ISO/TC 197 N 992

ISO/TC 197
Hydrogen technologies

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Secretariat: SCC (Canada)

ISO DIS 19881 Collated Comments (including CN) with resolutions

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Expected action:	INFO
Background:	Here are the collated comments (including those of China) from the DIS 19881 ballot, complete with the WG resolutions. See document N 990 for the DIS 19881 Form 13 ballot results.
Committee URL:	https://isotc.iso.org/livelink/livelink/open/tc197

Template for comments and secretariat observations

Date:2017-09-22	Document: DIS 19881	Project: WG 18

MB/ NC[1]	Line number	Clause/ Subclause	Paragraph/ Figure/Table	Type of comment[2]	Comments	Proposed change	Observations of the secretariat
FR 1 001				ge	The tests are performed at 85°C and at pmax but the protocol for the use include reaching this maximum pressure and temperature. In this case, it will be better to perform to perform the tests at higher pressure and temperature in order to avoid to be obliged to scrap the cylinders if by mistake these temperature and pressure are exceeeded"		This may be addressed by specifying pressure and temperature tolerances as follows: 85° C (+5 / -0° C) -40° C (+0 / -5° C) Pmax +2 – 0 Mpa Unless otherwise specified. Temperatures and pressures may be exceeded if specified by the manufacturer.
(GB 002				ge	The need for this standard is fully understood and agreed but the existing DIS requires significant work to enable it to be implemented in a satisfactory manner. It is requested that this standard does not progress to FDIS until appropriate changes have been made		Changes will be made in accordance with WG 18 review.
US 01 003		01		ge	Scope does not indicate for land vehicles only.	…containers intended only for the storage of compressed hydrogen gas for land vehicle operation.	Accept comment
US 02 004		01		ge	Consistency with terminology throughout document.	Change all references from "fuel cell vehicles" to "hydrogen fuelled vehicles"	Accept comment
GB 005		01		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 comment. Tank types are defined in Section 3.6. Service conditions are provided in Section 4.0.

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GB 006		01	a)	te	It is stated that cylinders are to be permanently mounted. Can they be removed or substituted?	Previous comment clarifying the meaning of "permanently mounted" needs to be incorporated into the text	Accept comment. Include new definition for "Permanently attached" – a container is intended to remain fixed to a particular vehicle for the lifetime of the container or vehicle, whichever comes first.
FR 2 007		02		ed	The list should be presented per ISO rules		Document has been reviewed by ISO CS and their recommended changes will be adopted.
FR 3 008		02		ed	Is it possible to list standards that are not ISO standards?		Yes, with restrictions.
US 03 009		02		te	Currently, all standards are referenced by date. While this ensures technical changes are not made without knowledge, it risks that referenced standards become obsolete or withdrawn as new editions are published. It is recommended that dates are removed, and if specific technical requirements are needed, they be placed directly in ISO 19881.	Delete the dates from all referenced standards	Document will follow editorial instructions of ISO CS. We will reference specific editions of standards where required by the document.
GB 010		03.01		te	This is not in keeping with ISO rules. Standards should specify technical requirements.	Remove in accordance with ISO rules	Reject comment. This concept is consistent with ISO/TC 58 documents, such as ISO 11439.
US 04 011		03.05		ge	Should include a definition for "container category". Note: Term is often used but never defined. Use is more specific than the "Webster's definition" so, should be defined in the standard.	Container category classification of containers based on usage and approach to regulation and approval Note—Requirements for the categories are given in 4.1.2. Category A and Category B containers are intended to provide a sufficient level of safety for the intended application, but test methods, and	Reject comment. Definition of container category is already in the document (Section 3.5).

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						records are different to facilitate regulatory compliance.	
GB 012		03.05		te	Why do we need 3 different categories of container?	Add clarification for different categories and give examples.	Reject comment. Definition of container category is provided in Section 3.5.
DE 013	1	03.05		Te	Category B contains the restriction of Type 4 containers only	Delete the restriction of the container type	Reject comment. The coverage for Type 3 tanks in the GTR is not sufficient from the perspective of long term stress rupture performance of composite fibers. Once the GTR document either specifies fiber stress ratios or includes a long-term stress rupture test, WG 18 will revise this document to include Type 3 tanks into Category B. GTR 13 IWG established a task force to address this issue.
GB 014		03.06		te	These definitions are not in keeping with those typically found in the TC58 standards. e.g. ISO 10439, ISO 10286	Align with ISO TC58 definitions	Accept comment. Align container type definitions with ISO 11439.
US 05 015		03.11		ed	Clarify that while full wrap covers the domes, it does not cover the end boss	…including the domes, <u>but not over the end boss</u>.	Reject comment.
US 06 016		03.14		ed	Reference to Clause 12.3 is incorrect, should be 11.3.	…leak test gas in Clause 11.3.	Accept comment. It is now 10.3 in document.

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US 07 017		03.14		te	First – requirements cannot be put in definitions. Second – specifying a blend with a minimum of 10% of H2 or He is not necessary technically, and inconsistent with the stated requirements of 11.3, which allows “an acceptable alternative”. Specifically, 2% mixtures of He are known to be easily detectable in a leak test, and 95%/5% mixtures of N2/H2 are known to be detectable, and are common, since any leakage of this gas mixture in air will not result in a combustible mixture	Modify definition: Gas for testing leaks that consists of dry hydrogen, or dry helium, or blends that contain these gases at a detectable level.	Accept comment.
DE 018		03.14		Te	Typical test gases for leak tests consist of 95% N2 and 5% H2.	Please reduce minimum hydrogen content to 5%.	Agree in principle, but see US 07 (17).
GB 019		03.23		te	ISO 19078 applies to CNG cylinders, the pressures and stresses in these containers will be different to those in the containers described here. Further manufacturers recommendations could vary significantly	Definition to be modified accordingly	Accept comment. Delete 3.23. *Only reference to rejectable damage is in Informative Annex (A.2), however need to reference ISO 19078 Annex A.2. (see ISO 19078).
GB 020		04.01.1	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 comment.
US 08 021		04.01.2		te	Need to clarify that the category A application is for cylinders and not included in category B. Remove category C and include into category A with clarification regarding the cycle life criteria to remain aligned with HGV-2 and to avoid unnecessary category distinction. Revise to clarify the interaction between this document and the GTR.	Rewrite 4.1.2 to read as follows: a) Category A containers are intended to be used for hydrogen fueled vehicle applications that are outside the scope of Category B. b) Category B containers are intended to be consistent with the UN GTR No. 13 for hydrogen fueled vehicles of ECE category 1-1 and 1-2. Additional qualification testing	Reject comment. HGV 2 was the seed document for this ISO document, with the requirement that there be harmonization with UN GTR 13 and inclusion of requirements for hydrogen powered industrial trucks.

