ORG	Clause/ Subclause (e.g. 3.1)	Paragraph/ Figure/ Table/ (e.g. Table 1)	Type of comment[2]	Comments	Proposed change	Observations/Actions
JAMA	All		ed	Mixture of "hydrogen fuelled" and "hydrogen-fuelled"	Change "hydrogen fuelled" to "hydrogen-fuelled"	
JAMA	I.J.1 (Rationale)	(d)	ed	Misspelling (d) Japan – Attachment 100 – Technical Standard For Fuel Systems Of Motor Vehicle Fueled By Compressed Hydrogen Gas;	Correct "Fueled" to "Fuelled"	
JAMA	3.12		ge	"space under the hood" is not an appropriate analogy for "Enclosed or semi-enclosed spaces" 3.12. "Enclosed or semi-enclosed spaces" indicates the special volumes within the vehicle (or the vehicle outline across openings) that are external to the hydrogen system (storage system, fuel cell system and fuel flow management system) and its housings (if any) where hydrogen may can accumulate (and thereby pose a hazard), as it may occur in the passenger compartment, luggage compartment and cargo compartment and space under the hood.	Delete the word as it may occur in the passenger compartment, luggage compartment and cargo compartment ~~and space under the hood.~~	TF 3 – Agrees to the following change: …as it may occur, e.g. in the passenger compartment, luggage compartment and cargo compartment. ~~and space under the hood.~~
EC	3.3		ed		"***Burst disc***~~*Burst-disc*~~" is the non-reclosing operating part of …"	
EC	3.5		ed		"***Hydrogen concentration*** ~~*Concentration of hydrogen*~~" is the percentage of …"	
EC	3.29		ed		"**Compressed ~~H~~hydrogen storage system (CHSS)" ~~indicates~~ means a system designed to store hydrogen fuel for hydrogen-fuelled vehicle and composed of** a pressurized container, pressure relief devices (PRDs) and shut off device(s) that isolate the stored hydrogen from the remainder of the fuel system and the environment."	
EC	3.32		ed		"Luggage compartment" is the space in the	

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					vehicle for luggage **and/or goods** accommodation, bounded by the roof, hood, floor, side walls, as well as by the electrical barrier and enclosure provided for protecting the **occupants**~~power~~ train from direct contact with live parts, being separated from the passenger compartment by the front bulkhead or the rear bulkhead."	
EC	3.46		ed		"Rupture" **or**~~and~~ "burst" both mean to come apart suddenly and violently, break open or fly into pieces due to the force of internal pressure."	
EC	5.1		ed		Compressed hydrogen storage system This section specifies the requirements for ~~the integrity of~~ the compressed hydrogen storage system. The hydrogen storage system consists of the high pressure storage container and primary closure devices for openings into the high pressure storage container. Figure 1 shows a typical compressed hydrogen storage system consisting of a pressurized container, three closure devices and their fittings. The closure devices **shall** include **the following functions, which may be combined:** (a) ~~A~~ TPRD; (b) ~~A c~~Check valve that prevents reverse flow to the fill line; and (c) ~~An a~~Automatic shut-off valve that can close to prevent flow from the container to the fuel cell or ~~ICE~~**internal combustion** engine. Any shut-off valve, and TPRD that form the primary closure of flow from the storage container shall be mounted directly on or within each container. At least one component with a check valve function shall	

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					be mounted directly on or within each container.”	
EC JRC	5.1		te	Over many cycles at extreme conditions, hydrogen diffusion may damage the liner, particularly non-metallic liners, causing blistering and cracking, leading to excessive permeation or leakage. This form of damage may be influenced by the maximum and minimum temperatures experienced during fuelling and during normal fuel use in vehicle operation (container defueling). Liner buckling has been evidenced when it was vented to atmospheric pressure following a pressure test.	Include performance based qualification test to demonstrate that liner buckling will not occur under operating conditions. Consider to add a rapid depressurization test. Alternatively, mitigate depressurization by means of e.g. restricting valves	TF 3 – Unlikely failure mode in service due to the need for multiple failures to occur, e.g. EFV, OTV and pressure regulator. Current GTR has 50 maintenance defueling cycles in pneumatic sequential test. Buckling may not be a life terminating event.
CSA	5.1.1, 6.2.2		te	There is no specification for rate of data collection or what happens if a portion of a pressure cycle or pressure hold test (parking performance) is out of the temperature or pressure specification.		JAMA JARI - To be discuss. Will need to be discuss with specific value. TF 3 – Data log at 1 Hz, recognize that these requirements are a minimum safety level, so acceptability of data should be left to the lab’s measurement uncertainly calculation. Add to 6.2.1. “Unless otherwise specified data sampling for pressure cycling shall be at least 1 Hz.”
NHTSA	5.1.1.1.		te	3 containers from a batch of 10 containers is not ok for a self-certification approach	Test 3 containers randomly selected Check if within 10% of BPo specified by manufacturer. Should initial BPo be average of 3 burst pressures? 3 randomly selected containers would provide increased rigor for validating the BPo. However, to maximize the effectiveness of this requirement, the language should stipulate that the 3 containers not come from	JAMA JARI - Disagree. The multiple batches include the production variation and are not appropriate for design qualification test., that is, container integrity evaluation. To be discuss. Different test procedure may

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					the same batch.	be necessary for self-certification approach. TF 3 – Add a statement to cover the fact that regulatory authorities do not need to source three containers from the same batch for their "market surveillance" validation purposes. Include this statement at the end of 5.1.1.1: "For the purpose of market surveillance or compliance validation testing, the containers do not need to be sourced from the same manufacturing batch. In this case, the tested containers do not need to have a burst pressure within +/- 10% of BP0." Also include the following statement at the end of 5.1.1.2: "For the purpose of market surveillance or compliance validation testing, the containers do not need to be sourced from the same manufacturing batch." Keep in mind that countries

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						that do not perform market surveillance or compliance validation testing, this statement does not apply. JAMA JARI – As discussion of June 25th, It should be stated that in this case the containers tested may not have a burst pressure within ±10 per cent of BP0.
NHTSA	5.1.1.2		te	Specifies ambient temp of 20±5 C	Recommend extending temperature range – possibly to 10-40 deg C.	JAMA JARI - Disagree. See JARI comment for 5.1.1.2. TF 3 – Reject, see JARI comment below.
EC	5.1.1.2		te		Three (3) new containers randomly selected from the design qualification batch are hydraulically pressure cycled at 20(**±**5)°C to 125 per cent NWP **(+2/-0 MPa)** without rupture for 22,000 cycles or until a leak occurs (para. 6.2.2.2. test procedure). Leakage shall not occur within a number of Cycles, where the number of Cycles is set individually by each Contracting Party at 5,500, 7,500 or 11,000 cycles for a 15-year service life."	JAMA JARI - Disagree with (+2/-0 MPa). The pressure condition should be "≥125% NWP and specified by manufacturer value". TF 3 – Agree with JAMA JARI comment on pressure, i.e. change the pressure requirement to be ≥125% NWP. Add general comment that states "Unless otherwise specified, maximum and minimum test pressures shall be specified by the manufacturer." Add to 6.2.1. (This comment has been

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						superseded by PTL 5.1.1.2 below) JAMA JARI – It should be changed to “Add general comment that states “Unless otherwise specified, the tolerances above the maximum and/or below the minimum test parameters may be recommended by the manufacturer.” Add to 6.2.1.” TF 3 – Agree with JAMA JARI comment
JARI	5.1.1.2		te	Specifies ambient temp of 20±5 C The temperature shall be specified based on ISO 554-1976 and JIS Z 8703:1983. The parts of temperature measurement are specified in Clause 6.2.2.2.	Recommend extending temperature range – possibly to 5-35 deg C.	TF 3 – Agree with this comment. Change to 5-35°C. This applies to other tests conducted at ambient temperature.
PTL	5.1.1.2		te		Three (3) new containers randomly selected from the design qualification batch are hydraulically pressure cycled at 20(±5)°C to ≥125 per cent NWP…	JAMA JARI - Partly agreed. The pressure condition should be “≥125% NWP and specified by manufacturer value”. TF 3 – Agree with JAMA JARI comment on pressure, i.e. change the pressure requirement to be ≥125% NWP. Add general comment that states “Unless otherwise specified, the tolerances above the maximum and/or below the minimum test parameters may

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						be recommended by the manufacturer." Add to 6.2.1.
EC	5.1.2.1		te		A storage container is pressurized to 150 per cent NWP **(+2/-0 MPa)** and held for **at least** 30 sec (para. 6.2.3.1. test procedure). A storage container that has undergone a proof pressure test in manufacture is exempt from this test."	JAMA JARI - Partly agreed. It should be "at least 30 sec and specified by manufacturer value". The pressure condition should be "≥150% NWP and specified by manufacturer value". TF 3 – Change to "≥150% NWP and held for at least 30 seconds."
PTL	5.1.2.1		te		Recommend: A storage container is pressurized to **≥**150 per cent NWP and held for **at least** 30 sec…	JAMA JARI - Partly agreed. It should be "at least 30 sec and specified by manufacturer value". The pressure condition should be "≥150% NWP and specified by manufacturer value". TF 3 – Change to "≥150% NWP and held for at least 30 seconds."
NHTSA	5.1.2.4		te	Specifies ambient temp of 20±5 C	Recommend extending temperature range – possibly to 10-40 deg C.	JAMA JARI - Disagree. See JARI comment for 5.1.2.4. TF 3 - Change to 5-35°C.
PTL	5.1.2.4		te	20±5 C is an unnecessarily stringent test temperature range for the container skin and fluid. Recommend expanding test temperature range or allowing skin and fluid temperatures to rise to a reasonable temperature incapable of harming a robust container or materially affecting test performance.	Recommend extending temperature range – possibly to 10-40 deg C. OR The storage container is exposed to chemicals found in the on-road environment and pressure cycled to 125 per cent NWP at 20° (**±**5)°C as measured in air for 60 per cent	JAMA JARI - Disagree. See JARI comment for 5.1.2.4 for temperature range. It is not necessary to specify measurement points which are shown in 6.2.3.4 as is described.

