SGS 6 - 02

Draft proposal for GTR Hydrogen Vehicles - Chapter xx: Installation and Functional Requirements

(based on a proposal by TÜV SÜD Automotive, AM-UAA/Ortenburger, 11-Oct-2008, as revised by Mr. Rothe (GM), Mr. Bindl (TUEV Rheinland), Mrs. Ortenburger (TUEV SUED) on December, 05th)

The requirements are compiled from the following regulations:
ECE Draft Regulation TRANS WP29 GRPE 2004-03 (in the following ECE GH2)
ECE Draft Regulation TRANS WP29 GRPE 2003-14 (in the following ECE LH2)
Japanese Regulation Attachment 100 for Hydrogen and Fuel Cell Vehicles (in the following Japan 100)
OICA-proposal, Document SGS-3-05

Content:

2.5 Single failure conditions test

Drafting task force comments is in Red under the remarks

1.1 General

No.	Text	Source	Remarks from the SGS 5th meeting – Drafting task force comments	Japanese comments and Justification	US comments	OICA comments
1.1.1	The hydrogen system of a vehicle shall function in a safe and proper manner. It shall reliably withstand the chemical, electrical, mechanical and thermal service conditions	ECE GH2 4.2.1.1. ECE LH2 4.1.1	move to Chapter A of GTR proposal PART A	Japan agrees with the comment at left under "Remarks".	move to part A of GTR	Move to Chapter A of gtr proposal.
1.1.2	The number of hydrogen components, connections and the length of lines shall be kept to the minimum compatible with safety and the correct functioning of the hydrogen system.	ECE GH2 4.2.1.1.	Recommended to be deleted Delete	Japan agrees with the comment at left under "Remarks". Since being kept to the "minimum" cannot be demonstrated, we demand the deletion of this sentence.	Delete.	Delete.
1.1.3	The materials used in the hydrogen system shall be compatible with gaseous or liquid hydrogen.	ECE GH2 4.2.1.2. ECE LH2 4.1.3	move to Chapter A of GTR proposal *Part A*	Japan agrees with the comment at left under "Remarks".	Delete.	Move to Chapter A of gtr proposal.
1.1.4	The operating temperatures should be: - in the internal combustion engine compartment -40 ℃ to +120 ℃ - on board -40 ℃ to +85 ℃ - cryogenic temperatures if applicable - system temperatures as applicable	ECE LH2 4.1.7.	Temperatures Will be spe-cified under component requirements – recommended to be deleted here *DELETE* *The temperature range may be added for the storage system as required.*	Japan agrees with the comment at left under "Remarks".	Not needed. Recommended to be deleted. Temperatures will be Specified under component requirements as needed	Delete.

1.1.5	A hydrogen system shall fulfill at least the following functions: − refuelling − protection against overpressure; − excess flow protection − automatic shut-off − safety management − boil-off management for LH2	ECE LH2 4.2.1. and 4.2.2 ECE GH2 6.1.6	Definition for Hydrogen system required! move to Chapter A of GTR proposal and add justifications and editorial improvement *Consider in part A that the protection of the compressed H2 container against over-pressurisation is covered by the filling station!* *Definitions will be in part B*	Japan agrees with the comment at left under "Remarks". (It was agreed at SGS that the LH2 provisions would be discussed *after* basic agreement on the CH2 provisions is reached.)	Definition for Hydrogen system. move to part A of GTR proposal and include justifications / editorial improvement	Definition for hydrogen system requierd. Move to Chapter A of gtr proposal and add justification and editorial improvement. Consider in Part A that the protection of the container against over-pressurisation is covered by filling station.

1.2 Installation on board

No.	Text	Source	Re-marks	Japanese comments and Justification	US comments	OICA comments
1.2.1.	No component of the hydrogen system, including any protective materials that form part of such components, shall project beyond the outline of the vehicle or protective structure.	ECE GH2 4.1.5 ECE LH2 4.1.8.1 and 4.3.3	Definition for the outline of the vehicle has to be provided (e.g. EU-definition – to be provided by TÜV Rheinland) Exhaust pipes should not be part of the hydrogen system (to be considered in the definition) Requirement should	Delete. Since the designers of vehicle manufacturers take into account such accidents as contacting/colliding with pedestrians and driving over the curb, they would not position the hydrogen system in such a way that it would project	Recommended to move to part A of the GTR.	Delete, there is not such requirement for conventional vehicles.

