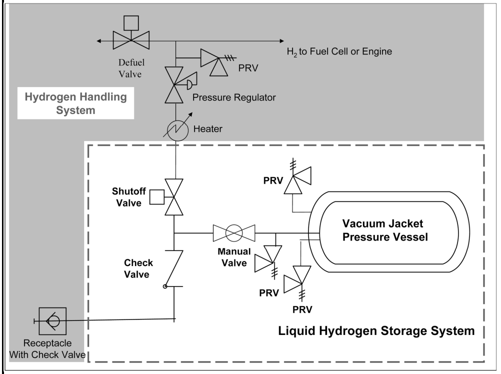
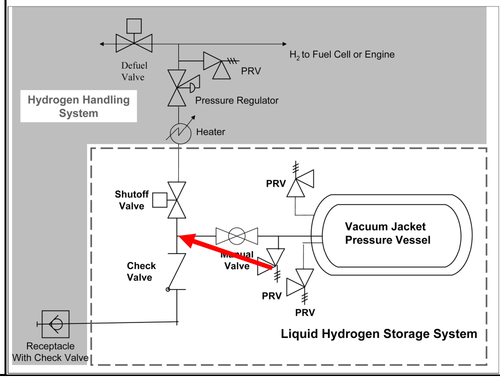
| Ref. Clause No./ Annex | Text (existing draft 21. Sept. 2009) | Proposed change by the Requestor | Comment (justification for change) |
|---|---|---|---|
| **Table of Contents** | **Table of contents** | **2nd and 3rd sub-clauses shall be included and the numbering of pages** | **Better handling of the draft regulation** |
| **A 1** | | **Numbering not consistent**<br><br>**Example A 1 (Introduction)**<br>**A1.1 "In the on-going debates..."**<br>**A1.2 "For decades..."**<br>**A2 (GTR Action Plan)**<br>**A2.1 "Given that..."**<br>**A3 Description of Compressed Hydrogen FC vehicles**<br>**...** | **Better handling of the draft regulation** |
| **A1.1 .last sentence** | In the late 1990's, the European Community allocated resources to study the issue under its European Integrated Hydrogen Project. A few years later, the United States outlined a vision for a global wide initiative, the International Partnership on the Hydrogen Economy, and invited Japan, European Union, China, Russia and many other countries to participate in this effort. | In the late 1990's, the European Community allocated resources to study the issue under its European Integrated Hydrogen Project **and forwarded the results, two ECE-drafts for compressed gaseous and liquefied Hydrogen, to UN-ECE**. A few years later, the United States outlined a vision for a global wide initiative, the International Partnership on the Hydrogen Economy, and invited Japan, European Union, China, Russia and many other countries to participate in this effort. | **The European community did not only perform a European project but involved also Japan and USA for development of ECE-drafts which were forwarded to UN-ECE.** |
| **A1.2 .last sentence** | The safe use of hydrogen, particularly in the compress gaseous form, lies in preventing catastrophic failures due to volatile combination of fuel, ambient air and ignition sources. | The safe use of hydrogen, particularly in the compress**ed** gaseous form, lies in preventing catastrophic failures due to volatile combination of fuel, ambient air and ignition sources **but also due to pressure and electric hazards** (see 8.). | **Editorial**<br><br>**Two safety objectives that were agreed by the WP29 and SGS and that are subject to part B are missing see also A1.8** |

<table>
<tr><th>Ref. Clause No./ Annex</th><th>Text (existing draft 21. Sept. 2009)</th><th>Proposed change by the Requestor</th><th>Comment (justification for change)</th></tr>
<tr><td>A19 (A3.2.1.4)</td><td>Liquefied hydrogen is stored at cryogenic conditions. In order to maintain the hydrogen in the liquid state, the container needs to be well insulated, including use of a vacuum jacket that surrounds the storage container. Pressure regulators (PRVs) and Pressure relief valves (PSVs) protect both the hydrogen storage container(s) and the vacuum the jacket(s) surrounding the storage container(s) from over-pressure due to heat transfer from ambient or during external fires.</td><td>Liquefied hydrogen is stored at cryogenic conditions. In order to maintain the hydrogen in the liquid state, the container needs to be well insulated, including use of a vacuum jacket that surrounds the storage container. Pressure relief devices (PRDs) protect both the hydrogen storage container(s) and the vacuum ~~the~~ jacket(s) surrounding the storage container(s) from over-pressure due to heat transfer from ambient or during external fires.</td><td>Technically wrong<br><br>Pressure regulators do not protect the containers or the vacuum jacket.<br><br>For safety the containers are equipped with Pressure relief devices e.g. Pressure relief valves.</td></tr>
<tr><td>A Figure 4</td><td>
</td><td>
</td><td>The container in this figure has 3 safety valves – that is not correct, one PRV must be located downstream of the main shut off valve</td></tr>
</table>