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					number … The temperature of the container skin and internal fluid may exceed 25 C during the test however may not exceed 40 C.	TF 3 - Change to 5-35°C. PTL withdraws "OR" comment.
EC	5.1.2.4		te		The storage container is exposed to chemicals found in the on-road environment and pressure cycled to 125 per cent NWP **(+2/-0 MPa)** at 20° (±5)°C for 60 per cent number of Cycles pressure cycles (para. 6.2.3.4. test procedure). Chemical exposure is discontinued before the last 10 cycles, which are conducted to 150 per cent NWP **(+2/-0 MPa)**.	JAMA JARI - Not agreed. The storage container is exposed to chemicals found in the on-road environment and pressure cycled to **≥125% NWP and specified by manufacturer value** at **temperature range 5-35 deg C** for 60 per cent number of Cycles pressure cycles (para. 6.2.3.4. test procedure). Chemical exposure is discontinued before the last 10 cycles, which are conducted to **≥150% NWP and specified by manufacturer value**. TF 3 - change the pressure requirements to be ≥125% NWP and ≥150% NWP.
PTL	5.1.2.4		te	Allow flexibility in setting an upper pressure limit.	The storage container is exposed to chemicals found in the on-road environment and pressure cycled to **≥**125 per cent NWP at 20° (±5)°C for 60 per cent number of Cycles pressure cycles (para. 6.2.3.4. test procedure). Chemical exposure is discontinued before the last 10 cycles, which are conducted to **≥**150 per cent NWP	JAMA JARI - Not agreed. See above "EC 5.1.2.4". TF 3 – Agree to ≥ 125% and 150% values.
JARI	5.1.2.4		te	Specifies ambient temp of 20±5 C The temperature shall be specified based on ISO 554-1976 and JIS Z 8703:1983. The parts of temperature measurement are	Recommend extending temperature range – possibly to 5-35 deg C.	TF 3 – Agree, see above.

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				specified in Clause 6.2.2.2.		
JARI	5.1.2.4		te	Chemical exposure can be continued up to the last 10 cycles. It seems not to be affect to increase just a few hours of chemical exposure.	Chemical exposure is discontinued **after** ~~**before**~~ the last 10 cycles, which are conducted to **≥**150 per cent NWP	JAMA JARI - Partly agreed: Chemical exposure is discontinued **after** ~~**before**~~ the last 10 cycles, which are conducted to **≥**150 per cent NWP **and specified by manufacturer value.** TF 3 – Agree to add: "Chemical exposure is discontinued after the last 10 cycles." Rationale is that this change makes the test less burdensome without changing the severity of the test.
EC	5.1.2.5		te		The storage container is pressurized to 125 per cent NWP **(+2/-0 MPa)** at ≥85°C for **at least** 1,000 hr (para. 6.2.3.5. test procedure).	JAMA JARI - Not agreed. The storage container is pressurized to **≥**125 per cent NWP **specified by manufacturer** at ≥85°C **specified by manufacturer** for **at least** 1,000 hr (para. 6.2.3.5. test procedure). TF 3 – Agree to change pressure requirement to ≥125% NWP, and add "for at least 1,000 hr."
PTL	5.1.2.5		te	Allow flexibility in setting an upper pressure limit.	The storage container is pressurized to **≥**125 per cent NWP at ≥85°C for **at least** 1,000 hr (para. 6.2.3.5. test procedure).	JAMA JARI - Partly Agreed. See above JAMA/JARI comment on "EC 5.1.2.5". TF 3 - Agree
NHTSA	5.1.2.5, 6.2.3.5		te	5.1.2.5 states temp ≥ 85 deg C 6.2.3.5 states temp 85±5 deg C	Recommend 85±5 deg C	JAMA JARI - Not agreed. See above JAMA/JARI

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						comment on "EC 5.1.2.5". TF 3 – Agree with ≥85°C only.
CSA	5.1.2.6		te	There is no tolerance specified for relative humidity during the +85°C cycles.	Recommend >95% RH.	JAMA JARI - Disagree. ≥80% RH is preferable like PLI proposal. It is impossible to keep ">95% RH" due to condensation on the piping at lower temperature of fluid at the start of the testing. Actual measurement value was 89% RH to 98% RH humidity setting of constant temperature chamber from the results of JARI's testing. TF 3 – Agree to change to ≥80% relative humidity
CSA	5.1.2.6		te	There is no tolerance specified for temperatures	Recommend -40°C (-5/+0)°C and +85°C (-0/+5)°C	JAMA JARI - Not agreed. The storage container is pressure cycled at ≤ -40°C **specified by manufacturer ……**and at ≥ +85°C **specified by manufacturer** …… TF 3 – Change temperature tolerances to ≥85°C and ≤-40°C.
EC	5.1.2.6		te		The storage container is pressure cycled at ≤ -40°C to 80 per cent NWP **(+2/-0 MPa)** for 20 per cent number of Cycles and at ≥ +85°C and 95 per cent relative humidity to 125 per cent NWP **(+2/-0 MPa)** for 20 per cent number of Cycles (para. 6.2.2.2. test procedure).	JAMA JARI - Not agreed. The storage container is ….to ≥80 per cent NWP **specified by manufacturer** for 20 per cent number …≥125 per cent NWP **specified by manufacturer** for 20 per cent

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						number of Cycles (para. 6.2.2.2. test procedure). TF 3 – Change pressure tolerance to ≥80% NWP and ≥125% NWP.
PTL	5.1.2.6		te	There is no tolerance specified for relative humidity during the +85°C cycles.	Recommend ≥80% RH.	JAMA JARI - Agree. More realistic. TF 3 – Agree to change to ≥80% relative humidity.
PTL	5.1.2.6		te	Allow flexibility in setting an upper pressure limit.	The storage container is pressure cycled at ≤ -40°C to **≥**80 per cent NWP for 20 per cent number of Cycles and at ≥ +85°C and ~~**95**~~ **≥80** per cent relative humidity to **≥**125 per cent NWP for 20 per cent number of Cycles	JAMA JARI - Not agree. The storage container is pressure cycled at ≤ -40°C to **≥**80 per cent NWP **specified by manufacturer** for 20 per cent number of Cycles and at ≥ +85°C and ~~**95**~~ **≥80** per cent relative humidity to **≥**125 per cent NWP **specified by manufacturer** for 20 per cent number of Cycles TF 3 – Agree, see above. Specified by manufacturer already discussed above.
NHTSA	5.1.2.6		te	Extreme temperature cycling starts with cold cycling followed by hot cycling. This is not in accordance with HGV2 and EC79	Recommend resolution between standards.	EC JRC - Regulation EC 79 /2009 is to be repealed. UN Reg. 134 applies in the EU with additional criteria for material qualification Agree with the comment, also harmonization with ISO/DIS 19881 would be desirable. JAMA JARI - Disagree. The original text shall be kept.

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						When testing the hot cycling first, it may be disadvantageous for the Type3 containers due to the decreasing of residual stress by autofrettage. TF 3 – Agree, change the order of hydraulic testing to be hot cycles first, then cold cycles to be consistent with other standards (HGV 2, ISO/DIS 19881 and EC R79). This will be inconsistent with SAE J2579. Rationale is that switching from hot cycling to cold cycling may be tougher for type 3 designs. Ensure that the new test procedure in 6.2.3.6 covers method of switching from hot cycling to cold cycling which addresses JARI JAMA comment.
EC	5.1.2.7		te		Hydraulic residual pressure test. The storage container is pressurized to 180 per cent NWP **(+2/-0 MPa)** and held **at least** 4 minutes without burst (para. 6.2.3.1. test procedure)."	JAMA JARI - Not agreed. Hydraulic residual pressure test. The storage container is pressurized to **≥**180 per cent NWP **specified by manufacturer** and held **at least** 4 minutes **specified by manufacturer** without burst (para. 6.2.3.1. test procedure)." TF 3 – Agree to ≥180% NWP