			be reworded concerning the outline of the vehicle. Korea recommends moving this requirement to part A. *Part A – need to explain why this is not required in the part B of the GTR. Or how it would be covered by the system safety requirements.*	beyond the outline of the vehicle. Rather than focusing on the projection, we should draft the design requirements in terms of locating the system as close to the inside as possible so that safety can be ensured even in the event of such accident.		
1.2.2	No component of the hydrogen system shall be located near the exhaust of an internal combustion engine or other heat source, unless such components are adequately shielded against heat.	ECE GH2 4.1.7 ECE LH2 4.1.8.2	Definition is needed. Delete or put to part A unless this requirement . is changed to an objective r. *Protection of storage system from sunlight and heat.* *Need* *(1) justification for sunlight and heat protection* *(2) objective requirement* *(3) test procedure*	Japan 100 3-5-9 Gas containers, piping, etc. that may be affected significantly by the heat of the exhaust pipes, mufflers, etc., shall be protected by appropriate heat-insulating measures. Moreover, gas containers exposed to direct sunlight shall be provided with an adequate cover or other adequate sunshade. Refer to B-5 of Japan's Draft Proposal. The requirement for direct-sunlight protection in the vehicle is necessary, particularly because sunshine test is not included in the approval test procedures	Delete or put to part A of the GTR	To be discussed, how to demonstraite compliance? Sunlight protection could be considered.

				for gas containers.		
1.2.3	The hydrogen system shall be installed such that it is protected against damage under normal operating conditions.	ECE GH2 4.1.6	move to Chapter A of GTR proposal *Move to part A*	Japan 100 3-5-3 Gas containers and piping, etc. shall be securely installed so as to prevent shifting or damage while traveling, and sections thereof that is liable to damage shall be protected by covering. Refer to B-5 of Japan's Draft Proposal.	move to Chapter A of GTR proposal	To be discussed, how to demonstraite compliance?
1.2.4	A container or container assembly shall not be installed in the internal combustion engine compartment.	ECE GH2 4.2.1	Design restrictive: should be deleted – there are enough covering requirements to make the system safe In Japanese regulations there are no cor-respond-ding require-ments Alternative comment: leave it as a guidance (eventually in Part A) *DELETE (to be discussed in section 1.5)*	Delete. We may develop standards on hydrogen motorcycles in the future, and this provision may lead to problems.	Design restrictive. Need justification. Recommended for part A of the GTR.	Delete.

1.3 Shut Off, Regulating and Non Return Devices

No.	Text	Source	Remarks	Japanese comments and Justification	US comments	OICA comments
1.3.1	The flow of hydrogen from a container or container assembly into the fuel supply line except the boil-off management system shall be secured with an automatic shut off device (normally closed). This device shall be mounted directly on or within either every container or one container in a container assembly.	ECE GH2 4.4.1. ECE LH2 4.4.1.1	In-Tank regulator must be considered by additional requirement (regarding overpressurisation of downstream parts) Definition for container assembly is needed ***Issue: Japan requires one main shut-off valve per container; others allow one main shut-off valve per storage system (multiple containers)*** ***Japan will bring forth a risk assessment for Japan's proposal 100 3-1-1 and the above issue.***	Japan agrees with the comment at left under "Remarks". Japan 100 2-10 "Container attachments" mean a main shut off valve, a container check valve (=container non-return valve) and a container safety valve (= pressure relief device). Japan 100 3-1-1 Container attachments shall be attached directly to each gas container. Refer to A-2 of Japan's Draft Proposal for the justification.	This can be addressed by setting definition for the H2 storage system. The hydrogen storage system should be defined to include all tanks and components that form the pressure boundary of the stored hydrogen. The shut-off valve is (by definition) part of the storage system.	To be discussed: Safety purpose is already addressed 1.5.1, See left or use Japan 100,3-1-1.
1.3.2	A container check valve shall be capable of preventing reverse flow at pressures ranging from the general-use pressure to the minimum pressure that is normally used.	Japan 100 3–1–3	Japan is asked for explanation. *A storage system shall be capable of preventing reverse flow on the fill line.*	Since this provision just describes the normal function of a check valve, it may be moved to the Definition section.	Need explanation. However, fill check valve is a required part of the storage system if it forms part of the primary pressure boundary.	OICA : delete here. could be part of definition section

1.3.3	An excess flow system for the fuel line and the filling line shall be part of the hydrogen system	ECE GH2 4.1.16. Japan 100 3-2-1	excess flow system must be defined Excess flow system only covers big H2-releases, only limits the flow (not necessarily shut off function). Is it sufficient to have a H2-sensor which gives the signal to shut off the cylinder (might be slower than other excess flow device) Check valve on the filling line is recommended. (is state of the art) *Delete: Explain that this issue is being addressed by 1.5.1 in part A.*	Refer to A-3 of Japan's Draft Proposal for the justification.	Not needed. The H2 leakage detection system is already covered.	To be discussed: Worst case releases Is covered by 1.5.1
1.3.4	In the filling line a check valve shall be provided near the container.		Result of discussion concerning excess flow device (1.3.3) (Testing of the check valve is covered by requirements of the storage system) *Delete; covered by 1.3.2*	Delete this paragraph. The details, including the relation with the receptacle, are specified in 1.9.2. There is also an inconsistency in the content between this paragraph and 1.9.2. Therefore this paragraph should be deleted. Refer to A-2 of Japan's	Not needed in regulation.	OICA : delete here. may be combined with 1.3.1

				Draft Proposal for the justification.		