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					If this comment is accepted, need to remove Category C throughout document. Also need to add the number of cycles for Category A hydrogen powered industrial trucks.	may be required to comply with the UN GTR No. 13. NOTE—The UN GTR No. 13, when adopted by a regulatory authority within its jurisdiction for a given class of vehicles, would supersede the requirements of this ISO standard. It is not intended that the requirements of this ISO Standard would be imposed in addition to the UN GTR No. 13 requirements.	The 3 categories support this mandate.
GB 022		04.01.2	4th para	te	Regulatory compliance is not appropriate for standards.	Delete text referring to regulatory compliance	Accept comment. Modify to read: Category A, Category B and Category C containers are intended to provide a sufficient level of safety for the intended application, but test methods, and records are different.
FR 5 023		04.01.3		te	Why do we limit lifetime to 25 years?		25 years is the expected maximum life of a vehicle and is based on fiber stress rupture and life cycle fatigue. These are fixed containers in vehicles.
US 09 024		04.01.4		te	Need to consider how these various category tanks are identified and controlled to avoid the usage of a certain category tank for the incorrect application	Add criteria to confirm category tank and application	Reject comment. Containers are labeled in accordance with section 15.
US 10 025		04.02.2	Item b	te	The pressure after fill represents a “normal” condition. This should be clarified. Also, the possibility of highly infrequent rise to 150% is possible under multiple fault conditions is possible. What temperature – tank or ambient?	Modify item b as follows: normally up to 125 percent of the nominal working pressure immediately after filling~~, regardless of temperature~~ and infrequently up to 150 percent under dispenser fault conditions. See ISO 19880-1.	Accept comment with modification. normally up to 125 percent of the nominal working pressure immediately after filling, regardless of gas temperature and infrequently up to 150 percent under dispenser fault conditions. ~~See ISO 19880-1.~~

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US 11 026		04.03		ge	Need explanation of the various categories.	Include a note to refer to the rationale in Annex D (D.3, D.4 and D.5)	Accept comment. Include note referring to Annex D.3, D.4 & D.5.
GB 027		04.03	b)	te	What is the rationale for the three values for b)? What determines which is to be used?	Clarify	See above (US 11)
US 12 028		04.04.1		ed	Not clear for the reason for indicating “low of” and “high of”	Eliminate “low of” and “high of”	Accept comment
GB 029		04.04.1		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	85C has been proven to be a settled temperature inside a vehicle for at least several hours during certain days. Just like -40C can be a settled temperature in Alaska for certain periods of time.
GB 030		04.04.3		te	The clause suggests that temperatures can go above 85°C. Specific limits of time and temperature need to be defined.	Define limits.	Reject comment. Limits do not have to be defined because the limits of time and temperature are defined by the statement that the bulk materials’ temperature cannot change.
GB 031	2	04.07	2nd 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…..”	Accept comment with modification. The vehicle manufacturer or system integrator shall be responsible for the protection of the container, container valves, pressure relief devices, and connections as required ~~by applicable regulations per the authority having jurisdiction (AHJ).~~

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							~~Standards that apply to this requirement include SAE J2578, SAE J2579, IEC 62282-4-101, UN GTR No. 13, or other equivalent standards.~~
GB 032		06.02		te	This is a performance based standard, therefore appropriate criteria and test methods need to be specified.	Include appropriate criteria in normative text	Agree in principle, however there is no need to copy/paste acceptance criteria and test methods from appropriate standards. Include ISO 11114-series. NOTE Material performance data and/or acceptance criteria in hydrogen environments can be found in ISO 11114-series, the Sandia National Laboratory Technical Reference for Hydrogen Compatibility of Materials or ANSI/AIAA G-095, ANSI/CSA CHMC 1, ASME B31.12, and SAE J2579, Appendix B, or in equivalent national requirements.
US 13 033		06.03.1		te	Lead and bismuth are limited to 0.003 %. The traditional limits for "other" elements for alloy 6061 is typically 0.05%. The value was reduced to 0.0003 when it was thought that lead and bismuth were the factors in sustained load cracking, which has now been attributed to excess silicon. Given that excess silicon has been shown to be issue with sustained load cracking, would it not be appropriate to revisit the limit?	Consider removing the requirement for lead and bismuth to be limited to 0.003%, vs. 0.05%.	Accept comment with modification. Currently ISO 7866 has no reference to a lead limit. The impurity limit~~s~~ for ~~lead and~~ bismuth in any aluminum alloy shall not exceed 0,.003 percent.
US 14 034		06.03.1		te	Given that excess silicon alloys are known to be a problem with sustained load cracking, it would be best to exclude them rather than recommend against them.	…Excess silicon 6xxx series aluminium alloys with yield strengths above 250 MPa (e.g. 6351 and 6082 ~~should~~ shall not be used in fuel containers of liners.	Accept comment.