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						and add at least 4 minutes.
PTL	5.1.2.7		ed		The storage container is pressurized to 180 per cent NWP and held **for** 4 minutes without burst (para. 6.2.3.1. test procedure).	JAMA JARI - Agree. TF 3 – Agree to ≥180% NWP and add at least 4 minutes.
JAMA	5.1.2.7		ed	In a process of developing UNR for motorcycles, the WG drafted it based on UNR134 and made a couple of editorial changes to make clear the meaning of the terms. They recommend those changes should be reflected to GTR13 and UNR134.	~~Hydraulic residual pressure test~~ **Residual proof pressure test**	
PTL	5.1.2.8		ed	The statement "…baseline initial burst pressure (BPo) determined in para. 5.1.1.1…" is confusing and needs clarification. BPo is called "midpoint burst pressure", not "baseline initial burst pressure", in 5.1.1.1. Also, BPo is not determined in 5.1.1.1 since it is supplied by the manufacturer and may be confused with the test results from 5.1.1.1.	"…verify that the burst pressure is at least 80 per cent of the ~~baseline burst pressure determined in~~ **BPo** found in para. 5.1.1.1."	JAMA JARI - Agree.
JAMA	5.1.2.8		ed	See JAMA04	5.1.2.3. ~~Residual burst strength test~~ **Residual strength burst test**	
EC JRC	5.1.3		ge	Verification test for expected on-road performance is complicated to execute because lack of tolerance is some test parameters and because test conditions are demanding for test equipment	Bear in mind that the pneumatic sequential tests has to be practicable and repeatable, allowing reproducibility of results in different test facilities	TF 3 – Agree, this is the purpose of the current exercise.
EIGA	5.1.2		ge/te	EIGA presented WG 24 refuelling risk assessment which identified risks for tank over-temperature scenarios possibly necessitating the addition of tests to cover 95°C and 140°C gas temperatures.	Increase test temperature to 95°C in parking performance test and add one hydraulic pressure cycle to 140°C. EIGA invites experts to attend EIGA-hosted industry working group.	TF 3 – Reserve judgment until members have digested EIGA analysis and recommendation. JAMA JARI - Disagree. (1) JAMA-JARI basically thinks that the station-side should respond to station failures

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						(2) EIGA should explain the rationale of the proposals on 95C and 140C. Most of TF3 member do not understand the technical background or rationality of the proposals at all. It should also be explained why these station failures cannot be handled within station technologies. TF 3 to solicit results of EIGA industry working group (Paul Karzel)
EC JRC	5.1.3		te	The gas bulk temperature is typically 5-10°C higher than the tank material temperature. Fixing the inner tank temperature limit to 90°C would make the test procedure more similar to the expected on-road performance	Consider adding a test where the softening temperature of the polymeric materials are measured at a temperature as high as 105 °C	TF 3 – Should material requirements be specified (e.g. Tg and Tsoft), or should a performance test be specified? JAMA JARI - Disagree with 105℃. Although performance test is ideal there is not appropriate test procedure. If the material requirements are necessary it should be the same description as SAE J2579 below. ------------------------------------- SAE J2579-2018JUN : F.1.2 Softening Temperature Polymeric materials from finished liners shall be tested according to ISO 306 with the appropriate method specified by the supplier of the polymeric material. The softening

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						temperature shall meet requirements of the containment vessel manufacturer, to at least 100 °C. TF 3 – Agree with JAMA JARI recommended language.
PTL	5.1.3		ed/te	Figure 3 includes proof test, gas cycle, permeation and burst. Each test has its own pass/fail criteria. The criteria “shall not leak” is only applicable to the gas cycle test. Further, the ‘hydrogen storage system’ does not undergo the entire sequence (burst test is container only).	Remove sentence and insert in section 5.1.3.2 (ambient and extreme temperature gas pressure cycling test). Replace sentence with “A hydrogen storage system (or container only, as specified) shall undergo the following sequence of tests, which are illustrated in Figure 3.	TF 3 – Agree
PTL	5.1.3		te	Pass/fail criteria for the gas cycle test may need to be elaborated on. Does the OTV and all its components have to be functional (check valve, shut-off valve, TPRD)? Does “leak” include internal leakage or external leakage only? Does the OTV have to be used as intended in the vehicle or is it only there to be part of the pressure cycles? There is extensive testing on the OTV in section 5.1.5. Does this cover any of the above questions?	Add language that states the fuel system shall not leak and the specific components (shut-off valve, check valve and TPRD) shall maintain functionality during the test.	TF 3 – Agree
EC	5.1.3.1		te		A system is pressurized to 150 per cent NWP **(+2/-0 MPa)** for **at least** 30 seconds (para. 6.2.3.1. test procedure). A storage container that has undergone a proof pressure test in manufacture ~~is~~**may be** exempt**ed** from this test.”	JAMA JARI - Not agreed. A system is pressurized to 150 per cent NWP **<u>specified by manufacturer</u>** for **at least** 30 seconds **<u>specified by manufacturer</u>** (para. 6.2.3.1. test procedure). ….. TF 3 – change pressure to

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						≥150% NWP and change time to at least 30 seconds. No change for exemption language.
EC	5.1.3.2(b)		te		The first group of pressure cycling, 25 cycles are performed to 80 per cent NWP **(+2/-0 MPa)** at ≤ -40 °C, then 25 cycles to 125 per cent NWP **(+2/-0 MPa)** at ≥ **+**50 °C and 95 **(±2)** per cent relative humidity, and the remaining 200 cycles to 125 per cent NWP **(+2/-0 MPa)** at 20 (± 5) C; The second group of pressure cycling, 25 cycles are performed to 125 per cent NWP **(+2/-0 MPa)** at ≥ +50 °C and 95 **(±2)** per cent relative humidity, then 25 cycles to 80 per cent NWP **(+2/-0 MPa)** at ≤ -40 °C, and the remaining 200 cycles to 125 per cent NWP **(+2/-0 MPa)** at 20 (± 5) °C."	EC JRC - Note that ISO/DIS 19881 tolerances for pressure are ±1 MPa. Does this make more sense? JAMA JARI - Not agreed. The first group of pressure cycling, 25 cycles are performed to ≧80 per cent NWP **specified by manufacturer** at …. then 25 cycles to ≧125 per cent NWP **specified by manufacturer** at ≥ **+**50 °C and **≧80** per cent relative humidity, and the remaining 200 cycles to ≧125 per cent NWP **specified by manufacturer** …… The second group of pressure cycling, 25 cycles are performed to ≧125 per cent NWP **specified by manufacturer** at …..and **≧80** per cent relative humidity, then 25 cycles to ≧80 per cent NWP **specified by manufacturer** at ….the remaining 200 cycles to ≧125 per cent NWP **specified by manufacturer** at …… TF 3 – Previous agreed changes to pressure and temperature tolerances are

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						covered.
EC JRC	5.1.3.2 (b)		te	There is no tolerance for temperature fluctuations in the CHSS during cold / warm cycles	Allow ±5°C fluctuation in the system during cold / warm cycles	TF 3 – Previous agreed changes to pressure and temperature tolerances are covered.
PTL/ NHTSA	5.1.3.2 (b)		te	Add a table to clearly itemize the test parameters	Table to be provided by PTL/NHTSA	TF 3 – Agree
EC JRC	5.1.3.2(b)		te	Container performance does not seems to significantly change for pneumatic cycle made at -40°C ambient in comparison to tests made at ambient -25 °C	Consider performing test at -25 °C, but adding a test where the tensile properties of the plastic materials are measured at temperatures lower than -40 °C	TF 3 – Agree to change the ambient temperature for cold gas cycling to -25°C. Rationale – Reduction of test burden for test facilities due to component restriction of -40°C performance. New temperature (-25°C) is a more realistic real world operating condition for defueling rates required in the test. This rationale is already used for the hot ambient gas cycling condition where +50°C ambient temperature is specified, yet components are rated to +85°C. This change does not compromise the safety intent of the test because in-tank gas temperatures will reach -40°C.
NHTSA	5.1.3.2(b)		te	Cold cycles are done at 80% NWP. This is not representative of real world conditions.	Recommend cycling to NWP.	EC JRC – Agree JAMA JARI - Disagree. The map of non-communication refuelling in J2601 should be referred to meet the real world conditions. NHTSA withdraws comment.

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PTL	5.1.3.2(b)		te	Cycles are performed to 80% NWP at -40C.	Recommend cycling to NWP. SAE J2601 H70T40 target pressures for fueling from 2MPa at -40C are ≥70MPa.	EC JRC – Agree JAMA JARI - Disagree. The map of non-communication refuelling in J2601 should be referred to meet the real world conditions. PTL withdraws comment.
NHTSA	5.1.3.2(b)		te	No lower container temperature specified for cold gas cycling.	Container temperature should be allowed to go below -40 deg C.	EC JRC - Agree. Results of JRC experiments show that for the cycles with temperature equilibration tank wall temperatures reach -47°C while for the consecutives cycles without equilibration temperatures the tank wall cools down to -60°C. JAMA JARI - Disagree. Lower container temperature should not be specified. Container temperature can be allowed to go below -40 deg C according to current description. NHTSA withdraws comment.
PTL	5.1.3.2(b)		te	No lower container temperature specified for cold gas cycling.	Should be a requirement that minimum container temperature is lower than -40C. When performing cold cycles at ≤-40C, it is impossible to complete the defuel if the tank reaches an internal temperature of -40C (tank cannot warm up, as ambient temperature is already below -40C)	EC JRC - Alternatively consider performing the test at an ambient temperature of -30°C (as in ISO/DIS 19881). JAMA JARI - Disagree. Lower container temperature should not be specified. Container temperature can be