1.4 Overpressure Protection (more discussion and justification/data on the subject of overpressure protection of the low pressure section requested)

No.	Text	Source	Remarks	Japanese comments and Justification	US comments	OICA comments
1.4.1	The hydrogen system downstream of a pressure reducer shall be protected against overpressure due to the possible failure of the pressure regulator. The set pressure of the overpressure protection device shall be lower than or equal to the maximum allowable working pressure for the appropriate section of the hydrogen system.	ECE GH2 4.1.18 Japan 100 3-4-1	US: this is covered by leak measurements (OICA) TÜV: does not cover preventing philosophy or mechanical damage by escaping parts US: How could this requirement be tested in case of self certification at a whole vehicle level? *TUV and Germany to provide a justification and safety hazard due to burst.*	Refer to B-2 of Japan's Draft Proposal for the justification.	This is covered by leakage detection provision (OICA). Besides, the system downstream of the hydrogen storage system does not have to be regulated (other than for hydrogen leak detection). The volume is very small and the energy associated with burst is far less than in the storage system.	OICA : delete here. Mid & low pressure sections are not burst Hazard if volumes do not exceed 1liter or volume / pressure does not exceed 25bar liter, see EU PED.
1.4.2	The vent of the overpressure protection device shall be protected against blockage, e.g. by dirt, ice, and ingress of water etc., so far as is reasonably practicable.	ECE GH2 4.6.4	o.k, see OICA proposal, not part of the Japanese Regulation, applicable to the high pressure vent line, justification material will be provided by SAE, OICA to provide a proposal for the requirement and the test	Delete. Because it is a matter-of-course that the overpressure protection device should function without failures throughout the vehicle's life cycle, it is not necessary to specify such details like this paragraph.	Recommended for part A of the GTR. Or may combine with OICA's PRD requirements	Delete, could be covered by 1.4.9

			Delete *Covered by 1.4.9*			
1.4.3	It must be ensured so far as is reasonably practicable that the overpressure protection device and the associated vent line remain capable of functioning.	ECE LH2 4.4.2.2	Revised, ok OICA to provide information from BMW *(defer for later discussion on LH2)*	(It was agreed at SGS that the LH2 provisions would be discussed *after* basic agreement on the CH2 provisions is reached.)	Recommended for part A of the GTR.	LH2 will covered later.
1.4.4	It shall not be possible to isolate the overpressure protection device and pressure relief device from the hydrogen components or section of the hydrogen system that it protects.	ECE GH2 4.6.2	o.k.,revised applicable to high pressure and LH2 storage *This issue can be addressed by the container's bon-fire test. (set all manual lock valve(s) to close position)* *Check with BMW for LH2.*	Explanation needed as to why this paragraph is necessary. Is the compliance with this standard checked in design drawings, or is it checked by disassembling the vehicle after crash test? Clarification needed on how to demonstrate the compliance.	Recommended for part A of the GTR.	To be discussed, how to demonstraite compliance?
1.4.5	A pressure relief device shall be provided and installed into the opening of a container or at least one container in a container assembly, or into an opening in a valve assembled into the container, ~~in such a manner that it shall discharge the hydrogen into an atmospheric outlet that vents to the outside of the vehicle.~~	ECE GH2 4.5.1	Revised, TPRD, PPRD ,to be considered in container requirements Modified the language *Delete – This issue is being addressed by the storage system's bonfire test. Provide explanation in Part A.*	Japan 100 2-10 "Container attachments" mean a main shut off valve, a container check valve (=container non-return valve) and a container safety valve (= pressure relief device). Japan 100 3-1-1	Recommended for part A of the GTR.	OICA : delete here. Performance covered by bonfife test.

			Japan will provide a risk assessment to justify all three following components for each container: main shut off valve, a container check valve (=container non-return valve) and a container safety valve (= pressure relief device). *Container assembly = Storage system*	Container attachments shall be attached directly to each gas container. The term "container assembly" does not exist in the Japanese standards. "Container assembly" is being discussed more as the concept here. We need further studies, especially since no specific procedures have been determined for bonfire test yet. We need to revisit this paragraph later and discuss it based on the study results.		
1.4.6	The internal dimensions of the vent shall not impede the function of the pressure relief device.	ECE GH2 4.5.4	o.k *Delete – this will be covered by the bonfire test in the hydrogen storage section* *Consideration will be made for container or storage system for bon-fire test*	Japan agrees with the comment at left under "Remarks". Careful discussion is necessary since the test procedures have yet to be decided for bonfire test that involves a "container assembly", which does not exist in the Japanese standards.	Recommended for part A of the GTR. The functionality (dimensions) of the vent will be confirmed in the bonfire/ localized fire test.	OICA : delete here. Performance covered by bonfife test.