| Ref. Clause No./ Annex | Text (existing draft 21. Sept. 2009) | Proposed change by the Requestor | Comment (justification for change) |
|---|---|---|---|
| **A22** | In the case of 70 MPa compressed hydrogen storage system, the pressure may have to reduced from as high as 87.5 MPa (12,5000 psi) to levels typically under 1MPa at the inlet of the fuel cell system. | In the case of 70 MPa compressed hydrogen storage system, the pressure may have to **be** reduced from as high as 87.5 MPa (**ca.**12,500~~0~~ psi) to levels typically under 1MPa at the inlet of the fuel cell system. | **editorial** |
| **A5.1 ff** | **Units “miles” etc.** | **Use SI units consequently throughout the whole paper**<br><br>**Correction required** | **SI-units only** |
| **A xy** | **Telltale/driver warning** | **Delete** | **To enter such a chapter with telltale requirements was disagreed by the working group because design requirements shall not be included. The requirement for information and warning of the driver is covered by chapter B 5.2.1.2.3** |
| **B1 Purpose** | **Purpose:** This regulation specifies performance requirements for hydrogen-powered vehicles. The purpose of this regulation is to minimize human harms that may occur as a result of fires or explosions related to the vehicle fuel system and/or from electric shock caused by the vehicle’s high voltage system. | **Purpose:** This regulation specifies performance requirements for hydrogen-powered vehicles. The purpose of this regulation is to minimize human harms that may occur as a result of fires**, burst** or explosions related to the vehicle fuel system and/or from electric shock caused by the vehicle’s high voltage system. | pressure related harms are not included but essential as the main difference between a h2-fuel system and a gasoline fuel system is the pressure! |
| **B 5.1** | Titel:<br><br>“Hydrogen Storage System” | Hydrogen Storage System **for CGH2-Storage** | **The Chapter 5.1 only covers CGH2. LH2 will be covered by an additional chapter later (5.2?). So enumeration and Titel must show that only CGH2-systems are addressed.** |
| **B 5.1.2.1** | **5.1.2.1 Material requirements** | **Numbering inconsequent**<br><br>**5.1.1 Material requirements** | **editorial** |

| Ref. Clause No./ Annex | Text (existing draft 21. Sept. 2009) | Proposed change by the Requestor | Comment (justification for change) |
|---|---|---|---|
| **B 5.1.1** | | At least one “key test” (cycle test or creep rupture test) should be performed to fatigue failure and repeated during tests parallel to operation. | This is the best way to assess real scatter and to ensure that no rupture before end of life may occur with a higher probability than agreed. |
| **B 5.1.1** | | Tests parallel to operation have to be introduced. This is the best way to ensure fatigue properties not weaker than assessed by design type tests! | From the current point of state-of-the-art of science and technology new designs will age different to known ones. Therefore the aging of containers can not get assessed reliably during the design type process |
| **B 5.1.2** | The storage system does not have to be re-qualified if the subsystem components are exchanged for components with **comparable function, fittings, and dimensions, and meet comparable component performance qualification specifications.** A change in the TPRD hardware, its position of installation and/or venting lines requires re-qualification with a bonfire test.**????** | **If subsystems or components are changed the function, strength and material compatibility must be proved in dependence of the type of change.**<br><br>**See table ... in annex ...**<br><br>A change in the TPRD hardware, its position of installation and/or venting lines requires re-qualification with a bonfire test.**If the eutectic or the pressure bearing parts are changed also the durability tests must be performed.** | **5.1.2 is Not objective, not reproduceable, not quantitativly measurable**<br><br>**There must be included a table of the relevant tests that must be performed in case of changes, e.g. change of material, change of sealings, change of housings, etc. Otherwise the change of components can not be evaluated.**<br><br>**If the eutectic or pressure bearing parts of a TPRD are changed the bonfire test is not sufficient for evaluation, because also the strength and durability for in use must be proved . There were several accidents in Europe (e.g. bus fire in Rendsburg) caused by TPRDs that did not stand the in use conditions (high temperature creeping)** |
| **B5.1.2.1.1** | | All papers being referenced should be distributed by the country using it for argumentation! | e. g. SAE 2009-01-0012 and presentation at 2009 SAE Global Congress |