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JP 035		06.03.1		te	Material properties At the moment, the material property specifications shall not be indicated concretely like "a maximum tensile strength of 950 MPa for chrome-molybdenum steel" In the document of UN GTR13, there is the indication below. **Material compatibility and hydrogen embrittlement** "...the SGS working group recommended that Contracting Parties continue using their national provisions on material compatibility and hydrogen embrittlement and recommended that requirements for these topics be deferred to Phase 2 of the gtr activity." Several countries have been conducting their research towards GTR13 Phase 2. In the latest research in Japan, the acceleration limits of fatigue crack growth don't exist on chrome-molybdenum steel which have a extremely high tensile strength in hydrogen environment. In this case, it is impossible to apply design by analysis to cylinder design. ISO 9809-1 seems not to cover the conditions of high pressure hydrogen gas.	The following red letters should be deleted. Steels shall be aluminum killed and produced to predominantly fine grain practice. ~~Steels shall have a maximum tensile strength of 950 MPa for chrome-molybdenum steel and 880 MPa for carbon-manganese steels. For all other steels,~~ the container manufacturer shall demonstrate that exposure to high-pressure hydrogen under the service conditions provided in Clause 4 will not cause any harmful corrosion, deformation, or deterioration of the material.... ~~The following limits shall not be exceeded in the cast analysis:~~ (should be deleted including the table) ~~NOTE 950 MPa is the accepted maximum value per ISO 9809-1.~~	Accept comment. Check if this is the only reference to ISO 9809 – if so, delete from normative references.
GB 036	3	06.03.1	3rd para.	te	The restricted alloys are not clear.	Change to “Aluminium alloys 6351 and 6082 shall not be used.”	Accept comment.
US 15 037		06.05		ed	Clarification of intent, that hybrid fiber reinforcement is allowed.	“Structural reinforcing filament material types shall be glass fiber, aramid, fiber, or carbon fiber, or mixtures thereof. If…”	Accept comment with modification to change to or mixtures or hybrids thereof
GB 038	2	06.06	2nd para.	te	Delete note and add required Tg criteria to normative text		Reject comment. Non-mandatory note.

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DE 039		07.03.1		Te	Simulation of composite reinforcement sufficient Additional simulation of the liner results in an increased simulation effort.	Delete liner	Reject comment. For type 2 and 3 designs the liner takes some of the load therefore it is important in a simulation.
GB 040		07.03.1	1st para.	te	Why is B not included? Stress analysis must be included for all categories of cylinders	Change to "The stress analysis is applicable to all categories."	Reject. Category B designs are meant to mirror UN GTR13 requirement and GTR 13 does not require stress analysis.
GB 041		07.03.2		te	What is the rationale for the values of stress ratio's used?	Add explanation/justification.	Reference Norm's stress ratio document. Craig will provide link.
GB 042		07.03.3		te	Further explanation is required.	Add explanation/justification.	Reject comment. Rationale is provided in text of 7.3.3. Also reference Norm's stress ratio document. Craig will provide link.
GB 043	3	08		te	Permit taper threads for aluminium alloy cylinders?		Reject comment. Need a rationale for the use of tapered threads in aluminium alloy containers up to 700 bar nominal working pressure.
GB 044		09.01 , 9.2		te	It is not the role of an ISO standard to specify conformity assessment, this is the role of national regulations.	Remove – see ISO rules	Reject comment. ISO 11439 includes similar text.
GB 045		09.03		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 – see ISO rules	Reject comment. This is just a guidance section.

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GB 046	3	10.01		te	The un-acceptable defects need to be specified.	Add specific requirements.	Reject comment. Clause 10.1 specifies that defects are per manufacturer's specification.
DE 047		10.03		Te	What is the reason to conduct the tensile testing at -50°C, at ambient temperature, and at 85°C? Container temperatures are restricted from -40°C up to +85°C.	Please provide rationale	**Accept comment Change to -40 C.**
GB 048		10.03	3rd para.	te	As the Secretariat replied previously the value of -50°C "is based on an allowance for lower temperatures which may occur during rapid defueling during vehicle operation". If this is the case then should the upper value of 85C also be increased i.e. to accommodate the maximum temperature during filling		Agree in principle. See above #47. No change needed.
US 16 049		10.08		ed	Clarify wording	Add a comma after "9809-1".	Accepted comment.
GB 050		11.01	a)	te	There is no specific requirement within the standard for the manufacturer to specify limits.	Minimum requirements to be specified	Reject comment. The manufacturer shall specify the minimum limits.
GB 051	3	11.02		te	Delete reference to CGA Pamphlet	Delete reference to CGA Pamphlet	Reject comment. Delete reference to ISO. Confirm CGA Pamphlet has reference to calibration and accuracy. *Look for similar reference to CGA C6.4 to potentially delete in favour of ISO only.*

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GB 052	3	11.02		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 larger containers.	Reject comment. Wording is sufficient as is because it allows for more time if needed for "complete expansion."
GB 053		11.03		te	The hazards associated with the release of gas must also be highlighted.	Add suitable **"WARNING NOTICE"**	Reject comment. Already a note present in 10.3 with words Extreme Care.
GB 054		12.04.2.2		te	1 burst test in 10 batches is too few e.g. resin control and cure can change from batch to batch	Increase the frequency of burst testing	Reject comment. One burst is 10 isn't too few if one can demonstrate consistent control from batch to batch. This approach is in use in ISO 11439.
GB 055		12.04.2.3		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. Up to the manufacturer to determine how to recall vessels. Beyond the scope of this standard.
GB 056	3	12.05.2.1	b)	te	What determines the relevant number of test cycles? Why are there 3 different options for Category B cylinders? Change kPa on last line to MPa	Clarify. Change kPa on last line to MPa	Reject. Rationale is provided in UN GTR 13. See Annex D.3, D4 and D.5. Accept change kPa to Mpa
GB 057	2	12.05.2.3		te	Every 10th batch is too few.	Increase frequency – 12.4.2.2	Reject comment. One burst is 10 isn't too few if one can demonstrate consistent control from batch to batch. This approach is in use in ISO 11439.
US 17 058		16.01.2		te	Need to consider how these various category tanks are identified and controlled to avoid the usage of a certain category tank for the incorrect application	Revise 16.1.2 a) I d as follows: number of **design** cycles ~~used in the test program (Category B containers only)~~	Reject comment. This is a label issue. Label as required in clause 15 should be adequate. See above.

