g. Category A containers on fuel cell buses and Category

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					cargo such as garbage trucks or box trucks.		C containers on forklifts.
GB	58.	10.01 , 10.2		te	It is not the role of an ISO standard to specify conformity assessment, this is the role of national regulations.	Remove.	Reject. These requirements assure the integrity of the container design. (reword)
GB	59.	10.03		te	This section needs to be amended. Standards must specify what should be done, but not who does it. This is the duty or regulations.	Amend as necessary.	Reject. These requirements assure the integrity of the container design. (reword)
GB	60. 3	11.01		te	The un-acceptable defects need to be specified.	Add specific requirements.	Reject. Minimum defect size is up to the container manufacturer to specify.
SE	61.	11.03	3 rd para	te	Vague definition of specifications.		Accept. Delete: "or colder" and "or hotter"
GB	62.	11.03	3 rd para.	te	What is the basis for -50°C? -40°C is referred to elsewhere in the standard.	Verify correct value.	This value is based on an allowance for lower temperatures which may occur during rapid defueling during vehicle operation
GB	63. 2	11.04		te	Other methods may be used.	Change to "...continuous filament windings or equivalent method."	Accept.
GB	64. 2	11.05		te	Other methods may be used.	Change to "...continuous filament windings or equivalent method."	Accept.
CA	65.	11.10.02		ge	Consider adding a time limit requirement for a batch. Low volume production has a potential for 200 units spanning more than a year without changes to the manufacturing processes.	Add line "In no case shall a "batch" be permitted to exceed one 12 month period."	Change to the following: "The batch size shall be determined and managed under the container manufacturer's quality control system"
SE	66.	11.11		TE	"Satisfactory results" is vague	The results shall meet all applicable requirements, or similar.	

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GB	67.	12.01	a)	te	There is no specific requirement within the standard for the manufacturer to specify limits.	If this is a requirement, then this needs to be specifically stated.	Reject. The limits are specified by the container manufacturer
GB	68.	12.01	Table 2	te	Why are there no entries in 2 nd column?	Add values or delete column.	Accept. Delete column
IT	69. -	12.02		Te	For Type I cylinders "Proof pressure test" has to be included as alternative to Volumetric Expansion Method. This alternative is a valid and internationally recognized method. A possible reference is clause 11.2 of ISO 9809-1	To include for Type I cylinders "Proof Pressure test". A reference for text is of clause 11.2.1 ISO 9809-1	Accept. Suggest A.11 procedure per ISO 11439
GB	70. 3	12.02		te	Why is a CGA document cited and not an ISO standard?	Add suitable ISO reference or specify procedure.	Accept. Suggest A.11 procedure per ISO 11439
GB	71. 3	12.02		te	30s is considered to be insufficient time and particularly for large containers.	Give consideration to a longer period, e.g. 1minute for "portable" containers and 2 minutes for large containers.	Accept. Addressed if A.11 of ISO 11439 is used
IT	72. 2	12.03		Te	For Type I cylinders it is considered an alternative method a leak test as e.g. per clause 11.4 of ISO 9809-1	Add a Note: for Type I cylinders leak test according to clause 11.4 of is considered an alternative method	Reject. No additional value provided by ISO 9809-1 language.
CA	73.	12.03		ge	Leakage and permeation are already defined in Clause 3.12 for leakage and Clause 3.19 for permeation and the final line in the clause ("Any gas detected beyond...") already provides a quantitative cause for rejection. Additional language specifying a compliance requirement for permeation is not necessary.	"Permeation through the wall in compliance with Clause 19.3.11 shall not be considered to be leakage."	Accept
SE	74.	12.03		TE	Leak test gas/mixtures must be defined for hydrogen service.	Use a gas or gas mixture which has leak characteristics equivalent to hydrogen	Accept per above comment
SE	75.	12.03		TE	-	Add reference to applicable permeation test	Reject. See comment above regarding elimination of permeation test.
GB	76.	12.03		te	The hazards associated with the release of gas	Add suitable warning.	Accept.