1.4.7	The vent of the pressure relief device shall be protected against blockage, e.g. by dirt, ice, and ingress of water etc., so far as is reasonably practicable.	ECE GH2 4.5.5	See 1.4.2 OICA to provide a proposal for the requirement and the test *Delete – covered by 1.4.9*	Delete. Because the pressure relief device is essentially required to function without failures throughout the vehicle's life cycle, it is not necessary to specify such details like this paragraph. In every vehicle, the vent of the pressure relief device is equipped with a rubber or plastic cap at the tip so that it is protected against blockage by dirt, ice, and ingress of water.	Same as 1.4.2 Recommended for part A of the GTR. Or may combine with OICA's PRD requirements	Delete, could be covered by 1.4.9
1.4.8	In case the pressure relief device of a LH2-container is a burst disc and is installed within the inner tank, an appropriate exhaust vent in the outer jacket is required.	ECE LH2 4.4.2.1	Container requirements *Check with BMW for LH2.*	(It was agreed at SGS that the LH2 provisions would be discussed *after* basic agreement on the CH2 provisions is reached.)	Container requirements Delete here	LH2 will covered later.
1.4.9	The hydrogen gas discharge from pressure relief devices at the gas container or upstream of the first pressure regulator located downstream of the gas container of CGH2 systems shall not be directed • into or towards the vehicle passenger or luggage compartments	OICA-proposal	o.k. NHTSA will provide objective requirement, *Add this sentence:* *"The hydrogen discharge outlet shall be protected against blockage,e.g. by cap"*	Japan agrees with the comment at left under "Remarks".	o.k. NHTSA will provide objective requirement,	O.K. See add proposed sentence :"The hydrogen discharge outlet shall be protected against blockage,e.g. by cap.

	• into or towards any vehicle wheel housing • towards hydrogen gas containers • forward from the vehicle, or horizontally from the back or sides of the vehicle The hydrogen gas discharge from other pressure relief systems shall not be directed • towards exposed electrical terminals, exposed electrical switches or other ignition sources • into or towards the vehicle passenger or luggage compartments • into or towards any vehicle wheel housing • towards hydrogen gas containers					

1.5 Leakages and Releases

No.	Text	Source	Remarks	Japanese comments and Justification	US comments	OICA comments
1.5.1	If a single failure downstream of the main hydrogen shut off valve results in a hydrogen concentration in air greater than 4% by volume within enclosed or semi enclosed volumes on the vehicle, the main hydrogen shutoff valve(s) shall close. Any single failure downstream of	OICA-Proposal 3	o.k. *Need to address warning for failure upstream* *[If a single failure of the hydrogen system results in a hydrogen*	Japan agrees with the comment at left under "Remarks".	o.k. Already in the draft GTR	O.K. Alternative requirement to 1.5.3

	the main hydrogen shut off valve shall not result in a hydrogen concentration in air greater than 4% by volume in the passenger compartment.		*concentration in air greater than 4% by volume within the passenger compartment, luggage compartment, and spaces within the vehicle that contain unprotected ignition sources, the main hydrogen shutoff valve(s) shall close and provide warning.* *The enclosed spaces that contain the storage system shall not contain unprotected ignition sources. All spaces containing the hydrogen storage system shall vent to the outside of the vehicle]* *Need definitions for "unprotected ignition source"* *Rationale: The modification was made to cover leaks upstream of the hydrogen system shut-off valve.* *And to allow gas tight housing for container*			

			system.			
1.5.2	Hydrogen releases from the vehicle exhaust system e.g. purge shall be limited locally at the point of discharge throughout normal operation including start-up and shutdown to less than 4% average concentration of hydrogen in air by volume in any moving 3 seconds time interval.	OICA-Proposal 4	*o.k*	For the justification, read Japan's answer in Action Item No. 21 for the 5th SGS Meeting.	o.k Already in the draft GTR	O.K.
	Alternatively separate provisions shall be made to show concrete rationales and justifications that it is not hazardous at all to exceed instantaneously over 4% concentration of hydrogen.		*Delete*	Delete. The criterion "not hazardous at all to exceed instantaneously over 4% concentration" is vague, and it does not mention how to demonstrate the compliance with that criterion. In other words, this paragraph cannot be called a technical standard.		Discussion needed for the 2nd sentence, as the criterion is vague, there is the tendency to delete this.
1.5.3	If potentially hazardous conditions within enclosed or semi enclosed volumes on the vehicle resulting from a single failure cannot be minimized as described above, all non-welded connections of hydrogen-carrying components and the hydrogen components which can leak, and that are mounted within the passenger or luggage compartment, shall be	ECE LH2 4.4.3.1 Japan 100 3-5-2 OICA-proposal	o.k. *Delete – addressed in 1.5.1 remarks*	Japan agrees with the comment at left under "Remarks". Refer to B-3 of Japan's Draft Proposal for the justification.	o.k. Already in the draft GTR	O.K. Alternaitiv requirement to 1.5.1