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						allowed to go below -40 deg C according to current description. PTL withdraws comment.
CSA	5.1.3.2(b)		te	There is no tolerance specified for the relative humidity during +50°C cycles (5.1.3.2 (b)).	Recommend >95% RH.	EC JRC - Prefer ≥80% RH JAMA JARI - Not agreed. Delete the humidity condition. It is not needed to evaluate the influence of humidity in the pneumatic sequential tests. Because that is evaluated in the hydraulic sequential tests. TF 3 – Reduce relative humidity requirement to ≥80% to be consistent with hydraulic test requirements.
PTL	5.1.3.2(b)		te	There is no tolerance specified for the relative humidity during +50°C cycles (5.1.3.2 (b)). 95%RH at 50C is an unrealistic condition that is unnecessarily severe for an “on-road performance” test. If the intent is to cycle the HSS in an extreme humidity environment, 80%RH at 50C should be sufficient.	Recommend ≥80% RH.	EC JRC - Agree, in any case as RH depends on temperature: 80% RH at 55°C means that as soon as temperature decreases in the tank water condensates in its outer walls (e.g. during emptying). JAMA JARI - Not agreed. Delete the humidity condition. See the above JAMA/JARI comment. TF 3 – Reduce relative humidity requirement to ≥80%

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						to be consistent with hydraulic test requirements.
CSA	5.1.3 5.1.3.2(c)		te	Figure 3 specifies fueling with hydrogen gas at <-35°C (5.1.3) whereas Clause 5.1.3.2 (c) specifies a hydrogen gas fueling temperature of ≤-40°C.	Recommend SAE J2601 T40 fueling specification window of -33°C to -40°C within 30 seconds of fueling initiation. Follow the procedure in Powertech report. Figure 5.1.3 does not match the text and is not according to SAE J2601. Recommend following SAE J2601 (correction confirmed by NHTSA).	EC JRC – Agree JAMA JARI - Agreed. TF 3 – Agree.
PTL	5.1.3.2(c)		te	Fueling gas temperatures ≤-40°C violate SAE J2601 fueling conditions.	Recommend SAE J2601 T40 fueling specification window of -33°C to -40°C within 30 seconds of fueling initiation.	EC JRC - Alternatively consider performing the test at an ambient temperature of -30°C (as in ISO/DIS 19881). JAMA JARI - Agreed. TF 3 – Agree.
JAMA	5.1.3.3		ed	See JAMA04	Extreme temperature static **gas** pressure leak/permeation test.	
EC	5.1.3.4		te		The storage container is pressurized to 180 per cent NWP **(+2/-0 MPa)** and held **at least** 4 minutes without burst (para. 6.2.3.1. test procedure)."	JAMA JARI - The storage container is pressurized to ≧180 per cent NWP **specified by manufacturer** and held **at least** 4 minutes **specified by manufacturer** without burst (para. 6.2.3.1. test procedure)." TF 3 – Agree to change pressure to ≥180% NWP and time to at least 4 minutes.
EC	5.1.3.5		te		The storage container undergoes a hydraulic burst to verify that the burst pressure is ~~within 20~~**at least 80** per cent of the baseline burst pressure determined in para. 5.1.1.1. (para. 6.2.2.1. test procedure)."	JAMA JARI - Agreed. TF 3 – Agree
PTL	5.1.3.5		ed, te	The statement "…baseline burst pressure	"…verify that the burst pressure is ~~within 20~~	JAMA JARI - Agreed.

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				determined in 5.1.1.1…" is unclear as "baseline burst value" is not a defined value. Does this mean the average of the 3 bursts in 5.1.1.1? Does this mean BPo (called "midpoint burst pressure", not "baseline initial burst pressure", in 5.1.1.1)? Also, BPo is not determined in 5.1.1.1 since it is supplied by the manufacturer and may be confused with the test results from 5.1.1.1. Agree with EC that 5.1.3.5 wording should be consistent with 5.1.2.8	**at least 80** per cent of ~~the baseline burst pressure determined in~~ **BPo found** in para. 5.1.1.1."	The same as Clause 5.1.2.8. (Residual burst strength test). TF 3 - Agree
CSA	5.1.4		te	Testing may be performed using compressed air – this can lead to an unsafe condition (high pressure air combined with minor oil residue).	Delete the clause: ~~However, Contracting Parties under the 1998 Agreement may choose to use compressed air as an alternative test gas for certification of a container for use only within their countries or regions.~~	JAMA JARI - Agreed. TF 3 – Agree. Rationale is that there must be a way to measure any potential leakage that creates a flame greater than 0.5m. Therefore nitrogen and helium cannot be used.
PTL	5.1.4		te	Agree with CSA however nitrogen or helium could be used in place of air.	"may choose to use ~~compressed air~~ nitrogen or helium as an alternative test gas for certification…"	JAMA JARI - Partly agreed. Nitrogen should not be used. Because the increasing rate of temperature of nitrogen gas may be lower than that of hydrogen gas. TF 3 – Disagree. Rationale is that there must be a way to measure any potential leakage that creates a flame greater than 0.5m. Therefore nitrogen and helium cannot be used.
PTL	5.1.4		te	If there is a concern with devices venting through the pressure relief device but NOT through the intended outlet port, the proposed edit should be considered.	"A temperature-activated pressure relief device shall release the contained gases in a controlled manner **through its intended vent or outlet port** without rupture."	JAMA JARI - Need to be discussed on definition of "intended vent".

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				Powertech has experienced TPRDs that vented but not through the intended outlet meaning that hydrogen gas or ignited hydrogen gas would possibly vent at the TPRD into the surrounding area rather than through its vent line.		TF 3 – Agree JAMA JARI – It should be stated that "intended vent or outlet port" is the exit of TPRD TF 3 – Agree with the following: "A temperature-activated pressure relief device shall release the contained gases in a controlled manner through its intended outlet port without rupture."
EC	5.1.5.2		ed		Check valve and automatic shut-off valve qualification ~~on~~ requirements. Design qualification testing shall …"	
EC	5.2		ed		This section specifies requirements for the ~~integrity of the hydrogen~~ **vehicle** fuel ~~delivery~~ system, which includes the **compressed** hydrogen storage system, piping, joints, and components in which hydrogen is present."	
JAMA	5.2.1.1.2		ge	Harmonize with UN R134	Add underlined words Fuelling receptacle label A label shall be affixed close to the fuelling receptacle; for instance inside a refilling hatch, showing the following information: fuel type <u>(e.g. "CHG" for gaseous hydrogen)</u>, NWP, <u>MFP,</u> date of removal from service of containers.	TF 3 – Agree
JAMA	5.2.1.3.1	(a)	te	Not restrict the protection means to a cap. (a) Storage system TPRDs. The outlet of the vent line, if present, for hydrogen gas discharge from TPRD(s) of the storage system shall be <u>protected by a cap;</u>	Modify as below. Storage system TPRDs. The outlet of the vent line, if present, for hydrogen gas discharge from TPRD(s) of the storage system shall be protected <u>from ingress of dirt and water (e.g.</u> by a cap<u>);</u>	TF 3 – Agree with first suggestion, i.e.: Storage system TPRDs. The outlet of the vent line, if present, for hydrogen gas discharge from TPRD(s) of the storage system shall be

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					Or from blockage with foreign substances. (e.g. by using a cap)	protected from ingress of dirt and water (e.g. by a cap);
EC	5.2.1.3.1 (c)		ed		Other pressure relief devices (such as a burst **disc**~~disk~~) may be used outside the hydrogen storage system. The hydrogen gas discharge from other pressure relief devices shall not be directed: (i)Towards exposed electrical terminals, exposed electrical switches or other ignition sources; (ii)Into or towards the vehicle passenger or ~~cargo~~ **luggage** compartments; (iii)Into or towards any vehicle wheel housing; (iv)Towards hydrogen gas containers."	
EC	5.2.1.4.1		ed		Hydrogen leakage and/or permeation from the hydrogen storage system shall not directly vent into the passenger **or**~~,~~ luggage~~, or cargo~~ compartments, or to any enclosed or semi-enclosed spaces within the vehicle that contains unprotected ignition sources."	
EC	5.2.1.5		ed		The hydrogen fuelling line **(e.g. piping, joint, etc.)** ~~and the hydrogen system(s)~~ downstream of the main shut off valve(s) **to the fuel cell system or the engine** shall not leak. Compliance shall be verified at NWP (para. 6.1.5. test procedure)."	
JAMA	5.2.1.6		ed	Correction	(b) Yellow in ~~colour~~ color if the detection system malfunctions and shall be red in compliance with ~~section~~ para. 5.2.1.4.3;	
EC	5.2.1.6(b)		ed		Yellow in colour if the detection system malfunctions **(e.g. circuit disconnection, short-circuit, sensor fault).** ~~and~~**It** shall be red in compliance with section para. 5.2.1.4.3;"	
EC	5.2.1.6(d)		ed		Remains illuminated when 2 ± 1.0 per cent	

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					concentration or detection **system** malfunction~~)~~ exists and the ignition locking system is in the "On" ("Run") position or the propulsion system is activated.”	
EC	5.2.2.1		te		The volumetric flow of hydrogen gas leakage shall not exceed an average of 118 NL per minute for **the time interval, Δt, as determined in accordance with paragraph 6.1.1.1. or 6.1.1.2.**~~60 minutes after the crash~~ (para. 6.1.1. test procedure.	JAMA JARI - Agree. TF 3 – Agree
EC	5.2.2.2		ed		Hydrogen gas leakage shall not result in a hydrogen concentration in the air greater than 3 ± 1.0 per cent~~]~~ by volume in the passenger **and**~~,~~ luggage~~ and cargo~~ compartments (para. 6.1.2. test procedures). The requirement is satisfied if it is confirmed that the shut-off valve of the storage system has closed within 5 seconds of the crash and no leakage from the storage system”	
JAMA	5.2.2.3		ed	Correction	Container ~~D~~displacement	
EC	6.1.1		ed		The main stop valve and shut-off valves for hydrogen gas, located in the downstream hydrogen gas piping, are **in normal driving condition**~~kept open~~immediately prior to the impact.”	
EC	6.1.1.2		te		Post-crash leak test - Compressed hydrogen storage system filled with compressed helium… The average helium flow rate over the time interval is therefore V_{He} = (M_f-M_o) / Δt x 22.41 / 4.003 x (~~P_o/~~P_{target} **/ P_0**) where V_{He} is the average volumetric flow rate (NL/min) over the time interval and the term ~~P_o/~~ P_{target} **/ P_o** is used to ….”	JAMA JARI - Agreed. TF 3 – Agree with suggested language. Also change in the text Ptarget/P0.