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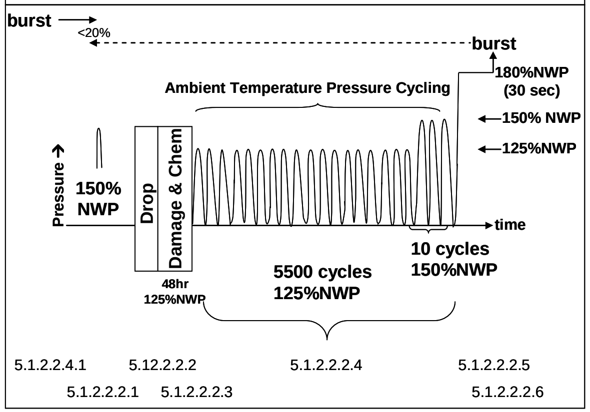
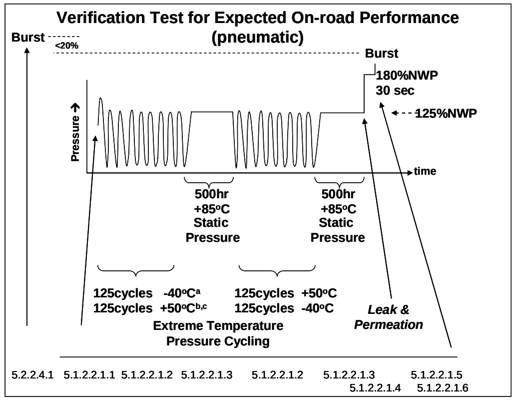
|---|---|---|---|
| **B5.1.2.1.1** | 5.1.2.1.1 Baseline Initial Burst Pressure Test: At least 3 new storage containers will undergo a hydraulic burst test to verify that the initial burst pressure of each container is ≥ 180% NWP and to determine $BP_0$, the average value, as the baseline initial burst pressure for 5.1.3.2. To accommodate at least 20% of NWP manufacturing variability, $BP_0$ must be ≥ 200% NWP. | Baseline Initial Burst Pressure Test: At least 3 new storage **system** will undergo a hydraulic burst test.<br><br>The following requirements shall be demonstrated:<br><br>1. The initial burst pressure of each container is ≥ 180% NWP,<br><br>2. BP0, the average value, shall be ≥ 200% NWP and<br><br>3. The manufacturing variability of the 3 burst results shall be ≤ 20% NWP | The requirements must be defined quantitatively and objectively. The existing requirement does not give reproduceable and objective figures.<br><br>The tolerances for production or the manufacturing variability respective must be the same and fixed for all products of the same pressure level. Thus the variability shall be referred to the NWP and not to a variable test result (BP)<br><br>Container must be replaced by storage system because the components must be included for same safety requirements as container (performance of the system!). the baseline burst test must show, that the components do not burst or leak before the container. If only the container is tested another burst test for the components must be included in the test procedures. |