	enclosed by a gas tight housing .					
1.5.4	The gas tight housing shall be vented to the atmosphere as follows: Not emitting directly into the passenger compartment or luggage compartment; Not emitting toward the tyre housing; and Not emitting toward the exposed electrical terminals, electrical switches or other ignition sources	ECE GH2 4.10.1 Japan 100 3–5–2–2 3-5-2-2-1 to 3	o.k. *Delete – addressed in 1.5.1 remarks*	Japan agrees with the comment at left under "Remarks". Refer to B-3 of Japan's Draft Proposal for the justification.	o.k. Already in the draft GTR	O.K. could be covered by 1.4.9
1.5.5	Any connecting system shall be secured to the gas tight housing or sleeve and the lead-through. to ensure that a joint is bubble free for 3 minutes during leak test at 0.01 MPa with air.	ECE GH2 4.10.5 ECE LH2 4.4.3.7 and 4.4.3.6.	Revised Move to Test requirements *Delete*	Clear explanation needed as to the definition of "connecting system" and the relation between the "connecting system" and the "gas tight housing or sleeve and the lead-through". Japan will comment after the explanation is given.	How to perform compliance test without modification of vehicle/components? Need justification for the requirements and the test's 3 min & 0.01 Mpa limits.	To be discussed, improve language if kept, may be moved to test section.
1.5.6	There shall be no unprotected ignition sources inside the gas tight housing.	ECE GH2 4.10.3 ECE LH2 4.4.3.4.	o.k. *Delete – addressed in 1.5.1*	Japan agrees with the comment at left under "Remarks".	Recommended for part A of the GTR.	O.K.
1.5.7	Any connecting system and lead-through in the body of the vehicle for ventilation of the gas tight housing shall have at least the same cross sectional area as the tube of the pressure relief device if it vents into the gas-tight housing	ECE LH2 4.4.3.5.	Revised. O.k *Delete – addressed in 1.5.1*	(It was agreed at SGS that the LH2 provisions would be discussed *after* basic agreement on the CH2 provisions is reached.)	Recommended for part A of the GTR.	Delete here, LH2 will covered later.

1.6 Fuel Lines and Fittings US comments :Subjective and therefore not suitable for self-certification

No.	Text	Source	Remarks	Japanese comments and Justification	US comments	OICA comments
1.6.1	Rigid fuel lines shall be secured such that they shall not be subjected to critical vibration or other stresses, e.g. they shall be supported at an interval of 1 m or less..	ECE GH2 4.7.1, Japan 100 3–5–8	Performance requirement with design example *Delete 1.6.1 to 1.6.5* *Justification for not accepting the Japanese requirement shall be provided in part A.* *Also, recommended practices can be mentioned as part of the write-up*.	Refer to C-3 of Japan's Draft Proposal for the justification. The following is a quote from the standards for vehicles fueld by high-pressure gas: Japan 100 3-5-8 Gas piping with both ends secured shall have an appropriate bend at its midpoint, and shall be supported at an interval of 1 m or less.	Design restrictive. Need justification to show why this req. is needed for H2 vehicles and not conv. gasoline vehicles. Recommended for part A of the GTR.	To be discussed, more technical information required To be discussed, not agreed among OICA members
1.6.3	Flexible fuel lines shall be secured such that they shall not be subjected to torsional stresses and abrasion is avoided.	ECE GH2 4.7.2	To be tested by visual inspection see 2.1	Further discussions are necessary on the safety of flexible hoses. This paragraph should be revisited after the safety issue is well discussed.	See 1.6.1	
1.6.4	At fixing points, rigid fuel lines and flexible fuel lines shall be fitted in such a way that galvanic and crevice corrosion are prevented,.	ECE GH2 4.7.4	To be tested by visual inspection see 2.1	Japan supports the proposed requirement, except for the part on flexible hoses. Japan 3-5-7 Metal parts of the supporting fixtures for	See 1.6.1	To be discussed, not agreed among OICA members

				the piping shall not be in direct contact with the piping. However, this provision shall not apply to cases where the piping is soldered or welded to the supporting fixtures.		
1.6.5	At passages through the vehicle body or other hydrogen components, the fuel lines shall be fitted such that they shall not be subjected abrasion e.g. by grommets or other protective material.	ECE GH2 4.7.6		Delete. Protection by grommets, etc. is generally performed, not just for the fuel lines. It is therefore unnecessary to specify such details here.	See 1.6.1	Delete