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					must also be highlighted.		Add: "Precautions should be taken in consideration of the potential for the release of combustible gas." to the note.
CA	77.	13.03		ge	Requirements should apply to all cylinder types, not limited to composite containers.	"The coating on all defective containers may be stripped, using a method that does not affect the integrity of composite containers, and re-coated.	Reject. It refers to the stripping method not being harmful to the surface of composite containers.
GB	78.	13.04.2.2		te	1 in 10 is too few.	Increase the frequency.	Reject. Safe in service experience with this requirement. Commenter does not provide rationale.
GB	79.	13.04.2.3		te	How would it be possible to test containers that may already have been installed? Is it practical to recall and test cylinders?	Reconsider requirements.	Reject. Container manufacturer records would be used to locate containers.
GB	80.	13.05.1		te	For better clarity, the test criteria should appear after the test procedure.	Re-arrange order of text.	Accept.
SE	81.	13.05.2.1		TE	-	Define cycle rate	Accept. Add: "The maximum pressurization rate shall be 2 750 kPa per second."
GB	82. 1	13.05.2.1	b)	ed	Poor English	Change to "..MPa and at least..."	
GB	83. 3	13.05.2.1	b)	te	What determines the appropriate value?	Clarify.	Regulation set by each country will determine the value
GB	84. 2	13.05.2.3		te	Every 10 th batch is too few.	Increase frequency.	Reject. Safe in service experience with this requirement. Commenter does not provide rationale.

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GB	85.	14.01		te	The text for this section could be improved if that from ISO 7866 or 9809 is used.	Replace with text based on, for example, section 6.4 Failure to meet test requirements in ISO 7866.	Accept. Replace 14.1 with Clause 6.5 of ISO 9809-1.
SE	86.	14.02		ed	Vaguely worded	Containers with leaks not meeting the requirements of Clause 12.3....	Accept
SE	87.	14.03		ed	Vaguely worded	Rejected containers not meeting the requirements of Clause 12.2....	Accept
GB	88.	15		te	Is this relevant to this standard?	Consider removing this clause.	Reject. TPRDs are mandatory.
GB	89. 2	15		te	ISO 19882 is not listed in the normative references.	Add if required.	Accept
GB	90. 3	15		ed	Clause 19.3.8 is the wrong reference.	Change to 19.3.9	
SE	91.	15	Note	GE	i) "demonstrated" in accordance with what? ii) Container or vehicle manufacturer?	Clarify requirements	Reject. Fire testing; container manufacturer or vehicle manufacturer; add: "of this International Standard"
GB	92.	16		ed	Wrong reference for Annex.	Change "B" to "C".	
SE	93.	17.01.1		GE	-	Label position should be agreed with vehicle manufacturer to assist reading when installed in the vehicle	Accept.
GB	94. 1	17.01.1		te	For greater clarity.	Change to "For composite containers, markings may be....."	Reject. Labelling requirements apply to all types of containers.
CA	95.	17.01.2		ge	The use of manufacturer approved mounting should be a requirement for integrators and users. Improper container mounting, i.e. one that doesn't consider container expansion, can pose a safety hazard to the public.	Add line "The statement "Mounting Shall Be In Accordance With The Container Manufacturer's Instructions"	Accept. Add as new h)
CA	96.	17.01.2		ed	Consider restructuring clause with sub-clause (a) containing mandatory information and sub-clause (b) containing the statement about non-mandatory	Revise section as follows: "Each container complying with this International	