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.GB 059		16.02		te	Dispatch as identified in 16.2 is not dispatch i.e. it is an inspection requirement	Rename section	Accept comment. Change to Dispatch inspection.
GB 060		17		te	Quality assurance requirements are not appropriate for an ISO standard. The following text is used by ISO/TC 58 ***Inspection and testing*** *The following text on inspection and testing is applicable for standards for design and manufacture of an ISO/TC58 product or for periodic inspection:* *Assessment of conformity to this international standard shall be carried out in accordance with the applicable regulations of the countries of use.* *Tests and examinations performed to demonstrate compliance shall be conducted using instruments calibrated before being put into service and thereafter according to an established programme.*	Modify text accordingly	Accept comment. Replace paragraph with new.
GB 061	3	18.01		te	Incorrect term – see text above	Replace “Independent inspection or test agency” with “Inspector” and add a definition for inspector in 3.	Accept comment. modify to All design qualification tests shall be conducted or witnessed by an authorized inspection body, where necessary.
GB 062		18.01	Table 4	te	What is the justification for having reduced testing for category B containers? Category B should be removed.	Remove.	Reject comment. Category B containers are included in UN GTR 13.
CA 063		18.03.11.2		te	Tolerance required for temperature. It is impossible to hold the environment at exactly 15C. To use 15C as a nominal value is not reasonable since permeation rate is temperature sensitive so what deviation from 15C is acceptable? EC 79 uses ±2C, HGV2 uses 20C±5C which is probably too	“…placed in an enclosed chamber at 15C ±2C, …” OR “…placed in an enclosed chamber at 15C ±5C, …”	Accept comment. “… placed in an enclosed chamber at 15C ±5C, …”

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					broad. Permeation rates at 15C would vary from those at 25C. Suggest the EC 79 value.		
US 23 064		18.03.11.2	3	te	"….and monitored for 500 hours to establish a steady state permeation rate." This is not clear. "Steady state" is not defined. Does the test only last 500 hours regardless of whether "steady state" is reached? Or must there be 500 hours AND steady state reached?	Eliminate the "steady state" term. Just require permeation at the end of 500 hours to be below the maximum allowable. If there is concern that there is a rising value occurring even at the 500 hour mark, then increase the length of the test to 1,000 hours, at which time still cannot exceed the permeation limit.	See below (065)
CA 065		18.03.11.2	Procedure	Te	The statement that a container shall be "….monitored for 500 hours to establish a steady state permeation rate" is unclear. What is the definition of steady state? Does the test only last 500 hours regardless of whether "steady state" is reached? Or must there be 500 hours AND steady state reached?	Either steady state should be defined as something like "less than 1% change in permeation rate over any 24 hour period", or the test should simply be a 500 hour test period, and the rate of permeation measured at the end of 500 hours shall be less than 6.0 Ncc of hydrogen per hour per liter water capacity.	Agree in principle. Change text to: One container shall be filled with hydrogen to the nominal working pressure (±1 MPa), placed in an enclosed sealed container at 15^0C ±5C ~~and monitored for 500 hours to establish a steady state permeation rate~~. The test shall continue until the measured permeation reaches a steady state based on at least 3 consecutive readings separated by at least 12 hours being within ±10% of the previous reading.
US 24 066		18.03.12.2		te	The torque should be applied in each direction (insertion and removal).	"…to twice the installation torque specified for the fittings, in both the clockwise and counter-clockwise directions. The container…"	Reject comment. Worst case is in the installation, not de-installation mode.

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US 25 067		18.03.13.2		ed	The reference to clause 5.4 should be to clause 4.4.	"…as specified in Clause ~~5.4~~ 4.4."	Accept change.
US 26 068		18.03.13.2		te	Considering the size of some fuel tanks, and the shortage of hydrogen gas cycle test facilities worldwide, manufacturers should be allowed to either use subsize tanks for this test (same diameter, but shorter length), or be allowed to insert filler material into tanks to reduce volume. The purpose of the test is to determine the combined effect of permeation, stress, and temperature has on the liner material, especially in the vicinity of end bosses. This can be accomplished with representative subsize tanks.	"Manufacturers may use tanks of reduced volume for this test, either by reducing the length of a design such that the end dome stresses are not affected, or by using a filler material inserted into a tank to reduce the internal volume."	Agree in principle. Some allowance currently exists by using test specimens manufactured in accordance with the Change of Design table. Add: Subscale specimens may be used for this test with diameters reduced by as much as 20% and lengths reduced by as much as 50%. The defueling rate shall be specified by the container manufacturer ~~and shall not allow the gas temperature to be lower than the minimum allowable gas temperature as specified in Clause 4.4~~.
US 27 069		18.03.13.2		ed	Clarify wording	"… The fill rate shall not exceed 60 g/s, and the maximum allowable gas temperature shall not be exceeded. The…"	Accept comment
GB 070		18.03.13.2		ge	Cycling with hydrogen is a specialised process. Are such facilities readily available?		Yes. CSA Group, Powertech, Kiwa, ET
DE 071		18.03.13.2		Te	The splitting of the second 500 cycles into 250 cycles at -30°C and 250 cycles at 50°C leads to much tougher requirements on the test environment (cooling chamber needed).	The second 500 cycles should be conducted completely at 50°C according to HGV2.	Reject comment. Felt the need to include both temperature extremes in the test.

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CA 072		18.03.13.2		ed	Same as comment for 18.3.7.2 "….to at least 125 percent of nominal working pressure (±1 MPa)….". It can't be "at least 125 percent" if one is allowing +/- 1 MPa. Simply say "125 percent (+/- 1 MPa)"	"….shall be pressure cycled, 2 (± 1) MPa to ~~at least~~ 125 percent of nominal working pressure (±1 MPa)….".	Agree with modification. Change "….shall be pressure cycled, 2 (± 1) MPa to ~~at least~~ 125 percent of nominal working pressure +2 / -0 MPa)….". *Do a global change for pressure and temperature tolerances.*
CA 073		18.03.13.2		ed	Clause 5.4 doesn't exist. They must mean Clause 4.4	"….as specified in Clause ~~5.4~~ 4.4."	Accept comment.
CA 074		18.03.13.2	Procedure	Te	The requirement that "The fill rate shall not exceed 60 g/s and the maximum allowable gas temperature. The defueling rate shall be specified by the container manufacturer and shall not allow the gas temperature to be lower than the minimum allowable gas temperature as specified in Clause 5.4", can result in an exceedingly long test when larger volume containers are involved. There also may not be any test facilities capable of conducting such a test when larger container volumes are involved. Consideration needs to be given to allowing the internal container volume to be reduced. Since temperatures are controlled by the fueling and defueling limitations, then the hydrogen gas cycle test examines the combined effects of permeation and stress on the liner and liner/end boss interface. The effect of temperature is therefore considered even if the volume of the container is reduced.	"Each cycle shall consist of filling and venting of the container. The fill rate shall not exceed 60 g/s and the maximum allowable gas temperature. The defueling rate shall be specified by the container manufacturer and shall not allow the gas temperature to be lower than the minimum allowable gas temperature as specified in Clause 5.4. *The testing may be conducted on a container with a reduced internal volume. Alternatively, the length of a design may be reduced such that the end dome stresses are not affected.*	See US Comment #25