1.7 Safety Instrumented System and Electrical Installation

No.	Text	Source	Remarks	Japanese comments and Justification	US comments	OICA comments
1.7.1	Safety instrumented systems shall be fail-safe, redundant or self-monitoring. Definition: “Safety instrumented systems” are process control systems that prevent animpermissible fault range from being reached by an automatic intervention in the process.	ECE LH2 4.4.1 ECE GH2 4.12.1 ECE LH2, 2.37	Definition must be amended *Requirements for: Detection system; Refuelling system* *Set requirements for self monitoring, warning, fail-safe and functional.*	This should be placed in the Definition section. However, the necessity of this paragraph as a technical standard needs to be discussed. Justification that without this paragraph the safety would be compromised should exist. The paragraph also needs to mention	Need explanation.	To be discussed, demonstration of compliance is unclear, what is the justification for that? Definition is missing, otherwise should be deleted.

				how to demonstrate the compliance at the time of approval. Lacking both of the above, this paragraph cannot be called a technical standard.		
1.7.3	The metallic components of the hydrogen system shall have electrical continuity with the vehicles´s earth	ECE GH2 4.11.2 ECE LH2 4.8.3	*Delete – recommended practice; exists in industry standards.*	It is not appropriate to require this uniformly.	Recommended for part A of the GTR. Should wait for input from ELSA.	Delete.
1.7.4	During the refilling process the hydrogen system shall have the means to provide electrical coninuity with the refilling facilities before hydrogen transfer is permitted.	ECE GH2 4.11.3	*Delete –* *Japan will provide test data for justification in part A.*	Delete. The provision on electrical earthing exists for the refilling facilities. On the other hand, the receptacle has electrical continuity with the vehicle body which is earthed into the ground through its tires. This means there is no difference in potential between refilling facilities and vehicle, and therefore this paragraph is unnecessary.	OK. Should wait for input from ELSA.	To be discussed.
1.7.5		ECE GH2 4.11.4	See 1.7.6			See 1.7.6
1.7.6	There shall be no unprotected ignition sources inside the gas tight housing or inside the refilling hatch	ECE LH2 4.4.3.4 Japan 100-3-6-2-3	*Delete – see 1.5.1*	Japan supports the TUV draft. Refer to C-1 of Japan's	This is recommended design practice. Put in part A.	To be discussed. How is conliance demonstrated, Partly covered by 1.5.6.

				Draft Proposal for the justification.		

1.8 Removable Storage System US comments : Alliance member companies do not foresee using removable hydrogen storage systems

No.	Text	Source	Remarks	Japanese comments and Justification	US comments	
1.8.1	A removable storage system may be removed from the vehicle for refilling. The container(s) or container assembly and the hydrogen components forming the removable storage system shall be permanently installed within the removable storage system.	ECE GH2 4.2.2	*Delete: 1.8.1.thru 1.8.13 - Removable Storage System shall fulfill the storage system requirements. Currently, not enough data to justify additional requirements.* *OICA will check with PSA.*	Under the Japanese standards, removal of the system from the vehicle is prohibited unless it is required for testing or maintenance. It is not possible to remove the system for refilling. Japan 3–5–1 Gas containers, piping, etc. shall not be such one that is removed for filling the hydrogen gas.	Has this design/concept been validated for 10,000 PSI containers? US automakers do not foresee using removable H2 storage system. There is no real world data/experience on removable storage system for H2. We suggest addressing this later when data and experience/practices are available.	No agreement in OICA about general use of RSS.
1.8.2	The components of a hydrogen system within a removable storage system shall fulfil all the requirements of this Regulation as if it were permanently installed in the vehicle unless otherwise stated below.	ECE GH2 4.3.1		Same as above.		
1.8.3	A removable storage system shall protect the container(s) or container assembly and hydrogen components forming the removable storage system from	ECE GH2 4.3.2		Same as above.		

	damage during the handling operations necessary for installation, removal, storage and handling.					
1.8.4	Effective measures shall be taken to prevent unauthorised removal of the removable storage system.	ECE GH2 4.3.3		Same as above.		
1.8.5	A single interface for the flow of hydrogen shall be provided between the removable storage system and the part of the hydrogen system permanently installed in the vehicle. The nominal working pressure of the hydrogen system at the interface shall be less than or equal to 3.0 MPa.	ECE GH2 4.3.4		Same as above.		
1.8.6	At the time of disconnection of the removable storage system, the volume of hydrogen released shall not exceed 200 Ncm3 and shall not be released near a possible ignition source. The build up of hydrogen due to successive disconnections shall be prevented.	ECE GH2 4.3.6	To be discussed!	Same as above.		
1.8.7	The part of the removable storage system connector permanently fitted to the vehicle shall be of a unique design for the applicable vehicle type and shall not be compatible with standard refilling nozzles for either hydrogen or other gaseous fuels.	ECE GH2 4.3.7		Same as above.		
1.8.8	The flow of hydrogen from a removable storage system shall be prevented if a removable storage system is installed with a higher maximum allowable working pressure than that of the	ECE GH2 4.3.8		Same as above.		