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					information. (c) through (g) should then be revised to (v) through (ix) Statement "marking in accordance with government regulations, including at a minimum:" is confusing since the entire clause is a requirement. There is no point in nesting minimum marking requirements in a clause for mandatory marking requirements.	Standard shall be marked as follows: (a) Mandatory information: i. name and contact... . . . ix. The statement "Container Service Life..." (b) Non-mandatory information can be added..."	
GB	97.	17.02		te	This needs to be moved to end of section to be in the correct chronological order.	Move to appropriate position,	Unclear comment
GB	98. 1	17.02		ed	Poor English.	Change to "Prior to despatch from the manufacturer, every container..."	
GB	99.	18		te	Quality assurance requirements are not appropriate for an ISO standard.	Remove.	Accept. Replace Clause 18 text with Clause 5.2.7 of ISO/DIS 17519 (2015) for composite transport tubes: "The manufacturer shall specify methods and procedures in accordance with a quality assurance system acceptable to the Inspector and that will comply with any relevant regulations of the country(ies) where the <u>containers</u> are to be produced used"
GB	100.2	18.02	b)	ed	Incorrect text.	Change to "...quality system. As a minimum..."	No longer relevant
GB	101.3	19.01		te	Incorrect term.	Replace "Independent inspection or test agency" with "Inspector" and add a definition for inspector in 3.	Reject. Independent inspection and test agency defined in

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							Clause 10.1.
GB	102.	19.01	Table 3	te	Extreme temperature cycling test is not relevant to type 1 cylinders.	Remove requirement.	Accept
GB	103.	19.01	Table 3	te	Accelerated stress rupture test is not relevant to type 1 cylinders.	Remove requirement.	Accept
GB	104.	19.01	Table 3	ed	Clause reference 19.3.3 incorrect.	Change to 19.3.4	
GB	105.	19.01	Table 3	ed	Clause reference 19.3.4 incorrect.	Change to 19.3.5	
GB	106.	19.01	Table 3	ed	Clause reference 19.3.5 incorrect.	Change to 19.3.6	
GB	107.	19.01	Table 3	ed	Clause reference 19.3.6 incorrect.	Change to 19.3.7	
GB	108.	19.01	Table 3	ed	Clause reference 19.3.7 incorrect.	Change to 19.3.8	
GB	109.	19.01	Table 3	ed	Clause reference 19.3.8 incorrect.	Change to 19.3.9	
GB	110.	19.01	Table 3	ed	Clause reference 19.3.9 incorrect.	Change to 19.3.10	
GB	111.	19.01	Table 3	ed	Clause reference 19.3.10 incorrect.	Change to 19.3.11	
GB	112.	19.01	Table 3	ed	Clause reference 19.3.11 incorrect.	Change to 19.3.12	
GB	113.	19.01	Table 3	ed	Clause reference 19.3.12 incorrect.	Change to 19.3.13	
GB	114.	19.01	Table 3	ed	Clause reference 19.3.13 incorrect.	Change to 19.3.14	
GB	115.	19.01	Table 3	ed	Clause reference 19.3.14 incorrect.	Change to 19.3.15	
GB	116.	19.01	Table 4	te	What is the justification for having reduced testing for category B containers? Category B should be removed.	Remove.	Reject. Category B containers are UN GTR #13 containers that have specified cycle lives.
JP1	117.	19.02	Table 4	te	Test requirements for Category B containers Category B containers are Type 4 designs of 70 MPa nominal working pressure. (see Clause 5.1.2 Category) So the columns for Type 1, 2 and 3 in Table 4 are unnecessary.	The columns for Type 1, 2 and 3 in Table 4 shall be deleted.	Accept.
JP2	118.	19.02	Table 4	te	19.5.5 Permeation test This test is included in Clause '19.5.6 Container test for expected on-road performance'. So the	The column for Clause '19.5.5' in Table 4 shall be deleted.	Accept.