| Ref. Clause No./ Annex | Text (existing draft 21. Sept. 2009) | Proposed change by the Requestor | Comment (justification for change) |
|---|---|---|---|
| **B5.1.2.1.2** | Baseline Pressure Cycle Life (Leak Before Break) Test. At least 3 new storage containers will undergo ambient hydraulic pressure cycling from <2MPa to 150%NWP without rupture for 11,000 cycles (2 times the number of cycles required for 5.1.2.2.1.4) or until leak occurs. The pressure cycle life, PCL, of a storage container is the number of cycles until leak. If no leak occurs, then PCL is equated to 11,000. All 3 storage containers must have a pressure cycle life, PCL, within 25% of PCL0. PCL0, the average of the measured PCLs, is the baseline pressure cycle life for 5.1.3.2. | Baseline Pressure Cycle Life (Leak Before Break) Test. At least 3 new storage **systems** will undergo ambient hydraulic pressure cycling from <2MPa to 150%NWP without rupture **or leak** for 11,000 cycles (2 times the number of cycles required for 5.1.2.2.1.4) ~~or until leak occurs~~. The pressure cycle life, PCL, of a storage **system** is the number of cycles until leak. **Cycle tests should be continued to failure.** All 3 storage **systems** must have a pressure cycle life, PCL, within 25% of PCL0. PCL0, the average of the measured PCLs, is the baseline pressure cycle life for 5.1.3.2. | "Container" must be replaced by "storage system" because the components must be included for same safety requirements as container (performance of the system!)<br><br>This was the agreed philosophy instead of the component approach in the ECE-drafts.<br><br>As written now the container might fail by leak after the first cycle! This is not acceptable.The system must stand 11000 cycles without failure (either leak or rupture) because in no other test in this GTR the safety of the system with regard to cycling strength is covered (all other tests only show in use conditions but no safety margin except this test. As we do not have a hydraulic cycling test as required in ISO or EC or ECE this test must show the required number of cycles without failure. The reliability level at the working point (about 500-1,000 LC at 125%) could only be confirmed in detail by continuing the test until break. A comparable test is required for all other applications e.g. CNG, hazardous goods, etc.. |
| **5.1.2.1** | **Material Requirements** | **Numbering must be:**<br><br>**5.1.1** | **editorial** |
| **5.1.2.1** | **Material Requirements** | **To be done!** | **Requirements are missing but essential! Cannot be moved to A, must be addressed here.** |

| Ref. Clause No./ Annex | Text (existing draft 21. Sept. 2009) | Proposed change by the Requestor | Comment (justification for change) |
|---|---|---|---|
| **B5.1.2.2** | **vehicle life** | The basis for calculation of filling cycles should be the real driving range per refueling in combination with the users behavior. Filling cycles should be surveyed by the onboard computer. | The used average fueling range of 483 km is very high and not representative for currently or in the near future available technical solutions. As long as the net of fueling stations is not very small meshed customers will refuel more frequent. The rationale for this figure has strongly been derived from vehicles with very different technical constraints. It is said that Prob 2(the Probability that a vehicle has a fueling range below 200 miles) is below 10^-6. Why then do many of the prototype hydrogen vehicles have a range of about that size??? (only one in a million types should have that!) |
| **B5.1.2.2.** | **cycling test** | Either additional gas cycling tests are required which have to be finished by hydraulic cycling to the leakage or better type III cylinders are treated in another manner. | A burst test shows steadily a significant reduction of strength of type IV-cylinders not before becoming critical in terms of fatigue scatter. Burst tests do not allow any conclusions on residual service life or service safety of type II or type III cylinders. Therefore there are two alternatives: Residual cycle or creep rupture tests should be done instead of burst tests.<br><br>The finalisation of the test by a rapid burst test does not show degradation. It only shows significant fibre weakening. This does not allow assessing the safety distance to fatigue limits. One cylinder should be enough providing parallel hydraulic tests show a good basis for scatter. |