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CA 075		18.03.14.3	Acceptable results	Te	"All containers shall either fail by leakage or exceed 45 000 pressure cycles." This number of cycles is far too excessive (what container in service will possibly go 45,000 cycles, representing tens of millions of miles) and needlessly time consuming in test labs (especially where Type 4 designs are involved). If a container does not fail within the number of cycles allowed under 18.3.2.3 (or 4.3), then the point has been proven that the design has LBB performance exceeding its design life (considering that one is cycle testing to 1.5x WP, rather than the 1.25x WP in normal service)	"All containers shall either fail by leakage or exceed ~~45 000 pressure cycles~~ the maximum number of filling cycles *for the design category*."	Accept comment.
CA 076		18.03.2.2		ed	Same as comment for 18.3.7.2 "….shall be pressure cycled, 2 (± 1) MPa to at least 125 percent of nominal working pressure (±1 MPa)….". It can't be "at least 125 percent" if one is allowing +/- 1 MPa. Simply say "125 percent (+/- 1 MPa)"	"….shall be pressure cycled, 2 (± 1) MPa to ~~at least~~ 125 percent of nominal working pressure (±1 MPa)….".	Agree with modification. Change "….shall be pressure cycled, 2 (± 1) MPa to ~~at least~~ 125 percent of nominal working pressure +2 / -0 MPa)….". *Do a global change for pressure and temperature tolerances.*
CA 077		18.03.2.3		Te	"(e) Category A containers exceeding a number of cycles that is 1 500 times the service life in years, or Category B containers exceeding 22 000 cycles, or Category C containers exceeding a number of cycles that is 2 250 times the service life in years, are permitted to fail by leak or rupture." 22,000 cycles is an excessive cycle life requirement. It represents safety factor on safety factor. It unfairly penalizes Type 3 designs as they have more limited pressure cycle lives compared to Type 4 designs. But fatigue life is over-rated. No container has ever failed in CNG service due to fatigue cracks. No container in CNG service has even experienced fatigue cracks. There is too much emphasis on fatigue life in the standards (and not enough on the causes of actual in-service failures!).	Delete (e). Item (e) actually does not appear to makes sense – if a container completes the (a), (b) or (c) requirements, why is there any need to complete the (e) requirement?	Accept comment with modification. See Draft.

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US 18 078		18.03.2.3	e)	te	Document does not need to specify how the containers are destroyed – too prescriptive.	Category A containers that do not fail within a number of cycles that is 1 500 times the service life in years or Category B containers exceeding 22 000 cycles shall be destroyed.	Accept comment.
DE 079		18.03.2.3	Note	Te	The containers are specified to withstand a maximum temperature. If the fluid temperature rise above the ambient temperature it has to be limited to the specified max. temperature of the container	Change text to: It is acceptable for the pressurizing fluid to rise above the ambient temperature as long as the temperature of the test chamber and the fluid do not exceed the maximum specified temperature of the container.	Accept comment
GB 080		18.03.2.3	Note:	te	A maximum temperature should be specified.	Add max. temperature	Accept See DE 79
CA 081		18.03.3.2.2		Te	Pendulum Impact Pre-Conditioning – The angle of the pyramid needs to be specified, otherwise the pyramid could be very pointed or very flat. Delete the specification that "…its distance from the axis of rotation of the pendulum shall be 1 m." This is because the length is a function of the angle (maximum height) of the pendulum when released. The 30J force is a function of the length of the connecting rod, the mass of the pendulum, and the angle (maximum height) applied on release.	Insert the requirement that the angle of the pyramidal faces shall be 45 degrees. Delete the 1 m requirement, as it is just one of the variables required to achieve 30J force.	Accept comment. See draft.
US 19 082		18.03.3.2.3	2	te	"Apply an amount of the test fluid to the glass wool sufficient to wet the pad evenly across its surface and through its thickness for the duration of the test, and sufficient to confirm that the concentration of the fluid is not changed significantly during the duration of the test." The methanol and nitrate fluids evaporate relatively quickly. It is not possible to ensure the pads are evenly wetted or the concentration has not changed for the duration of the test. It is better simply to state an amount of chemical to be applied at the start of the test.	Apply an amount of the test fluid to the glass wool sufficient to wet the pad evenly across its surface and through its thickness ~~for the duration of the test, and sufficient to confirm that the concentration of the fluid is not changed significantly during the duration of the test~~ *immediately prior to the start of pressure cycling*. Reapply the test fluid as needed to maintain pad saturation.	Accept comment.

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GB 083		18.03.3.2.3 Environmental fluids for exposure		te	It refers to "percent solution by volume". This is simpler expressed as an explicit ratio of units. For example "19 percent solution by volume" is simply "190 ml/l" or "190 mL/L". This is in line with modern practice and guidance within ISO and the SI authority relating to values where the numerator and denominator are the same quantity.	Replace "19 percent solution by volume" with "190 ml/l". Go through the draft and replace all values expressed as percent by volume with values expressed as ml/l.	Accept comment.
CA 084		18.03.3.2.4		te	The para requires pressure cycling followed by a minimum 24 hour pressure hold "…until the elapsed exposure time (pressure cycling and pressure hold) to the environmental fluids equals 48 hours." With a variable pressure cycle rate (albeit with a maximum pressurization rate specified), it's not reasonable for the standard to require the pressure cycling and pressure hold durations to total exactly 48 hours.	"…until the elapsed exposure time (pressure cycling and pressure hold) to the environmental fluids ~~equals~~ totals a minimum of 48 hours."	Accept comment
CA 085		18.03.3.2.4		ed	Same as comment for 18.3.7.2 "….shall be pressure cycled, 2 (± 1) MPa to at least 125 percent of nominal working pressure (±1 MPa)….". It can't be "at least 125 percent" if one is allowing +/- 1 MPa. Simply say "125 percent (+/- 1 MPa)"	"….shall be pressure cycled, 2 (± 1) MPa to ~~at least~~ 125 percent of nominal working pressure (±1 MPa)….".	Accept as above
CA 086		18.03.4.2	(b) and (e)	ed	Same as comment for 18.3.7.2 "….shall be pressure cycled, 2 (± 1) MPa to at least 125 percent of nominal working pressure (±1 MPa)….". It can't be "at least 125 percent" if one is allowing +/- 1 MPa. Simply say "125 percent (+/- 1 MPa)"	"….shall be pressure cycled, 2 (± 1) MPa to ~~at least~~ 125 percent of nominal working pressure (±1 MPa)….".	Accept as above
CA 087		18.03.5.2		te	Statement "…at pressures in excess of 150 percent of the nominal working pressure (±1 MPa) exceeds 350 kPa per second…" is awkward. No need for a tolerance on an absolute value. If the pressure exceeds 150 percent of nominal working pressure, the procedural requirements are triggered.	"…at pressures in excess of 150 percent of the nominal working pressure ~~(±1 MPa)~~ exceeds 350 kPa per second…"	Accept. *Change kPa to Mpa for consistency.*