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					independent permeation test is unnecessary.		
CA	119.	19.03		ed	Consider renaming section. Section 19.2 indicates Category B containers are to use Table 4 using procedures in Clauses 19.3 and 19.5. Clause 19.3 is titled Category A and C: design qualification tests. This may cause some confusion.		
GB	120.	19.03.10.2		te	The requirement to actually burst the cylinder is not stated, though this is part of the test.	Add suitable text.	Accept. Add: "At the completion of the test the container shall be burst"
CA	121.	19.03.10.3		ed	Clause references incorrect clause as the burst test. Burst test is Clause 19.3.6	"...when tested in accordance with the hydrostatic burst test in Clause 19.3.6."	
CA	122.	19.03.11.2		ed	Remove "pneumatically" – redundant language considering nitrogen, helium, and hydrogen are explicitly specified.	"A container shall be pneumatically pressurized to nominal working pressure with..."	
GB	123.	19.03.12		ed	For greater clarity, move text from 19.3.12.2 3 rd para. to start of clause.	Start the clause "This test shall only be required on Type 4 containers".	
SE	124.	19.03.12.2			EC Regulation requirement on which the requirement is based is 6.0NmL/hr/L water capacity at 15C	Change temp from ambient to 15 C for harmonisation.	Accept. Replace ambient temperature with 15C
GB	125.	19.03.12.2	2 nd para.	te	The statement regarding permeation is not relevant.	Delete.	Accept.
CA	126.	19.03.12.3		ed	Note references incorrect clause for permeation test. Permeation test is Clause 19.3.12	Replace 19.3.11 with 19.3.12	
GB	127.	19.03.12.3	1 st para.	te	Define Ncc	Add definition.	Accept. Add definition: Ncc (normal cubic centimeter) — dry gas that occupies a volume of 1 cm ³ at a temperature of 273.15 K (0 °C) and an absolute pressure of 101.325 kPa (1

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							atm).
GB	128.	19.03.13		ed	For greater clarity, move text from 19.3.13.2 1 st para. to start of clause.	Start the clause "This test shall only be required on Type 4 containers".	
DE/ 04	129.	19.03.14		te	Low ambient temperature cycling missing as critical part of container service conditions.	The first 500 cycles shall be conducted at ambient temperature, followed by a static hold at 115 percent of nominal working pressure at 55 °C for a minimum of 30 hours. The second 500 cycles shall be conducted with the container at an ambient temperature of -30 °C (250 cycles) and at 50 °C (250 cycles) .	Accept.
5	130.	19.03.14.2		ge	Cycling with hydrogen is a specialised process. Are such facilities readily available?		Yes
DE/ 04	131.	19.03.2.2		ed	Include real numbers of cycles required to be performed	Cycle the pressure in the container between 2 (±1) MPa to at least 125 percent of nominal working pressure at a rate not greater than 10 cycles per minute for the following number of cycles: i) Category A containers: Number of cycles equivalent to 1500 times the service life of the container in years. ii) Category B containers: Number of cycles equivalent to 22,000 cycles iii) Category C containers: Number of cycles equivalent to 2250 times the service life of the container in years.	
GB	132.	19.03.2.2	a)	ed	Poor English	Change to "...MPa and at least..."	
DE/ 04	133.	19.03.3		ed	Wrong numbering, should be 19.3.2.3		Agree
JP3	134.	19.03.3		ed	Acceptable results Clause number '19.3.3' is error in writing.	'19.3.3' shall be changed to '19.3.2.3'. And also '19.3.X.X' after that shall be changed to correct numbers.	Agree
GB	135.	19.03.3	Note:	te	A maximum temperature should be specified.	Add max. temp. e.g. 50°C	Reject. Note is clear – max.

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							temperature not necessary.
SE	136.	19.03.4.2.3		TE	-	Use either MPa or KPa throughout	Accept. See above re ISO secretariat
CA	137.	19.03.4.2.4, 19.3.6.2,		ed	Consider choosing either kPa or MPa as the pressure notation for the document to keep units consistent. Sections containing kPa are listed in the Clause/Subclause column.		
CA	138.	19.03.4.2.5		ed	Clause references incorrect clause as the burst test. Burst test is Clause 19.3.6	"...when tested in accordance with the hydrostatic burst test in Clause 19.3.6."	
GB	139.1	19.03.4.2.5		te	Is the reduction to 180% in line with other standards?	Confirm requirement.	In line with UN GTR #13 and CSA HGV 2
DE/ 04	140.	19.03.5.2		te	Remove requirement of container stabilization @ zero pressure.	The extreme temperature cycle test shall be performed in accordance with the following procedure: a) Stabilize the container at zero pressure and 85°C degrees or higher. b) Hydraulically pressure cycle between 2 (± 1) MPa and at least 125 percent of nominal working pressure for 4 000 cycles. The temperature limits specified in (a) shall be met on the container skin and in the working fluid in the container throughout the cycling. c) Stabilize the container at zero pressure and ambient conditions. d) Stabilize the container at zero pressure and -40°C degrees or lower. e) Hydraulically pressure cycle between 2 (± 1) MPa and at least 80 percent of nominal working pressure for 4 000 cycles. The temperature limits specified in (d) shall be met on the container skin and in the working fluid in the container throughout the cycling.	Accept
CA	141.	19.03.5.3		ed	Clause references incorrect clause as the burst test. Burst test is Clause 19.3.6	"...when tested in accordance with the hydrostatic burst test in Clause 19.3.6."	
GB	142.2	19.03.5.3		te	Is the reduction to 180% in line with other	Confirm requirement.	In line with UN GTR #13 and