| Ref. Clause No./ Annex | Text (existing draft 21. Sept. 2009) | Proposed change by the Requestor | Comment (justification for change) |
|---|---|---|---|
| B Figure 5.1.2.2.1 | Durability Performance Verification Test<br><br> | **Hydraulic proof test = 5.1.2.2.1.1**<br>**Drop impact = 5.1.2.2.1.2**<br>**Damage and Chem. exposure = 5.1.2.2.1.3**<br>**Ambient temperature pressure cycling and Extreme Fueling Usage = 5.1.2.2.1.4**<br>**Hydaulic residual pressure test = 5.1.2.2.1.5**<br>**Hydraulic residual pressure test = 5.1.2.2.1.6** | **editorial**<br>**Numbering of phases of the Durability performance test is to be corrected. Does not fit to the chapter numbering** |
| 5.1.2.2.1.2 | Drop Impact test<br>The storage container will be dropped at several impact angles. All drop tests may be performed on one storage container, or individual impacts on a maximum of 3 containers. Following the drop impact, the storage container(s) will be subjected to 1000 pressure cycles.<br>The containment vessel subjected to the 45° angle drop will undergo further testing as specified in the remainder of **5.1.2.2.2**, which includes the required 1000 pressure cycles | The storage system will be dropped at several impact angles. All drop tests may be performed on one storage system, or individual impacts on a maximum of 3 storage systems. Following the drop impact, the storage system(s) will be subjected to 1000 pressure cycles.<br>The containment vessel subjected to the 45° angle drop will undergo further testing as specified in the remainder of **5.1.2.2.1**, which includes the required 1000 pressure cycles | **Performance test on the system not only on the container. valves/TPRD etc. must be included**<br>**Numbering and reference!**<br>**editorial** |
| 5.1.2.2.1.3 | Surface damage and Chemical Exposure Test: The storage container will be subjected to surface damage and exposed to chemicals typical of worst-case on-road exposures. After 48 hours of exposure without leak, the container will be inspected to verify no further damage. | Surface damage and Chemical Exposure Test: The storage container will be subjected to surface damage and exposed to chemicals typical of worst-case on-road exposures. After 48 hours of exposure **at 125%NWP** without leak, the container will be inspected to verify no further damage. | **For better understanding and correspondence with figure 5.1.2.2.1**<br>**editorial** |

| Ref. Clause No./ Annex | Text (existing draft 21. Sept. 2009) | Proposed change by the Requestor | Comment (justification for change) |
|---|---|---|---|
| **5.1.2.2.1.4** | Extreme Fueling Usage; Ambient Temperature Pressure Cycling Test. The storage container will not leak or give visual evidence of deterioration when pressure cycled (repeatedly filled to 125% NWP and defueled to <2MPa) at 15 – 25°C ambient temperature. The number of pressure cycles will be 5500.. Chemical exposures are maintained throughout the first 1000 pressure cycles. The last 10 cycles are to 150% NWP. | Extreme Fueling Usage; Ambient Temperature Pressure Cycling Test. The test should be done with gas or left out. The storage **system** will not leak or give visual evidence of deterioration when **hydraulically** pressure cycled (repeatedly filled to 125% NWP and defueled to <2MPa) at 15 – 25°C ambient temperature.<br>… | **Performance test on the system not only on the container. valves/TPRD etc. must be included**<br>**“hydraulically” for information and better understanding and as differentiation between this test and the pneumatic test in 5.1.2.2.2** |
| **5.1.2.2.1.5** | Hydraulic Residual Pressure Test. The storage container will be pressurized to 180%NWP and held 30 seconds without burst. | Hydraulic Residual Pressure Test. The storage **system** will be pressurized to 180%NWP and held 30 seconds without burst. | **Performance test on the system not only on the container. valves/TPRD etc. must be included** |
| **5.1.2.2.1.6** | Residual Burst Strength Test . The storage container will undergo a hydraulic burst test to verify that the burst pressure is within 20% of the baseline burst pressure determined in **5.1.2.2.4.1.** | Residual Burst Strength Test . The storage **system** will undergo a hydraulic burst test to verify that the burst pressure is within 20% of the baseline burst pressure determined in **5.1.2.1.1** | **Performance test on the system not only on the container. valves/TPRD etc. must be included**<br>**Reference chapter: correct numbering, editorial** |
| **Figure 5.1.2.2.2** | <br>a 5 cycles after equilibration @ -40°C, <-35°C fuel; 5 equilibrated cycles with +20°C fuel<br>b 5 cycles after equilibration @+50°C, <-35°C fuel<br>c Maintenance defuel rate ≥50cy | **5.1.2.2.2.1 Proof pressure test**<br>**5.1.2.2.2.2 Fueling performance**<br>**5.1.2.2.2.3 Extreme temperature static pressure test**<br>**5.1.2.2.2.4 Permeation test**<br>**5.1.2.2.2.5 Residual proof pressure test**<br>**5.1.2.2.2.6 Residual strength burst test** | **editorial**<br>**Numbering of phases of the test is to be corrected. Does not fit to the chapter numbering** |