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EC	6.1.2		ed		Prior to the crash impact, the sensors are located in the passenger **and**~~,~~ luggage~~, and cargo~~ compartments of … (c)Atdistance within 100 mm of the top of luggage ~~and cargo~~ compartments within … … to more than 10 per cent of the targeted criteria in the passenger **and**~~,~~ luggage~~, and cargo~~ compartments.… The filtered readings from each sensor shall be below the targeted criteria of 3 ± 1.0 per cent for hydrogen **or**~~and~~ 2.25 ± 0.75 per cent for helium at all times throughout the 60 minutes post-crash test period.”	
TMC	6.2.5.1.2a		te	Rationale: Intent is to have the cylinder at 100%SOC. As written, “100% NWP” is confusing, as it could be interpreted as 70MPa at any temperature. Test environment temp dictates NWP, thus tank can be over/under 70MPa depending on ambient condition	“The container assembly is filled with compressed hydrogen gas to nominal working pressure, with pressure compensated for ambient test temperature.”	TF 3 – Agree to the following language: “The container assembly is filled with compressed hydrogen gas to 100% state of charge.”
EC	6.1.3.2.1.3		ed		Prior to the test the vehicle is prepared to allow remotely controllable hydrogen releases from the hydrogen system. The number, location and flow capacity of the release points downstream of the main hydrogen shutoff valve are defined by the vehicle manufacturer taking worst case leakage scenarios **under single failure condition** into account. As a minimum, the total flow of all remotely controlled releases shall be adequate to trigger demonstration of the automatic "warning" and hydrogen shut-off functions.”	
JAMA	6.1.3.2.1.3		te	“Hydrogen releases from the hydrogen system” needs to alter the test vehicle. A test method without modification of fuel lines also should be provided.	6.1.3.2.1.3. Prior to the test the vehicle is prepared to simulate ~~allow~~ remotely controllable hydrogen releases from the hydrogen system. Hydrogen releases may	TF 3 – Agree

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					<u>be demonstrated by using external fuel supply without modification of fuel lines of the test vehicle.</u> The number, location and flow capacity of the release points downstream of the main hydrogen shutoff valve are defined by the vehicle manufacturer taking worst case leakage scenarios into account. As a minimum, the total flow of all remotely controlled releases shall be adequate to trigger demonstration of the automatic "warning" and hydrogen shut-off functions.	
EC	6.1.4.3		ed		The measuring section of the measuring device is placed on the centre line of the exhaust gas flow within 100 mm from the exhaust **point of discharge**~~gas outlet~~ external to the vehicle."	
EC	6.1.5.2.		ed		Hydrogen leakage is evaluated at accessible sections of the fuel lines from the high-pressure section to the fuel cell stack (or the engine), using a gas **leak** detector or **a** leak detecting liquid, such as soap solution."	
NHTSA	6.2.2.1		te	Specifies ambient temp of 25±5 C	Test is done outdoors so recommend extending temperature range – possibly to 10-40 deg C.	JAMA JARI - To be discussed with 6.2.2.2. See JARI comment of 5.1.1.2 Recommend extending temperature range – possibly to 5-35 deg C. TF 3 – Previously accepted ambient temperature of 5 to 35°C.
PTL	6.2.2.1		te	20±5 C is an unnecessarily stringent test temperature range for the container skin and fluid. Recommend expanding test temperature range or allowing skin and fluid temperatures to rise to a reasonable	Recommend extending temperature range – possibly to 10-40 deg C. OR	JAMA JARI - To be discussed with 6.2.2.2. TF 3 – Previously accepted ambient temperature of 5 to

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				temperature incapable of harming a robust container or materially affecting test performance.	"The burst test is conducted at an ambient air and initial external container skin temperature of 20±5 C The temperature of the container skin and internal fluid may exceed 25 C during the test however may not exceed 40 C.	35°C.
JARI	6.2.2.1		te	Specifies ambient temp of 20±5 C	The ambient temperature shall be specified at 5-35 deg C based on ISO 554-1976 and JIS Z 8703:1983. The temperatures of the container surface and the fluid shall not be specified.	JAMA JARI - To be discussed with 6.2.2.2. TF 3 – Previously accepted ambient temperature of 5 to 35°C.
JARI	6.2.2.2		te	The fluid temperature shall be deleted from the specified objects. Because it is impossible to control the fluid temperature due to changing to the pressure. Furthermore the text (d) can be deleted as it is specified in the text (b).	(b) The **environment and** the container ~~**and fluid**~~ are stabilized at the specified temperature and relative humidity at the start of testing; the environment~~**, fuelling fluid**~~ and container skin are maintained at the specified temperature for the duration of the testing. The **fluid** ~~**container temperature**~~ may vary from the environmental temperature during testing; ~~**(d) The temperature of the hydraulic fluid within the container is maintained and monitored at the specified temperature.**~~	TF 3 – Reject because we now allow ≤-40°C and ≥85°C. It is possible to maintain the fluid temperature at the specified test conditions. Suggest the following for (d): The temperature of the hydraulic fluid entering the container shall be maintained at the specified temperature and monitored as close as possible to the container inlet. JAMA-JARI – Agree
JARI	6.2.2.2		te	To easier control during the testing, the pressure condition shall be specified ≤2 MPa.	(c) The container is pressure cycled between ≤2 ~~**(±1)**~~ MPa and the target pressure at a rate not exceeding 10 cycles per minute for the specified number of cycles;	TF 3 – Agree
NHTSA	6.2.3.2		te	Drop test description is too convoluted and requires number of ambient cycling tests. Needs simplification. Also need to broaden temperature range for ambient temperature	Only one drop test per container. Compliance test can be done in any of the 4 orientations specified. Ambient temperature range increased to possibly 10 to 40 deg C.	JAMA JARI - Partly agreed. Agreed if the one orientation is done with the one container to be used in the further testing in paragraph 5.1.2.

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						See JARI comment of 5.1.1.2 Recommend extending temperature range – possibly to 5-35 deg C. TF 3 – The multiple drops on one tank is considered worse case. For self-certification the member country can select the drop orientation. Specify the ambient temperature as 5 to 35°C. Add the following to the end of the clause (a) (ii) and (iii): "Containers that cannot meet the 488J requirement within 1.8m shall be dropped with a height of the lower end at 1.8m."
CSA	6.2.3.2		te	There is no specification for drop test concrete surface hardness or roughness		JAMA JARI – There is ISO 22965 as international standard for the concrete. However the general concrete surface will have enough hardness comparing with CFRP. So it will not be necessary to specify the concrete conditions. TF 3 – No need to specify concrete hardness
EC	6.2.3.2		ed		Drop (impact) test (unpressurized) …	

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					No attempt shall be made to prevent the bouncing of containers, but the containers may be prevented from falling over during the vertical drop test described ~~in b)~~ above. If more than one container is used to execute all ~~three~~ drop specifications, then those containers shall … "	
JAMA	6.2.3.2		te	In case the container is very lightweight, dropping from the height of 1.8m will not give the potential energy of 488 J.	Dropped once onto the end of the container from a vertical position with the ported end upward with a potential energy of not less than 488 J, with the height of the lower end no greater than 1.8 m. When the potential energy is not 488 J or over even if the height of the lower end is set to 1.8 m, drop the container with the height of the lower end at 1.8 m; Dropped once onto the end of the container from a vertical position with the ported end downward with a potential energy of not less than 488 J, with the height of the lower end no greater than 1.8 m. When the potential energy is not 488 J or over even if the height of the lower end is set to 1.8 m, drop the container with the height of the lower end at 1.8 m. If the container is symmetrical (identical ported ends), this drop orientation is not required;	JAMA-JARI – Withdraw. (Resolved in the clause of NHSTA 6.2.3.2)
NHTSA	6.2.3.3		te	No time specified between removal of container from environmental chamber and time of impacts.	Recommend max. time window of 30 min. 4between removal from chamber and impact test.	HMC: Agree to NHTSA JAMA JARI – Partly agreed. Recommend to add "The Pendulum impacts shall be added immediately after removal from the chamber". The time management effort should be avoided.