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					standards?		CSA HGV 2
GB	143.3	19.03.6.2	2 nd para.	te	To clarify what is required, a diagram should be added.	Add diagram of test arrangement.	Reject. Language is sufficient to perform the test.
GB	144.1	19.03.6.3	2 nd para.	te	Unnecessary requirement. Remove “at least 225 percent of the nominal working pressure and”	Change to “The minimum required burst pressure shall be in no case less than ...”	Reject. Existing language also covers Type 1 containers...
GB	145.1	19.03.7.2	a)	te	The geometry of the flaws need to be defined more precisely.	Define the flaws more specifically. See ISO7866 Annex E as an example.	Accept. Use same language as UN GTR #13 – “saw cuts” which implies a square cut profile. In metal cylinders the profile is critical re fatigue crack initiation, whereas in composite cylinders the flaw merely serves to cut the fibres.
GB	146.1	19.03.7.2	b)	ed	Poor English	Change to “...MPa and at least...”	
GB	147.1	19.03.7.2	d)	ed	Poor English	Change to “...MPa and at least...”	
US 2	148.	19.03.9	19.3.9.2.4	te	The minimum test temperature values are extremely low in comparison to some real-world fire events. They well could be measured values for a simple test where the flames are created by clean propane gas, but such fires create low fire demands. The low values place emergency responders at an inappropriate risk. The tanks need to perform well when exposed to vehicle fires involving spilled fuels. They also need to respond well to fires inside a garage or tunnel.	A technical basis needs to be documented for the low values specified in the standard, or the values need to be raised. Care needs to be taken to not extract values from inappropriate sources. (i.e., Extracting the early temperatures during a structural component fire test where the typical test exposure is 1 hour or more.) Current design values for fire more typically approach or exceed 1000°C. Increasing the minimum temperature might require changing the fuel specified in the test.	Reject. Fire test temperatures based on real world light duty vehicle fire data presented by GM and Japanese OEMs to SAE J2579 committee, See Annex D of this International Standard.
GB	149.	19.03.9.2.1	1 st para.	te	It is unclear if this test is for specific valve/PRD arrangements and limits the design/approval to particular valves etc.	Clarify.	The container is qualified with a particular PRD
GB	150.	19.03.9.2.1	2 nd para.	te	The dangers associated with using hydrogen in the fire test need to be emphasised and highlighted.	Add further warnings, bold text etc.	Reject. Test laboratories equipped to handle risks.

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SE	151.	19.03.9.2.2	1 st sent	TE	On the dome or cylindrical area?	Please clarify	It shall be farthest from where the PRD is installed, which is typically in the dome
GB	152.	19.04	2 nd para.	te	It is not the duty of the inspector to define test requirements, these should be included in the standard.	Add specific requirements.	Reject. Technically this is correct – the inspector may not be familiar with containers and testing so don't leave it in his hands to decide anything. However, one can see that there could be some kind of process change that doesn't affect the design, and common-sense should prevail. This is because it is not practical to cover every possible small change in a standard. And after all, the manufacturer could always cheat a standard if so inclined, so one must believe they are not going to request a change of design variance unless minor.
GB	153.	19.05		te	The concept of category B containers should be removed and the requirements added to those for categories A and C.	Combine with categories A and C in 19.4.	Reject. Category B containers are used for UN GTR #13 compliant light duty fuel cell vehicles, however, countries that have not adopted the UN GTR #13 regulation could safely use Category A containers for light duty fuel cell vehicles.
DE/ 04	154.	19.05.1		te	Delete “and Verification Test for Closure Durability”	Note: Containers subjected to these tests are intended to be integrated into a compressed hydrogen storage system, including all closure devices (such as shut-off valves, check valves, pressure relief devices, etc.) and piping, and are	Accept.