| Ref. Clause No./ Annex | Text (existing draft 21. Sept. 2009) | Proposed change by the Requestor | Comment (justification for change) |
|---|---|---|---|
| **5.1.2.2.2.1**<br><br>**Proof pressure test** | Proof Pressure Test: A system will be pressurized to 150%NWP | Proof Pressure Test: A system will be pressurized to 150%NWP with Hydrogen? hydraulically? | **For information and understanding** |
| **5.1.2.2.2.2**<br><br>**Fueling Performance** | Fueling Performance: Extreme Temperature Pressure Cycling Test (pneumatic). The system will be pressure cycled (repeatedly filled to 125% NWP and defueled to <2MPa) using hydrogen gas for 500 cycles. Half of the cycles will be performed at extreme ambient temperatures of 50C, and half at -40C. **The hydrogen gas fuel temperature will be <-35C. Five of the cycles will be performed after temperature equilibration at 50C, and five cycles after equilibration at -40C; an additional five cycles will be performed with >20C fuel after ambient-temperature equilibration at -40C. Fifty of the cycles will be performed using the maintenance defueling rate.** | **Refer to chapter 6** | **Test performance description is not clear –To avoid misunderstandings and to improve handling of the draft refer to relevant chapter in chapter 6 (when renumbering is completed)** |

| Ref. Clause No./ Annex | Text (existing draft 21. Sept. 2009) | Proposed change by the Requestor | Comment (justification for change) |
|---|---|---|---|
| **5.1.2.2.2.4 Leak/Permeation test** | Leak/Permeation Test. The system will be fully filled with hydrogen gas and held at a temperature of at least 55 ℃ to stabilize and measure the total discharge rate due to leakage and permeation. The maximum allowable discharge from the compressed hydrogen storage system is 150 ml/min for standard passenger vehicles. [The maximum allowable discharge for systems in larger vehicles is R*150 Ncc/min where R = (Vwidth+1)*(Vheight+0.5)*(Vlength+1)/30.4 and Vwidth, Vheight, Vlength are the vehicle width, height, length (m), respectively.]<br><br>If the measured permeation rate is greater than 0.005 mg/sec (3.6 cc/min), then a localized leak test shall be performed to ensure no point of localized external leakage is greater than 0.005 mg/sec (3.6 cc/min). | Leak/Permeation Test. The system will be fully filled with hydrogen gas and held at a temperature of at least 55 ℃ to stabilize and measure the total discharge rate due to leakage and permeation.<br><br>The permeation test requires the steady state permeation rate for hydrogen gas shall be less than 5,00 cm3 of hydrogen per hour per liter water capacity corrected for 55℃.(Annex TBD) (see proposal of Japan in 5.1.2.3.3 | **There exist different requirements in the same draft.**<br><br>**The permeation rate must be limited to a value with limit per hour and per liter.**<br><br>**The permeation rate is too high for avoiding explosion or fire hazards inside the vehicle. Here the safety target is not the explosion protection in a garage or any place (outside the vehicle) but the spaces inside the vehicle itself where ignition sources are not avoidable and located quite near to the H2-system.**<br><br>**Use the same requirement given by the Japanese proposal in 5.1.2.3.3: 5ccm per hour and per liter at 15℃ (corrected value for 55℃)**<br><br>**Or use the hysafe-value (6ccm per hour and per liter at 15℃)**<br><br>**Both values are validated by studies.** |
| **5.1.2.4.1 Bonfire test** | A hydrogen storage system will be pressurized to NWP and exposed to an engulfing fire. If activated, temperature-activated pressure relief device will release the contained gases in a controlled manner. | One hydrogen storage system will be pressurized with hydrogen to NWP **and a second system will be pressurized with hydrogen to 20% of NWP** and exposed to an engulfing fire. If activated, temperature-activated pressure relief device **shall** release the contained gases in a controlled manner.<br><br>**The container shall not burst.** | **Result of test is missing, must be included.**<br><br>**To cover all worst case scenarios the bonfire test must be performed at high and at low pressure.** |