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						TF 3 – Add the word "Immediately following a minimum of 12 hours…" to start the second sentence in 6.2.3.3(b)
CSA	6.2.3.3(a)		te	There is no specification for flaw cut dimensions, i.e. where one measures start of the length and depth, how does one cut the flaws, or width of flaws.		JAMA JARI – Wait for the specific proposals. TF 3 – Modify the sentence to: "The first cut is at least 1.25 mm deep and <u>at least</u> 25 mm long toward the valve end of the container. The second cut is at least 0.75 mm deep and <u>at least</u> 200 mm long toward the end of the container opposite the valve." Add flaw drawing from ISO 9809-2 Figure 5?
EC	6.2.3.3(b)		te		"(b) Pendulum impacts: …. After 12 hours preconditioning at – 40 **(+0/-2)** °C in an environmental chamber, the centre of …."	HMC: ~~After 12 hours~~ → After 24 hours (for inconvenience of the test), ≤-40℃ TF – 3 Already changed per previous comment JAMA JARI – Disagree with - 40 (+0/-2) °C. Should be changed to ≤-40°C. (Like the discussion at the last in-person meeting on Jun25.) TF 3 – Agree that this has been changed to ≤-40°C

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EC	6.2.3.4		te		Chemical exposure and ambient temperature pressure cycling test Each of the 5 areas of the unpressurized container preconditioned by pendulum impact (paragraph 6.4.**3.3.**~~2.5.2.~~) is exposed to … The exposure of the container with the glass wool is maintained for 48 hrs with the container held at 125 per cent NWP **(+2/-0 MPa)** (applied hydraulically) and 20 (±5) **°**C before …"	HMC: ≥125 per cent NWP JAMA JARI – Disagree with 125 per cent NWP (+2/-0 MPa) and 20 (±5) °C. Should be changed to ≥125%NWP and 5-35**°**C. (Like the discussion at the last in-person meeting on Jun25.) TF 3 – Agree to change to ≥125%NWP and 5-35**°**C.
CSA	6.2.3.4		te.	Difficult to ensure that test fluids pads are wetted for the duration of the test (6.2.3.4).	Recommend that a sufficient amount of the test fluid is applied to the glass wool sufficient to ensure that the pad is wetted across its surface and through its thickness for the duration of the 48 hour exposure. Use Powertech test procedure. States to soak wool pads and puts plastic covering to prevent evaporation. From test procedure: Wool pads soaked in the test fluids were placed on top of each area. The areas were then covered with plastic to prevent evaporation of the test solutions. Recommend that wetted pads are covered for the duration of the test	HMC: Agree to CSA. Wool pads soaked in the test fluids were placed on top of each area. The areas were then covered with plastic to prevent evaporation of the test solutions JAMA JARI – Agree. TF 3 – Add: "A plastic covering may be applied over the glass wool to prevent evaporation." to the end of the second paragraph.
JARI	6.2.3.4		te	It is not necessary to specify the temperature for the ambient temperature pressure cycling test. Because that is already specified in Clause 5.1.2.4. Also as same as Clause 5.1.2.4, chemical exposure will be continued up to the last 10 cycles.	Pressure cycling is performed to the specified target pressures according to paragraph 6.2.2.2. at **specified temperature ~~20 (±5)°C~~** for the specified numbers of cycles. The glass wool pads are removed and the container surface is rinsed with water **after** the final 10 cycles to specified final target pressure are conducted.	HMC: Agree to JARI TF 3 – Change the sentence to "The glass wool pads are removed and the container surface is rinsed with water <u>after</u> the final 10 cycles…"
JARI	6.2.3.5		te	It is not necessary to measure the	The storage system is pressurized to the	HMC: Agree to JARI

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				temperature of fluid. Only the control of the temperature of container surface will be enough. Also the tolerance of temperature shall be specified in only 5.1.2.5.	target pressure in a temperature-controlled chamber. The temperature of the chamber and the **container skin** ~~**non-corrosive fuelling fluid is**~~ held at the target temperature ~~within ±5°C~~ for the specified duration.	TF 3 – Agree to add: "The temperature of the chamber and the **container skin** ~~**non-corrosive fuelling fluid is**~~ held at the target temperature ~~within ±5°C~~ for the specified duration."
CSA	6.2.3.6 6.2.3.7		te	There are no detailed test procedures for the -40°C and +85°C extreme temperature cycles including information for temperature measurements in the environment and fluid.	Recommend including new Clauses 6.2.3.6 and 6.2.3.7 to describe test procedures for -40°C and +85°C extreme temperature cycles, respectively. Include suggested means for achieving >95% RH using water spray method per ISO 11119.	HMC: Agree 5.1.2.6 Extreme temperature pressure cycling. ~humidity to 125 per cent NWP for 20 per cent number of Cycles ~~(para. 6.2.2.2. test procedure)~~ → (para. 6.2.3.6 and para. 6.2.3.7 procedure) JAMA JARI – Disagree. There is no need to set up a new Clauses, the description in 5.1.2.6 is sufficient. TF 3 – Per NHTSA 5.1.2.6 comment above we need to create test procedures for 6.2.3.6 and 6.2.3.7
EC	6.2.4		ed		Test procedures for expected on-road performance (para. 5.1.3.) (Pneumatic test procedures are provided; hydraulic test elements are described in para. **6.2.2.1.**~~6.3.2.~~)"	
PTL	6.2.4		ed		Test procedures for expected on-road performance (para. 5.1.3.) (Pneumatic test procedures are provided; hydraulic test elements are described in para. **6.2.3.**~~6.3.2.~~)"	

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CSA	6.2.4.1		te	Clause 6.2.4.1 requires filling at a constant 3 minute pressure ramp rate to 87.5 MPa (± 1 MPa). For gas cycles conducted at ambient temperatures of 20°C and 50°C, this could result in an unsafe storage system condition where the state of charges exceeds 100%. For gas cycles at ambient temperatures of -40°C, the maximum fill pressure of 56 MPa yields an overly conservative fill condition.	Recommend filling profiles in accordance with SAE J2601 H70T40 non-communications Table D13 (2-4 kg storage system) or Table D19 (4-7 kg storage system) or Table D25 (7-10 kg storage system). Fueling time should be increased for stage 1, 4, and 8. See Powertech report. Agree with above recommendation, however, according to latest version of SAE J2601 (Dec2016), tables listed above should be D19 (2-4kg), D25 (4-7kg) and D31 (7-10kg). Further, recommend using J2601/4 H70TA tables (currently under development) for cycles with fuel delivery temperature of 20C. Until J2601/4 is published, recommend ramp rate of ≤5MPa/min.	EC JRC – Agree HMC: Agree to CSA JAMA JARI - Agree with the policy of the reference of non-communication Tables from SAE J2601 for the ramp rate and final fill pressure. TF 3 – New PTL table addresses this comment.
PTL	6.2.4.1		te	Allow flexibility in setting the upper and lower limits. As long as the pressure cycle is within the prescribed range, it should meet the regulation.	Recommend: The storage system is pressure cycled between less than **or equal to** 2~~**(+0/-1)**~~ MPa and **greater than or equal to** the specified maximum pressure ~~**(± 1 MPa)**~~.	EC JRC - Note that ISO/DIS 19881 tolerances for pressure are ±1 MPa. HMC: ≤2MPa, ≥ NWP JAMA-JARI - Agree. TF 3 – Already covered by set minimum and maximum tolerances.
CSA	6.2.4.2		te	The test pressure for the gas permeation test is unclear (6.2.4.2).	Recommend filling the storage system to NWP at +15°C and heating the system to +55°C prior to the start of the test.	EC JRC – Agree HMC: Agree JAMA JARI – Disagree. No need to specify details of test procedure 6.2.4.2. Even if describing details, it

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						should not be restricted to one method. Propose the following two options for conducting the stable condition of SOC 100% ≥55 deg C. Option 1) Stabilize after filling the storage system to NWP at +15°C. After that keeping the temperature of 55 deg C after the valve is closed. (The pressure is not controlled) Option 2) Once increasing the temperature to 55 deg C, stabilize after filling the storage system ≥115% NWP or ≥SOC 100%. TF 3 – Replace with “A storage system is fully filled with hydrogen gas to 100% state of charge and soaked for a minimum of 12 hours at ≥55°C in a sealed container prior to the start of the test. The test shall continue until the measured permeation reaches a steady state based on at least 3 consecutive readings separated by at least 12 h being within ±10 % of the previous reading, or 500 hours, whichever occurs first. If the latter, calculate the theoretical steady state value… Rationale for removing the 30

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						hour minimum: It has been replaced by the steady state determination (>36h). Discussion to be continued regarding continuing the test indefinitely or including a 500 h hard stop with extrapolation of steady state value.
CSA	6.2.4.2		te	There is no definition for steady state for the gas permeation test (6.2.4.2).	Recommend steady state is achieved when three consecutive 24h readings do not fluctuate greater that 10%.	JAMA JARI - Disagree with 24h. Should be defined the same as SAE J 2579 below. ------------------------------------- SAE J2579-2018JUN : Appendix C steady-state permeation is defined as 3 consecutive overall permeation rates, at least 12 hours apart, where each successive value is within ±10% of the previous. TF 3 – Agree with SAE J2579 language: The test shall continue until the measured permeation reaches a steady state based on at least 3 consecutive readings separated by at least 12 h being within ±10 % of the previous reading, or 500 hours, whichever occurs first. If the latter, calculate the theoretical steady state value…