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						expected to meet the additional test requirements (Verification Test for Expected On-Road Performance [Sequential Pneumatic Tests], Verification Test for Service Terminating Performance in Fire, and Verification Test for Closure Durability) in the UN GTR or SAE J2579.	
JP4	155.	19.05.4	ALL	te	<p>Container test for performance durability</p> <p>To avoid the descriptions of looking similar, but different test methods, there is the way to describe as quotation from the UN GTR like Clause '19.5.6'. Example;</p> <p>19.5.6 Container test for expected on-road performance</p> <p>In order for a Category B container to be fully qualified for on-road vehicle usage, a container test shall be conducted at a system level in accordance with the UN GTR, SAE J2579, or equivalent fuel cell vehicle regulations or standards.</p>	<p>Clause '15.5.4.1 to 15.5.4.9' shall be deleted.</p> <p>And as comprehensive description, the following shall be added.</p> <p>"In order for a Category B container to be fully qualified for on-road vehicle usage, a container test shall be conducted at a system level in accordance with the UN GTR, SAE J2579, or equivalent fuel cell vehicle regulations or standards."</p>	<p>Reject.</p> <p>It is important to demonstrate that the test procedures for Category B are the same as Category A and C to demonstrate equivalent level of safety.</p>
DE/04	156.	19.05.4.3		te	Harmonize requirement for drop test with UN GTR test requirements and options	<p>The orientation of the container being dropped (per requirement of 19.3.8.2(a)) is determined as follows:</p> <p>One or more additional container(s) shall be dropped in each of the orientations described. The drop orientations may be executed with a single container or as many as four containers may be used to accomplish the four drop orientations.</p> <p>If more than one container is used to execute all three drop specifications, then those containers shall undergo pressure cycling according to para. 19.5.2 until either leakage or 22,000 cycles without leakage have occurred. Leakage shall not occur within number of Cycles (5,500, 7,500 or 11,000).</p> <p>The container used for further testing shall be identified as follows:</p> <p>(a) If a single container was subjected to all four drop orientations, then the container being dropped shall undergo further testing as specified;</p>	<p>Accept.</p> <p>Add this requirement as c) for Category B containers.</p>

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						(b) If more than one container is used to execute the four drop orientations, and if all containers reach 22,000 cycles without leakage, then the orientation of the container being dropped per requirement para. 5.1.2.2. is the 45° orientation (iv), and that container shall then undergo further testing as specified; (c) If more than one container is used to execute the four drop orientations and if any container does not reach 22,000 cycles without leakage, then the new container shall be subjected to the drop orientation(s) that resulted in the lowest number of cycles to leakage and then will undergo further testing as specified in paragraph 5.1.2.	
JP5	157.	19.05.5	ALL	te	Permeation test This test is included in Clause '19.5.6 Container test for expected on-road performance'. So the independent permeation test is unnecessary.	Clause '19.5.5' shall be deleted.	Accept.
GB	158.	19.06		te	For clarity, the requirements should be combined with those of 19.4.	Move to 19.4	Reject. There requirements are specific to Category C containers per IEC ____ and CSA HPIT 1.
AR	159.	20. Bibliography		Te	There's not any reference to the hydrogen safety ISO document: ISO/TR 15916	Add the following bibliographic reference: ISO 15916 – Basic considerations for the safety of hydrogen systems	Reject. The document does not reference ISO/TR 15916.
GB	160.	Annex A		te	Is this required? If so it is not really adequate and needs further details.	Remove and update 5.1.4 and 10.4	It is an informative annex, but needs to include reference to ISO 19078.
DE/ 04	161.	D.1.04.1		te	Common re-inspection periods acc. e.g. CG6.4 and FMVSS 304 is 3 years. However, Category C container should then exceed $4 \times 1,125 = 4,500$ cycles w/o leak/rupture		Accept. Modify minimum cycle requirements for Category C containers in 19.3.4 and 19.3.7.
DE/ 04	162.	D.1.06		te	Common re-inspection periods acc. e.g. CG6.4 and FMVSS 304 is 3 years.		Accept. See above.