	permanent part of the vehicle's hydrogen system.					
1.8.9	Opening of the automatic valve(s) mounted on a container(s) or a container assembly shall not be possible when the removable storage system is not correctly connected to the permanently fixed section of the vehicle's hydrogen system. A vehicle interface system shall verify that a correct connection between the removable container system and the vehicle is established before permitting the automatic valve(s) to open. The vehicle interface system shall also verify that the removable storage system is compatible with the vehicle's hydrogen system before permitting the automatic valve(s) to open.	ECE GH2 4.3.9		Same as above.		
1.8.10	Disconnection or removal of the removable storage system shall not be possible unless the automatic valve mounted on a container(s) or a container assembly is in the closed position and no combustion sources are in operation, for example, heaters on the vehicle.	ECE GH2 4.3.10		Same as above.		
1.8.11	Use of the hydrogen system shall be prevented if a partial or total failure of the removable storage system connector or electrical connectors between the removable storage system and the vehicle occurs, that may affect the safety of the hydrogen system.	ECE GH2 4.3.11		Same as above.		
1.8.12	The installation and removal	ECE GH2		Same as above.		

	operations for the removable storage system shall be illustrated on a label attached to the vehicle close to the mounting point of the removable storage system. The label shall also state the nominal working pressure of the container(s) or container assembly and the removable storage system connector.	4.3.12				
1.8.13	A label shall be attached to the removable storage system stating the nominal working pressure of the container(s) or container assembly and the removable storage system connector.	ECE GH2 4.3.13		Same as above.		

1.9 Refilling system

No.	Text	Source	Remarks	Japanese comments and Justification	US comments	OICA comments
1.9.1	For LH2-systems appropriate automatic measures shall be adopted in coordination with the refuelling station to ensure that no uncontrolled hydrogen release occurs during the filling procedure.	ECE LH2 4.1.9	*Defer for later discussion on LH2*	(It was agreed at SGS that the LH2 provisions would be discussed *after* basic agreement on the CH2 provisions is reached.)	Defer to LH2 requirement discussion.	Covered by LH2 later.

1.9.2	For GH2-systems the receptacle shall be integrated with a non-return valve.	ECE GH2 4.4.2	*The gas filling port shall prevent reverse flow.*	Japan supports the TUV draft. Japan 100 3-6-1 The gas filling port shall be provided with a gas filling valve having overflow prevention function. Refer to A-6 of Japan's Draft Proposal for the justification.	Recommended design practice. Should be in industry codes & standards. Part A of GTR.	To be discussed. Requirements covered in 1.3.1
	If the receptacle is not mounted directly on either the container or one container in a container assembly, the refilling line shall be secured by a non-return valve or an automatic valve integrating the function of a non-return valve. This valve shall be mounted directly on either the container or one container in a container assembly.		*Delete - addressed in the storage system*	Japan supports the TUV draft. Japan 100 2-10 "Container attachments" mean a main shut off valve, a container check valve (=container non-return valve) and a container safety valve (= pressure relief device). Japan 100 3-1-1 Container attachments shall be attached directly to each gas container. Refer to A-2 of Japan's Draft Proposal for the justification.		

1.9.3	The receptacle shall be secured against maladjustment and rotation. The receptacle shall also be protected from unauthorized interference, and the ingress of dirt and water so far as is reasonably practicable, e.g. a locked hatch. It shall be safe against reasonably foreseeable handling errors.	ECE GH2 4.9.1	To be tested by visual inspection see 2.1 Valid for LH2 and CGH2 *Delete – provide a write-up on for part A. Encourage industry to standardize filling receptacle.*	Move to Chapter A. Although this paragraph looks detailed, its criteria are vague, and it does not mention how to demonstrate the compliance.	Recommended for part A of the GTR.	OICA: delete, no objective requirement
1.9.4	The receptacle shall not be mounted within the external energy absorbing elements, e.g. bumper.	ECE GH2 4.9.3	*Delete*	Delete. If it must be kept, move to Chapter A.	Recommended for part A of the GTR.	OICA: Not regulated in conventional vehicle and not necessary to regulate in FCV.
1.9.5	The nominal working pressure of the receptacle shall be equal to the nominal working pressure of the hydrogen components upstream of and including the first pressure regulator.	ECE GH2 4.9.4	*Delete*	Delete. If it must be kept, move to Chapter A.	Recommended practices. Recommended for part A of the GTR.	OICA : delete, this is obvious.
1.9.6	A label shall be provided close to the receptacle, for example, inside a refilling hatch, showing the following information: gas type (GH2 or LH2) "xx" MPa for GH2-storage systems where "xx" = nominal working pressure of the container(s).	ECE GH2 4.9.6	*Agree;* *Need to determine the detail information for lable such as pressure and type of fuel.* *Or leave for contracting party to decide.*	Japan supports the TUV draft. However, the label information should be decided by each Contracting Party.	OK. Need to discuss on what information is needed for labelling.	OICA:ok,details of thelabel to be discussed
1.9.7	The gas filling port shall not be installed in the passenger compartment, luggage compartment and other places where ventilation is not sufficient.	Japan 100 3–6–2–2	*Delete – provide write up for part A.*	Refer to B-3 of Japan's Draft Proposal for the justification. Gasoline-vehicle standards are quoted in Japanese Safety Regulations for Road	Recommended for part A of the GTR.	OICA: To be discussed. Is this regulated on conventional vehicles?