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						Discussion to be continued regarding continuing the test indefinitely or including a 500 h hard stop with extrapolation of steady state value.
NHTSA	6.2.4.2		te	There is no definition for steady state for the gas permeation test (6.2.4.2).	Recommend 3 consecutive readings separated by at least 12 hours.	EC JRC – Agree JAMA JARI – Agree. TF 3 – See above
PTL	6.2.4.2		te	There is no definition for steady state for the gas permeation test (6.2.4.2).	Recommend steady-state permeation is defined as 3 consecutive overall permeation rates, at least 24 hours apart, where each successive value is within ±10% of the previous. Consecutively increasing rates are not considered to be at steady-state.	EC JRC - Separated at least 12 hours? HMC: Partly agree. ~~24 hours~~ → 12 hours JAMA JARI - Disagree with 24h. Should be defined the same as SAE J 2579 below. ------------------------------------ SAE J2579-2018JUN : Appendix C steady-state permeation is defined as 3 consecutive overall permeation rates, at least 12 hours apart, where each successive value is within ±10% of the previous TF 3 – See above
EC	6.2.4.2		te		Gas permeation test (pneumatic) A storage system is fully filled with hydrogen gas at 115 per cent NWP **(+2/-0 MPa)** (full fill	JAMA JARI – Disagree with 115 per cent NWP (+2/-0MPa). Should be changed to

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					density equivalent to 100 per cent NWP at +15 °C is 113 per cent NWP at +55 °C) and held …”	≥115%NWP. (Like the discussion at the last in-person meeting on Jun25.) TF 3 – Already covered above
PTL	6.2.4.2		te	Allow flexibility in setting an upper limit.	Gas permeation test (pneumatic) A storage system is fully filled with hydrogen gas at **greater than or equal to** 115 per cent NWP (full fill density equivalent to 100 per cent NWP at +15 °C is 113 per cent NWP at +55 °C) and held …”	HMC: Agree to PTL to ≥115% NWP JAMA JARI – Partly agreed. The following parenthesized description is unnecessary. (full fill density……) TF 3 – Already covered above
PTL	6.2.4.2		te	The 30 hour requirement makes no sense. This may be a copy error from SAE J2579 which prescribes a 30 hour hold at 55C prior to the permeation test (presumably to accelerate hydrogen saturation of the tank). There should also be a cap on the permeation test in case steady state is not reached. 500 hours is just a suggestion.	Recommend: “… and held at ≥55C in a sealed container until steady-state permeation ~~or 30 hours, whichever is longer~~ is reached. The test shall not exceed 500 hours.”	EC JRC – Agree HMC-Partly agree. 500 hours is for ambient temperature permeation test of HGV2 and EC406. In case of ≥55C condition, it needs to shorten. JAMA JARI – Agree. TF 3 – See above
EC JRC	6.2.4.2		te	Over many cycles at extreme conditions, hydrogen diffusion may damage the liner, particularly non-metallic liners, causing blistering and cracking, leading to excessive permeation or leakage. This form of damage may be influenced by the maximum and minimum temperatures experienced during fuelling and during normal fuel use in vehicle	Examining the tank liner periodically (after each series of gas cycling and high pressure hold) requiring that the tank liner should not show cracks. This is in line with the proposal of hydrogen compatibility tests inclusion.	HMC: Not agree. JAMA JARI – Disagree. Confirming the cracks after each series places a heavy burden on the actual work (It is almost impossible.), it is realistic to check leaks during

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				operation (container defueling). Liner buckling has been evidenced when it was vented to atmospheric pressure following a pressure test.		series tests and to conduct rupture test at the end. TF 3 – Reject comment, not practicable.
EC	6.2.5.1		ed		Fire test… Either one of the following two methods are used to identify the position of the system over the initial (localized) fire source: ~~6.2.5.1.1.~~**(a)** Method 1: Qualification for a generic (non-Specific) vehicle installation … ~~6.2.5.1.2.~~**(b)** Method 2: Qualification for a specific vehicle installation … fires originating from the direction of the passenger compartment, ~~cargo/~~luggage compartment, wheel wells or ground-pooled gasoline.	
EC	6.2.5.1.1		ed		The container may …	
EC	6.2.5.1.2		te		The following test requirements apply whether Method 1 or 2 (above) is used: (a) The container assembly is filled with compressed hydrogen gas at 100 per cent of NWP **(+2/-0 MPa)**. The container … **(b)** Localized portion of the fire test (**i**~~b~~) The localized fire exposure area is … (**ii**~~c~~) … within the localized fire **exposure** area, and at least … (**iii**~~d~~) Wind shields are … (**iv**~~e~~) … under the localized **fire** exposure area of … (**v**~~f~~) … in the localized fire **exposure** area has increased continuously to at least …. The temperature in the localized fire **exposure** area shall not exceed …. **(c)** Engulfing portion of the fire test	HMC: ≥100 per cent of NWP~ JAMA JARI - This item should be discussed in Task Force #4. TF 3 – Already changed to be 100% state of charge TF 3 – Remainder of comments are editorial

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					… **(d)** Documenting results of the fire test ….	
PTL	6.2.5.1.2(c) 6.2.5.1.2(f)		te	Why is the engulfing fire length limited to 1.65 m and not entirely engulfing? For tanks greater than 1.65 m using more than one single-point sensing TPRD, this forces system integrators to design systems for the test rather than a practical purpose. One approach is plumbing a TPRD back along the longitudinal axis of the tank to within 1.65 m of the other TPRD to ensure exposure during the engulfing portion. The engulfing fire should engulf the entire length of the container.	"…the length of the test article ~~up to 1.65 m maximum~~ (at least 2 thermocouples within the localized fire…"	HMC: Agree JAMA JARI - This item should be discussed in Task Force #4. TF 3 – Agree that this item should be discussed within TF 4.
EC	6.2.5.2		te		Engulfing fire test: The test unit is the compressed hydrogen storage system. The storage system is filled with compressed hydrogen gas at 100 per cent NWP **(+2/-0 MPa)**. …."	HMC: ≥100 per cent NWP JAMA JARI – Disagree with 100 per cent NWP (+2/-0MPa). Should be changed to ≥100%NWP. (Like the discussion at the last in-person meeting on Jun25.) TF 3 – Covered with addition of 100% state of charge requirement.
CSA	?		te	Storage systems containing repeating element tanks, i.e. 2 or more tanks of the same dimension and component and piping configuration, should be allowed to undergo a single tank pneumatic sequential test.		TF 3 – To be discussed
CSA	6.2.6.1.1		te	Testing sequence incorrect	Recommend reversing the order of final tests, i.e. Benchtop activation test then flow rate test.	HMC: Agree JAMA JARI – Agree. Furthermore the pressure

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						conditions ≤2 MPa to ≥125% NWP is preferable TF 3 – Agree, and also agree with carrying over min and max temperature and pre ssure tolerances to component tests.
CSA	6.2.6.1.2		ed	Error in the equation (missing superscript or “to the power of” symbol)	T life= 9.1 x Tact^0.503.	
CSA	6.2.6.1.2		te		Use of check valves to prevent pressure depletion should be optional since the failure of one sample results in the failure of the test.	TF 3 – Agree
EC	6.2.6.1.2		ed		Accelerated life test. … and five at an accelerated life temperature, Tlife = 9.1 x $Tact^{0.503}$ ~~0.513~~. The TPRD is placed in …. The three TPRDs tested at **Tact**~~tact~~ shall activate in less than …”	
JARI	6.2.6.1.2		te	It will be necessary to use check valve to confirm the activation of TPRDs.	If a manifold system is used, each pressure connection includes a check valve to prevent pressure depletion of the system when one specimen **activates** ~~**fails**~~.	TF 3 – Reject, see above
CSA	6.2.6.1.3		te		Recommend specifying -40°C or lower, or -40°C (+0/-5°C).	HMC: ≤ -40℃ JAMA JARI – Should be unified by "-40 ° C or lower". TF 3 – Agreed to carry over pressure and temperature min max tolerances.
CSA	6.2.6.1.4		te		Recommend accelerated cyclic corrosion test per ANSI HPRD 1 as this is a more representative automotive environment test.	Use pH 10 test JAMA JARI – Agree.