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GB 088	3	18.03.6	2nd para.	te	To clarify what is required, a diagram should be added.	Add diagram of test arrangement.	Reject comment.
CA 089		18.03.6	Flaw tolerance test	Te	A useless test – it has never been shown to do anything to any container design that that I have tested over the last 20 years. The amount of damage is insignificant. If it is decided not to delete this test, then there is a need to better define the flaw dimensions - it provides the lengths of the flaws (25 mm and 200 mm), but where is this length measured? On the outside surface, or on the bottom of the cut between where the required depth begins and ends (i.e. ignoring the radius on the edge of the cut caused by the use of a cutting wheel)?	Delete. If not deleted, specify that the specified cut depth shall extend for the entire specified length of the flaw. Industry should develop a meaningful alternative test to address the reduction in laminate thickness.	Reject comment. UN GTR 13 task force to address this.
CA 090		18.03.6.2	(b) and (d)	ed	Same as comment for 18.3.7.2 "….shall be pressure cycled, 2 (± 1) MPa to at least 125 percent of nominal working pressure (±1 MPa)….". It can't be "at least 125 percent" if one is allowing +/- 1 MPa. Simply say "125 percent (+/- 1 MPa)"	"….shall be pressure cycled, 2 (± 1) MPa to ~~at least~~ 125 percent of nominal working pressure (±1 MPa)….".	Accept. See above.
GB 091	1	18.03.6.2	a)	te	The geometry of the flaws need to be defined more precisely. Comment previously accepted but change not implemented	Define the flaws more specifically. See ISO7866 Annex E as an example.	See above CA 089. Reference Craig's figure/diagram.
US 20 092		18.03.6.2	a) and c)	te	It provides the lengths of the flaws (25 mm and 200 mm), but where is this length measured? On the outside surface, or on the bottom of the cut between where the required depth begins and ends (i.e. ignoring the radius on the edge of the cut caused by the use of a cutting wheel)?	Use the bottom of the cut, because otherwise one could measure the surface as 200mm, but only, say, 10 mm of the length could be at the required depth.	See above CA 089.
US 21 093		18.03.7.2	b)	ed	"… shall be pressure cycled, 2 (± 1) MPa to at least 125 percent of nominal working pressure (±1 MPa) ….". It can't be "at least 125 percent" if one	"… shall be pressure cycled, 2 (± 1) MPa to ~~at least~~ 125 percent of nominal working pressure (±1 MPa) ...".	Accept – see above

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					is allowing +/- 1 MPa. Simply say "125 percent (+/- 1 MPa)'		
CA 094		18.03.7.2	Procedure b)	Ed	"….shall be pressure cycled, 2 (± 1) MPa to at least 125 percent of nominal working pressure (±1 MPa)….". It can't be "at least 125 percent" if one is allowing +/- 1 MPa. Simply say "125 percent (+/- 1 MPa)'	"….shall be pressure cycled, 2 (± 1) MPa to ~~at least~~ 125 percent of nominal working pressure (±1 MPa)….".	Accept – see above.
DE 095		18.03.8		Te	For what reason is the permissible ambient temperature range restricted between -7°C and +43°C?	Please delete the following sentence: Testing shall be conducted with ambient temperatures between -7°C and 43°C.	Accept comment.
GB 096		18.03.8.2.1	1st para.	te	Understand that the container is qualified with a particular PRD and this needs to be made clear in the text	Incorporate text stating that the container is qualified with a particular PRD	Reject. Text indicates "… complete with the PRD specified in the design..."
GB 097		18.03.8.2.1	2nd para.	te	The dangers associated with using hydrogen in the fire test need to be emphasised and highlighted.	Add further **WARNING**, bold text etc.	Reject comment. Already present in text with words Extreme Caution.
US 22 098		18.03.8.2.2	3	ed/te	The meaning of "pressure compensated for ambient test temperature" is not clear. Does this mean that the contained mass in the tank should be correct? Or that the tank should be at a given pressure?	"Containers shall be pressurized with hydrogen to nominal working pressure (±1 MPa), pressure compensated for ambient test temperatures, <u>such that the proper mass of gas is contained,</u> and placed…"	Accept comment.
CA 099		18.03.9.2		te	Tolerance required for temperature, unless we agree the temperature is a nominal value. Suggestion is for this to be a limit, i.e. a minimum of 85C.	"…while at a minimum temperature of 85C."	Accept comment. Add tolerance of +5 / -0 C. Tolerance has been addressed at beginning of document.
GB 100		18.04	2nd 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 comment because it is impossible to define every minor change that could be made to a container.