| Ref. Clause No./ Annex | Text (existing draft 21. Sept. 2009) | Proposed change by the Requestor | Comment (justification for change) |
|---|---|---|---|
| **5.1.3**<br><br>**Production requirements** | Moved to A | **5.1.3 Storage System Production Requirements**<br><br>Manufacturers are expected to ensure that all production units meet the requirements of performance verification testing in 5.1.2. Manufacturers of storage systems must provide the following information to regulatory authorities upon request.<br><br>5.1.3.1 Documentation of Routine Production (Each Produced Unit). Documentation should include results of routine leak tests, proof pressure tests, and dimension, and NDE examinations verifying that expansion and flaw sizes are within design specifications. Documentation should show that components providing closure functions, such as the shut-off valve, check valve and the TPRD meet industry standards.<br><br>5.1.3.2 Documentation of Periodic Production Tests (Batch/Lot Tests). Documentation should include measurements and statistical analyses used to confirm that<br>…<br><br>a) the average (hydraulic) initial burst pressure of new storage containers is $\geq BP_0$ (established in 5.1.2.2.4.1) and that the initial burst pressure of every produced unit is $\geq$ 180% | **Insert production requirements again as proposed by OICA because**<br><br>**- the performance requirements refer to the production requirements**<br><br>**- the performance requirements do not prove evidence of statistical reliable results – thus a documentation and comparison of the production results to follow up the manufacturer´s reliability, low tolerance and variability of production is necessary.**<br><br>**- the control of the scatter is as important for safety level as the properties of the design type are.**<br><br>**- even the simplest test, the burst test shows a scatter of 10% deviation from the mean value easily, which is too much.** |

| Ref. Clause No./ Annex | Text (existing draft 21. Sept. 2009) | Proposed change by the Requestor | Comment (justification for change) |
|---|---|---|---|
| **5.1.4 Marking** | Tank label will contain the NWP, date of manufacture, and date of 15 year lifetime. | The container label shall contain the following data clearly legible and indelible:<br>Type<br>Sign or name of manufacturer<br>Date of manufacture<br>Serial number<br>Medium Hydrogen (abbreviation CGH2 is permitted)<br>NWP @ 15°C and MAWP<br>Capacity in liters<br>Lifetime or date of removal from service<br><br>Components shall be marked with the following data:<br>Sign or name of manufacturer<br>Serial or lot number<br>MAWP | **Container marking must show all data for safety (medium, maximum allowable pressure, filling mass, capacity, lifetime) and traceability (manufacturer, serial number, type, date)**<br>**Components must have at least the 3 markings for safety and traceability, reduced for space reasons.** |
| **New 5.2** | | **Insert new chapter for LH2-storage system** | **Missing in the draft and contents** |
| **5.2 old**<br>**Vehicle fuel system** | | **5.3 new**<br>**Vehicle fuel system** | **New numbering of all remaining chapters** |
| **5.2.1.1.1. H2 discharge system** | The outlet of the vent line, if present, for hydrogen gas discharge from TPRD(s) of the storage system shall be protected, e.g. by a cap. This will be verified by visual inspection. | The outlet of the vent line, if present, for hydrogen gas discharge from **PRD**(s) of the storage system shall be protected, e.g. by a cap. ~~This will be verified by visual inspection.~~ | **This requirement does not only address vent lines of TPRDs but all PRDs. So delet the T in TPRD.**<br>**This chapter covers performance requirements not inspection requirements. Move inspection requirement to chapter 6** |

| Ref. Clause No./ Annex | Text (existing draft 21. Sept. 2009) | Proposed change by the Requestor | Comment (justification for change) |
|---|---|---|---|
| **New requirement 5.3.1.1.3** | | 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. | **Insert new paragraph** |