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						TF 3 – Defer comment
CSA	6.2.6.1.4		te	Testing sequence incorrect	Recommend reversing the order of final tests, i.e. Benchtop activation test then flow rate test.	TF 3 – Agree
CSA	6.2.6.1.5		te	Unclear why sodium hydroxide and ammonium nitrate were added to vehicle environment test. Sodium hydroxide will react chemically and destroy aluminum (main body material of many PRDs) so a very difficult test if submerged (especially if conducted after sulfuric acid which affects anodized surfaces but does not cause mechanical degradation). Is this to check that aluminum coatings will prevent sulfuric acid interaction with bare aluminum? Methanol/gasoline is included in ANSI HPRD 1-2013 and ANSI HGV 3.1-2015 for vehicle crash scenarios, i.e. gasoline exposure from other cars.	Remove sodium hydroxide and ammonium nitrate	JAMA JARI – Agree. If testing with sodium hydroxide or ammonium nitrate is to be continued, It need to be described about the necessity of sodium hydroxide and ammonium nitrate. TF 3 – Keep the fluids but modify the procedure to allow for spray method only as described in HGV 3.1
CSA	6.2.6.1.5 (c)		te	Testing sequence incorrect	Recommend reversing the order of final tests, i.e. Benchtop activation test then flow rate test.	
CSA	6.2.6.1.7		ed		Recommend clarifying that “Each unit is dropped in one of the six orientations (6 units = 6 orientations).	
CSA	6.2.6.1.7 (b)		te	Testing sequence incorrect	Recommend reversing the order of final tests, i.e. Benchtop activation test then flow rate test.	
PTL	6.2.6.1.7		te	Suggest clarifying whether the TPRD may be dropped assembled to it’s test jig or in a disassembled form.		
JARI	6.2.6.1.7		ed	Current text can be read that each TPRD is dropped 6 times i.e. 36 times in total for 6 TPRDs.	Recommend should be selectable the following two options. Option 1) Each unit is dropped in one of the six orientations (6 units = 6 orientations). Option 2) One TPRD is dropped in 6	

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					orientations (1 unit = 6 orientations)	
CSA	6.2.6.1.8		te		Recommend adding "Prior to conditioning the component shall be purged with nitrogen and sealed at 2.5 per cent of NWP."	
CSA	6.2.6.1.8		te		Recommend specifying that the unit is held for a sufficient time to ensure the bulk temperature of the unit meets the temperature requirements specified below.	
CSA	6.2.6.1.8		te		Recommend specifying that the unit is immersed in a temperature controlled fluid and monitored for leakage (or equivalent method).	
CSA	6.2.6.1.9 6.2.6.1.10		te		Recommend three units instead of two to match the number of units required for the flow rate test.	
CSA	6.2.6.1.9 (c)		te		Recommend changing to "…two new (not pre-tested) TPRD units are pressurized to no more than 25 per cent NWP; and one new (not pre-tested) TPRD unit is pressurized to 100 per cent NWP."	
EC	6.2.6.1.10		ed		Flow rate test (a) Eight TPRD units are tested for flow capacity. The eight units consist of three new TPRD units and one **TPRD**~~TRPD~~ unit from …"	
CSA	6.2.6.2.1		ed		Add "hydrostatic" to "…and the <u>hydrostatic</u> strength test (para 6.2.6.2.1)."	
CSA	6.2.6.2.2		te	Last paragraph	Recommend specifying that the unit is immersed in a temperature controlled fluid and monitored for leakage (or equivalent method).	This is an external leak test only. Internal leakage of check valve and shut off valve is needed.
CSA	6.2.6.2.3 (a)		ed		Change "the valve unit **are** installed…" to "the valve unit **is** installed…"	
CSA	6.2.6.2.3 (a) (ii)		te	Clause 6.2.6.2.3(a) (ii) This is not a proper operational cycle for a shut-off valve.	Recommend using the same cycling procedure as ANSI HGV 3.1-2015 "Each duty cycle shall consist of filling through the inlet port. The inlet line shall then be	

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					depressurized. The automatic container valve shall be opened and closed within a period of 10 ± 2 seconds. During the off cycle, the downstream pressure of the test fixture shall be reduced to 50 percent of the test pressure.”	
CSA	6.2.6.2.4		te		Recommend accelerated cyclic corrosion test per ANSI HPRD 1 as this is a more representative automotive environment test.	
EC	6.2.6.2.4. (a)		ed		The component ~~must now~~ **shall not** show signs of …”	
CSA	6.2.6.2.5 (a)		te	Clause 6.2.6.2.5(a) unclear why sodium hydroxide and ammonium nitrate were added to vehicle environment test. Sodium hydroxide will react chemically and destroy aluminum (main body material of many shut-off valves) so a very difficult test if submerged (especially if conducted after sulfuric acid which affects anodized surfaces but does not cause mechanical degradation). Is this to check that aluminum coatings will prevent sulfuric acid interaction with bare aluminum? Methanol/gasoline is included in ANSI HPRD 1-2013 and ANSI HGV 3.1-2015 for vehicle crash scenarios, i.e. gasoline exposure from other cars.		
CSA	6.2.6.2.6 (a)		te	No provision for hydrogen exposure to non-metallic materials.	Recommend adding ISO 188 as this is a similar test procedure to ASTM D572.	
PTL	6.2.6.2.7 (a)		te	Not all solenoid valves are 12 V or 24 V systems.	Recommend changing the opening voltage requirement from “…9v for a 12V system or equal to 18V for a 24 V system” to “the minimum opening voltage at NWP at room temperature shall be less than or equal to 66% of the nominal system voltage.”	
NHTSA	6.2.6.2.8		te	No provision for testing at extreme temperatures		

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CSA	6.2.6.2.9		te		Recommend specifying this test is only applicable to valve units containing copper-based alloys exposed to the outside environment. This is not applicable to components containing copper-based alloy internal components (not exposed to the outside environment).	
NHTSA	6.2.6.2.10		te	No provision for testing at extreme temperatures		
EC	6.3.1.2.2.3 .4		te		Fourth step If V1 is greater than or equal to V2, … ~~The resulting Ri, which is the electrical isolation resistance value (in Ω), is divided by the working voltage of the high voltage bus in volt (V):~~ ~~Ri Ω / V = Ri Ω / Working voltage (V)~~ … If V2 is greater than V1, … ~~The resulting Ri, which is the electrical isolation resistance value (in Ω), is divided by the working voltage of the high voltage bus in volts (V).~~ ~~Ri Ω / V = Ri Ω / Working voltage~~ …" *In Table 3,* the reference to the figure, amend to read: "~~See Fig. 1 for full dimensions~~ **See Fig. 11 for full dimensions"** *In Figure 11,* the dimensions of the toe of the joint test finger, amend to read: "~~R2=0.05 cylindrical~~ **R2±0.05 cylindrical** ~~R4=0.06 spherical~~ **R4±0.05 spherical"** *Figure 12,* amend the title and replace the figure with:	

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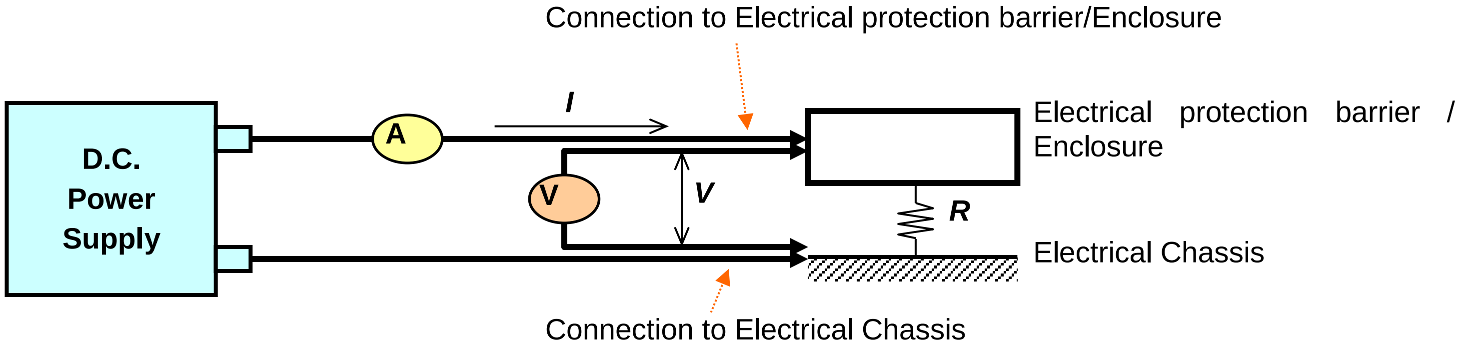
					"Figure 12 Example of the test method using D.C. power supply, voltmeter and ammeter	



EC	7.2.4.2		te		Shut-off valves qualification requirements … The ~~valve~~ **shut-off devices** shall meet …"	
EC	7.3		ed		LHSS fuel system integrity … with the exception of para. 5.2.1.1.**1.** The fuelling receptacle label shall …"	
EC	7.4.1.2		ed		Baseline initial burst pressure …. if at least one of the two passing criteria described in para. **7.2.1.2.**~~5.2.1.2.~~ is fulfilled. …"	
EC	7.4.2.3		ed		Vacuum loss test … (d) The line downstream the first ~~safety~~ **pressure** relief device is blocked and … … For steel containers the second part of the test is passed if the second**ary** pressure relief device does not open below 110 per cent of the set pressure of the first ~~safety~~ **pressure** relief device and limits the pressure in the container to a maximum 136 per cent of the MAWP if a safety valve is used, or, 150 per cent of the MAWP if a burst disk is used as	

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					the second**ary** ~~safety~~ **pressure** relief device. For other container materials, an equivalent level of safety shall be demonstrated."	
EC	7.5.1		ed		Post-crash leak test for the liquefied hydrogen storage systems … ... Exhaust from the venting of the pressure controls or the PRDs shall not be vented to the passenger **or**~~,~~ luggage~~, or cargo~~ compartments during …"	

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