				Vehicles, Article 18(9).		

1.10 LH2-Storage Systems US comments : Alliance currently defers comment on liquid hydrogen requirements

No.	Text	Source	Remarks	Japanese comments and Justification	US comments	OICA connents
1.10.1	A system shall be provided to detect failure in either circuit of a heat exchanger and prevent hydrogen from entering the other circuit(s) if the interface(s) is/are not able to withstand loss of pressure in either circuit.	ECE LH2 4.1.19	*1.10.1 thru 1.10.4 - Defer for later discussion on LH2*	(It was agreed at SGS that the LH2 provisions would be discussed *after* basic agreement on the CH2 provisions is reached.)	Recommended for part A of the GTR.	All LH2 specifics should be discussed later
1.10.2	Failure of the heating circuit of the heat exchanger shall not cause impermissible leakage from the hydrogen system.	ECE LH2 4.13	See OICA-proposal	Same as above.	Recommended for part A of the GTR.	
1.10.3	The passenger compartment, the luggage compartment and all safety-critical components of the vehicle (e.g. the brake system, electrical insulation) shall be protected against direct contact with the cryogenic fuel. Possible leakage of the cryogenic fuel shall be considered when assessing the protection that is required.	ECE LH2 4.11		Same as above.	OK. Needs better language	
1.10.4	Inflammable materials used in the vehicle shall be protected from liquefied air that may condense on un-insulated elements of the fuel system.	ECE LH2 4.12		Same as above.	Recommended for part A of the GTR.	

1.11 Information about Operation, Maintenance and Inspection

No.	Text	Source	Remarks	Japanese comments and Justification	US comments	OICA comments
1.11.1	The manufacturer shall provide information for appropriate operation, maintenance and inspection of the hydrogen system.		*OICA will provide a proposal for owner/user manual and label for identification, maintainance on storage system (example FMVSS 304)*	Move to Chapter A of gtr.	OK	Move to chapter A of the GTR.

2. Tests

2.1 Visual Inspection

No.	Text	Source	Remarks	Japanese comments and Justification	US comments	OICA comment
2.1.1	The hydrogen system has to be inspected visually regarding the relevant requirements in chapter 1, e.g. - apropiate installation - complete and correct configuration of the components installed into the vehicle, e.g. flow direction of check valves, mounting of the vent lines, layout of the components, etc. - labelling and marking		Delete - Refer to individual requirement and test procedure.	This paragraph should be revisited for discussion after the details of the requirements are determined.	Not subjected. Inspection of marking and label is OK.	To be discussed, when the requirements are agreed

2.2 Air Tightness Test

No.	Text	Source	Remarks	Japanese comments and Justification	US comments	OICA comment

2.2.1	The hydrogen system shall be pressurized to nominal working pressure using leak testgas and tested for leakage with a surface active agent without formation of bubbles for three minutes, or by using a demonstrated equivalent method,e.g. leak detector. The permitted leakage rate is applicable to tests with 100 per cent hydrogen only. Permitted leakage rates for other gases or gas mixtures shall be converted to an equivalent leakage rate to that for 100 per cent hydrogen.	ECE GH2 4.1.10	*To be discussed at the next meeting.* *TUV will provide test procedure.* *How to conduct compliance test?*	Delete "Permitted leakage rates for other gases or gas mixtures shall be converted to an equivalent leakage rate to that for 100 per cent hydrogen." The scope of this gtr does not include hydrogen blend fuel vehicles. "Other gases or gas mixtures" will not be used for leakage test at the time of vehicle testing. Unrealistic provisions are not necessary.	Possible with justification and a feasible test procedure.	To be discussed, could be part of the leakage test, details to be defined