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							Change “Inspector or test agency” to “authorized inspection body.”
CA 101		18.04	Table 6	te	Permeation test should be required for a boss material/geometry change subject to Note 10.	“X (10)” in Permeation test and Boss Material or Geometry box	Accept comment. Add asterisk to indicate geometry only.
GB 102		18.06		te	For clarity, the requirements should be combined with those of 18.4.	Move to 18.4	Reject comment. It is clearer to maintain separate sections.
US 28 103		18.06.2	2	te	Regarding the “note”, investigation shows the added nickel delays the transition from austenite (face centered cubic) to another crystalline structure. However, this occurs at a strain significantly above the working strain in a container. Evidence has not been presented that high nickel content significantly affects results at the working strain compared with lower nickel alloys. Therefore, while >12% nickel is acceptable, that high a level is unnecessary.	Revise 2nd paragraph by removing reference to 12% nickel: “Stainless steels SUS316L, AISI316L and AISI316 having ~~>12 percent nickel composition and~~ <0.1 percent magnetic phases by volume are suitable for hydrogen service.”	Accept comment. Material specs are elsewhere in the document. Delete ~~Stainless steels SUS316L, AISI316L and AISI316 having >12 percent nickel composition and <0.1 percent magnetic phases by volume are suitable for hydrogen service.~~ ~~NOTE Further investigation is required to confirm the need to retain the >12% nickel composition requirement.~~
US 29 104		18.06.3	2	Ed	There is only one “alloy” cited, the differences are the heat treat.	Change to one of the following: “A suitable aluminium alloy for hydrogen service is AA6061.” “A suitable aluminium alloy for hydrogen service is AA6061 in the T6, T62, T651 or T6511 heat treats.”	Accept comment. “A suitable aluminium alloy for hydrogen service is AA6061 in the T6, T62, T651 or T6511 heat treats.”

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FR 4 105		All doc		ed	Some tables do not have a title		Accept comment. Confirm tables are labelled.
FR 6 106		All doc		te	Are we sure that all requirements are not in contradiction with the regulation regarding vehicle fuel containers?		Yes. The document is harmonized with UN GTR 13.
GB 107		Annex A		te	It is not ideal for an ISO standard to quote CGA Pamphlets, replace with ISO standards where possible to do so	Option to Remove Annex A and update 5.1.4 and 10.4	See above
US 30 108		D.1.09	1	Te	The accelerated stress rupture test was originally developed to screen for a condition that was resulting in laminate failures in the field. However, this failure was noted as being related to manufacturing stresses, more likely shear stresses than stress ratio issues. A single test of this nature does NOT give meaningful confidence that stress rupture issues are addressed. Analysis can confirm that stress ratios are met. Stress ratios are set to give high reliability under sustained load based on studies of long-term testing with a large number of test specimens.	Reconsider the content of this paragraph.	Agree in principle, however the purpose of the test is a final check that the stress ratio / design calculations are correct, and that manufacturing issues are also addressed. The entire standard consists of single tests that are used to determine suitability and fitness for service.
US 31 109		D.1.14			The statement “because the plastic liner does not carry any of the wall stress, thus these designs are inherently leak before break” is not correct. It is correct that failure of the liner will cause a leak, and will not result in rupture. It is also correct that the fatigue life of the reinforcing fibers is significantly greater than the required life of the container, and therefore leak before break is not an issue.	Reword the last sentence: “This test does not apply to Type 4 designs because a failure of the plastic liner, which is non-loadsharing, will not result in rupture of the container, and because the fatigue life of the reinforcing fibers is significantly greater than the required life of the container.”	Accept comment.
US 32 110		D.3		te	If U.S. comment to 4.1.2 is accepted, this language must be revised. Incorporate information from D.5 and delete D.5.	Revise as follows: Category A containers are containers that are intended to be used hydrogen fuelled vehicle	Reject comment. US comment to 4.1.2 was rejected.

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						applications that are outside the scope of Category B. For heavy duty applications, the 750 cycles per year is based on the extreme condition of assuming 2 empty-to-full fuelings per day for continual full-day service. Transit authorities have required up to 25 years of life x 750 cycles = 18 750 cycles total. The robustness of this specification is assured by recognition that 18 750 cycles x 320 km (200 mi) /fueling cycle exceeds 6 million km (3.5 million mi) driven. For hydrogen powered industrial trucks, the 1 095 cycles per year is based on the extreme condition of assuming 3 empty-to-full fuelings per day for continual full-day service, which is a very realistic possibility for industrial truck applications.	
US 33 111		D.4		te	If U.S. comment to 4.1.2 is accepted, this language must be revised.	Category B containers are containers that are intended to be consistent with the UN GTR No. 13 for hydrogen fueled vehicles. Pressure cycles are greater than or equal to 5 500 and less than or equal to 11 000.	Reject comment. US comment to 4.1.2 was rejected.
US 34 112		D.5		te	An informative explanation of why it is necessary to conduct non-linear structural analysis of Type 2 and Type 3 containers would be helpful.	Rewrite D.5 to read: D.5, Design considerations for Type 2 and Type 3 containers Analysis of Type 4 cylinders is relatively straightforward because the composite stresses are linear with pressure. Analysis of Type 2 and Type 3 cylinders is more complicated because of non-linear behavior of the metal liner, specifically as it is subjected to autofrettage pressure. It is critical that stress ratio requirements are met to ensure high reliability in regards to stress rupture (see ISO/TR 13086-1 for additional information). Stress ratios are not an issue with Type 1 containers, as they do not have composite reinforcement. A thick liner, in combination with a high autofrettage pressure, can result in sufficient pre-stress on the composite such that the fiber is loaded in excess of the allowed stress ratio (see ISO/DTR 13086-3 [under development] for additional information).	Accept comment. Added as NOTE under Clause 7.3.1 D.5, Design considerations for Type 2 and Type 3 containers Analysis of Type 4 cylinders is relatively straightforward because the composite stresses are linear with pressure. Analysis of Type 2 and Type 3 cylinders is more complicated because of non-linear behavior of the metal liner, specifically as it is subjected to autofrettage pressure. It is critical that stress ratio requirements are met to ensure high reliability in regards to stress rupture (see ISO/TR 13086-1 for

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						Type 2 designs are not likely to experience an excessive pre-stress condition if the liner burst pressure does not exceed 150 % of nominal container working pressure, and the autofrettage pressure does not exceed 165 % of the nominal working pressure. Type 3 designs are not likely to experience an excessive pre-stress condition if the liner burst pressure does not exceed 30 % of nominal container working pressure, and the autofrettage pressure does not exceed 165 % of the nominal working pressure. It is important to accurately calculate stresses in order to ensure stress ratio requirements are met, particularly when the liner thickness or autofrettage pressure exceed the values noted above.	additional information). Stress ratios are not an issue with Type 1 containers, as they do not have composite reinforcement. A thick liner, in combination with a high autofrettage pressure, can result in sufficient pre-stress on the composite such that the fiber is loaded in excess of the allowed stress ratio (see ISO/DTR 13086-3 ~~[under development]~~ for additional information). Type 2 designs are not likely to experience an excessive pre-stress condition if the liner burst pressure does not exceed 150 % of nominal container working pressure, and the autofrettage pressure does not exceed 165 % of the nominal working pressure. Type 3 designs are not likely to experience an excessive pre-stress condition if the liner burst pressure does not exceed 30 % of nominal container working pressure, and the autofrettage pressure does not exceed 165 % of the nominal working pressure. It is important to accurately calculate stresses in order to ensure stress ratio requirements are met, particularly when the liner thickness or autofrettage