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					However, Category C container should then exceed 4 x 1,125 = 4,500 cycles w/o leak/rupture		
SE	163.	D.1.11	Last para	TE	Incorrect testing temperature noted. The figure was derived for 15C not a minimum of 15C.	Change to "...at a 15 C testing temperature."	Accept.
IT	164.-	Table 3		Te	Accelerate stress rupture test	Remove * from table as per text 19.3.10 being this test not required for Type I cylinders	Accept.
Fr			8.2	Te	Are you sure that for type 2 the unreinforced metal linet shall have a minimum burst pressure of 125% of nominal working pressure.	Chek that is really 125% of NWP	Yes it is correct.
Fr			8.3.1	Te	Why no stress analysis for category B containers?	Add category B vessels : "applicable for category A, B and C containers"	Not a requirement per the UN GTR #13.
Fr			11.5	Te	Composite containers with non-metallic liners : Why vessels manufactured with only Filament winding process are selected and the other on rejected? Why specification only on thermoset resin? How do you control that the performance of the liner is not affected by the process	Replace "shall be fabricated" by "should be fabricated" Replace "the winding shall be applied under controlled tension" by "the fibre shall be applied under controlled tension" Replace the sentence "after the windin is complete, composite using thermoset resiss shall be cured by a controlled process that not compromise the performance of the liner" by "the composite manufacturing processes shall not compromise the performance of the liner" Explain how to check (be explicit) that the performance of the liner is not affected.	Already discussed.
Fr			19.2	Te	Test requirements : table 3 : Test requirements for category A and C: Remove for 18.3.6 : Composite	Test name for 18.3.6 : Flaw tolerance test Add a point "." for colum Type 1 at 18.3.6	Accept. Change name of the test and add dot to the column for Type 1 containers.
Fr			19.3.13.1	Ed	Copy-Paste Bug : replace "permeation" by "boss torque"	Boss torque	Accept.
Fr			19.4	Te	19.4 : change of design table 6 : add a fire test requirement when the resin system material is	Add a fire test requirement when the resin system is changed	Accept. Add X(9) to the table.

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					changed. The resin behaviour is sensitive to temperature. This tested is needed for safety		
Fr			19.7	Te	Figure 5 : in fact it s a table: the stress distribution columns in % are a % of what? Explain and define the reference of %	Explain and define the reference of % for the columns dedicated for Distribution %	Completed by the manufacturer based on the results of stress analysis.
DE/0 4		19.6.2		ge	The research and standardization activities on this field are still ongoing (as already mentioned in the note). The steels which are considered to be suitable for hydrogen applications are limited to certain regional available steels. Among experts there are different view's on the appropriate Ni-Content.	Delete the Chapter.	Reject. These criteria are only for Category C and allow us to harmonize with the IEC standard for industrial powered trucks
DE/0 4		19.6.3		ge	Aluminum is considered considered to be suitable for hydrogen applications, however suitable Alluminum alloys are limited only to A6061-T6 type alloy's.	Aluminum alloys A6061-T6, A6061-T62, A6061-T651 and A6061-T6511 are suitable for hydrogen service. Suitable Aluminum alloys for hydrogen service are for example A6061-T6, A6061-T62, A6061-T651 and A6061-T6511.	Accept. Modify to: Suitable aluminum alloys for hydrogen service include A6061-T6, A6061-T62, A6061-T651 and A6061-T6511.

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