| Ref. Clause No./ Annex | Text (existing draft 21. Sept. 2009) | Proposed change by the Requestor | Comment (justification for change) |
|---|---|---|---|
| **5.2.1.2 old**<br><br>**Single failure of H2 fuel system** | *[If a single failure of the hydrogen system results in a hydrogen 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.*<br><br>*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]*<br><br>[1. Hydrogen leakage and/or permeation from the hydrogen storage system shall not be allowed to directly vent to the passenger, luggage, or cargo compartments.<br><br>2. If a single failure downstream of the main hydrogen shutoff results in a hydrogen concentration greater than 4%, by volume in air in the enclosed or semi-enclosed spaces of the vehicle then the main shutoff shall be closed and a warning to the driver shall be provided per 5.2.1.2.3.<br>*Need definitions for "unprotected ignition source"*<br>5.2.1.2.1 Any single failure downstream of the main hydrogen shut off valve shall not result in a hydrogen concentration in air of 4% or more by volume within the passenger compartment.<br><br>5.2.1.2.2 If a single failure downstream of the main hydrogen shut off valve results in a hydrogen concentration of 4% by volume in air in the enclosed or semi-enclosed spaces within the vehicle that are not suitable for flammable gases then the main hydrogen shutoff valve shall be closed and a warning to the driver shall be provided per 5.2.1.2.3. The vehicle manufacturers shall provide a list of spaces that are suitable for flammable gases which are exempted from this requirement. | 5.2.1.2.1 Hydrogen leakage and/or permeation from the hydrogen storage system shall not be allowed to directly vent to the passenger, luggage, or cargo compartments. (Peking proposal: Scheffler, Rothe, Ortenb.)<br><br>5.2.1.2.2 Any single failure downstream of the main hydrogen shut off valve shall not result in a hydrogen concentration in air greater than 4% by volume in the passenger compartment. (original OICA proposal)<br><br>5.2.1.2.3 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 shall close (original OICA proposal) and a warning to the driver shall be provided.<br><br>**Definition**:<br>Enclosed or semi-enclosed spaces: Volumes within the vehicle (or the vehicle outline across openings) that are external to the hydrogen system and its housings (if any) where hydrogen may accumulate and thereby pose a hazard such as the passenger compartment, luggage compartment, fuel storage compartment, space under the hood, or space under the vehicle. (Scheffler proposal) | **This solution avoids the wording "unprotected ignition sources" and requirements for explosion protection in the vehicle, but covers all essential requirements for the system upstream of the main shut off valve (5.2.1.2.1) and downstream of the main shut off valve (5.2.1.2.2 – 5.2.1.2.3)** |

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| **5.2.1.2.3** | **5.2.1.2.3 Driver warning**: The vehicle shall be equipped with a visual indicator (e.g. tell-tale) that provides a warning to the driver in the event of 5.2.1.2.2 or in the event of a malfunction of the hydrogen leakage detection system.<br><br>[The vehicle shall be equipped with a visual tell-tale(s) that provides a warning to the driver of (1) the hydrogen detection system malfunction or (2) in the event of unintended hydrogen leakage as described in section 5.2.1.2.2. The tell-tale(s) shall meet the following items:<br><br>(a) Shall be displayed in direct and clear view of the driver while in the driver's designated seating position with the driver's seat belt fastened;<br>(b) Shall appear perceptually upright to the driver while driving;<br>(c) Shall be yellow or amber in color if the detection system is malfunction and shall be red in the event of 5.2.1.2.2;<br>(e) When illuminated, shall be sufficiently bright to be visible to the driver under both daylight and night time driving conditions, when the driver has adapted to the ambient roadway light conditions;<br>(f) The detection malfunction tell-tale shall illuminate when a malfunction exists and shall remain continuously illuminated as long as the malfunction exists, whenever the ignition locking system is in the "On" ("Run") position;<br>(g) Shall extinguish at the next ignition cycle after the malfunction has been corrected;] | **5.2.1.2.3 Driver warning**: The vehicle shall be equipped with a visual **or acoustic** indicator (e.g. tell-tale) that provides a warning to the driver in the event of 5.2.1.2.2 or in the event of a malfunction of the hydrogen leakage detection system. | **Delete design restrictive requirements for tell tales as agreed in SGS meeting 3** |

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| **5.3.4 Marking** | *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).]* | A label shall be provided close to the receptacle, for example, inside a refilling hatch, showing the following information:<br>- **gas type** (GH2 or LH2)<br>- **NWP = "xx" MPa @ 15℃** for GH2-storage systems where "xx" = nominal working pressure of the container(s).at 15℃ which describes the permitted filling mass<br>- **MAWP = "yy" MPa** for GH2 and LH2 storage systems to show the maximum allowable working pressure for the tank and the high pressure components<br>- **Removal of containers from service latest: mm.yy**, date of date of removal from service of containers | **Safety information** |
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