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							pressure exceed the values noted above.
CN	35 15	3.5 4.1.2		ge	Definition of the Category B containers in Clause 3.5 is inconsistent with that in clause 4.1.2. UN GTR No. 13 is not limited to Type4 cylinders. And, Type4 cylinders are not limited to designs of 70 MPa. In China, Type3 cylinders are widely manufactured and used.	We recommend that **Clause 3.5** and **Clause 4.1.2** be changed as below. **3.5 Container category** "Category B containers are Type3 and Type 4 containers that are intended to be further qualified in accordance with the UN GTR No. 13 for fuel cell vehicles with a gross vehicle mass of 4 536 kg or less. " **4.1.2Category** Category B containers are Type3 and Type 4 designs of 70 MPa nominal working pressure and are intended to be further qualified in accordance with the UN GTR No. 13 for fuel cell vehicles with a gross vehicle mass of 4 536 kg or less.	Reject comment. The coverage for Type 3 tanks in the GTR is not sufficient from the perspective of long term stress rupture performance of composite fibers. Once the GTR document either specifies fiber stress ratios or includes a long-term stress rupture test, WG 18 will revise this document to include Type 3 tanks into Category B. GTR 13 IWG established a task force to address this issue.

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CN	4	18.3.4.2	The 1st paragraph	te	Number of extreme temperature cycling test is not calculated according to the design life of the container, because the service life could be a minimum of 10 years and a maximum of 25 years for category A and category C. For example, If a container of category A is designed for service life 10 years, its total number of ambient cycling test will be 7500 cycles. But, its number of extreme temperature cycling test shall reach 4000+4000=8000 cycles. In this case, the number of extreme temperature cycling test is more than the total number of ambient cycling test, which obviously, it is not rational.	Number of extreme temperature cycling test shall be calculated in accordance with different design life of containers. For example, for a container with a service life of 15 years, its' total number of ambient cycling test shall be 11,250 cycles for category A and 16875 cycles for category C. By calculation, it could be changed as below: **18.3.4.2 Procedure** The extreme temperature cycle test shall be performed in accordance with the following procedure: a) Stabilize the container at 85°C degrees or higher. b) Hydraulically pressure cycle between 2 (± 1) MPa and at least 125 percent of nominal working pressure (±1 MPa) for 36 percent of total ambient cycles for Category A containers and 27 percent of total ambient cycles for Category C containers. The temperature limits specified in (a) shall be met on the container surface and in the working fluid in the container throughout the cycling. c) Stabilize the container at ambient conditions. d) Stabilize the container at −40°C degrees or lower. e) Hydraulically pressure cycle between 2 (± 1) MPa and at least 80 percent of nominal working pressure (±1 MPa) for 36 percent of total ambient cycles for Category A containers and 27 percent of total ambient cycles for Category C containers. The temperature limits specified	Reject comment. The container does not spend its entire service life at the 2 temperature extremes, therefore it is not necessary to match the pressure cycling requirements to service life for this test.

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MB/ NC[1]	Line number	Clause/ Subclause	Paragraph/ Figure/Table	Type of comment[2]	Comments	Proposed change	Observations of the secretariat
						in (d) shall be met on the container surface and in the working fluid in the container throughout the cycling.	
CN	36	18.3.5.3	The 2nd paragraph	ed	Clause 8.1, Clause 8.3.2 and Clause 8.3.1	The clause No. should be: Clause 7.1, Clause 7.3.2 and Clause 7.3.1	Accept comment. Will check and confirm references.
CN	11	18.3.8.2.3	The 1st paragraph	te	The fire source is not limited to LPG burners. We proposed to increase CNG and kerosene and other fuels.	Our suggest is as below: **18.3.8.2.3 Fire source** The fire source shall consist of LPG,CNG, kerosene and other fuel burners …….	Reject comment. Need one fuel source to have consistent basis across labs. LPG offers superior flame control to meet the flame requirements of the test.
CN	37	18.3.13.2	The 2nd paragraph	ed	Clause 5.4	The clause No. should be: Clause 4.4	Accept.
CN	12	18.5.3	The 2nd paragraph	ed	Clause 8.1, Clause 8.3.2 and Clause 8.3.1	Clause 7.1, Clause 7.3.2 and Clause 7.3.1	Accept. Will confirm references.

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D:\ISO\data\prod_iso_comment-collation\work\temp\ISO_DIS 19881_ANSI.doc: Collation successful

D:\ISO\data\prod_iso_comment-collation\work\temp\ISO_DIS 19881_BSI.doc: Collation successful

D:\ISO\data\prod_iso_comment-collation\work\temp\ISO_DIS 19881_DIN.doc: Collation successful

D:\ISO\data\prod_iso_comment-collation\work\temp\ISO_DIS 19881_JISC.doc: Collation successful

D:\ISO\data\prod_iso_comment-collation\work\temp\ISO_DIS 19881_SCC.doc: Collation successful

Collation of files was successful. Number of collated files: 6

SELECTED (number of files): 6

1 **MB** = Member body / **NC** = National Committee (enter the ISO 3166 two-letter country code, e.g. CN for China; comments from the ISO/CS editing unit are identified by **)
2 **Type of comment:** **ge** = general **te** = technical **ed** = editorial

Template for comments and secretariat observations

Date:2017-09-22	Document: DIS 19881	Project: WG 18

MB/ NC[1]	Line number	Clause/ Subclause	Paragraph/ Figure/Table	Type of comment[2]	Comments	Proposed change	Observations of the secretariat

PASSED TEST (number of files): 6

FAILED TEST (number of files): 0

CCT - Version 4.0/2015

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