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Proposal for an Amendment to UN Global Technical Regulation No. 13 (Hydrogen and Fuel Cells Vehicles)

Submitted by the Task Force amending UN Regulation No. 134 (Hydrogen and Fuel Cells Vehicles) *

The text reproduced below was prepared by the Task Force involving the experts from France, Japan, the Netherlands, the European Commission, the European Association of Automotive Suppliers (CLEPA) and the International Organization of Motor Vehicle Manufacturers (OICA) as well as related industry experts on transposing Amendment 1 to UN Global Technical Regulation No. 13, Phase 2 (GTR13-PH2) into the UN Regulation No. 134. The modifications to the existing text of the UN Regulation No. 134 are marked in bold for new or strikethrough for deleted characters. This document amends working document GRSP/2024/25. The changes are highlighted in red.

* In accordance with the programme of work of the Inland Transport Committee for 2024 as outlined in proposed programme budget for 2024 (A/78/6 (Sect. 20), table 20.5), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

I. Proposal

Part 1, paragraph 51., amend to read:

"51. Requirements for Compressed Hydrogen Storage System (CHSS) and its primary closures are defined in paragraph 5.1. The provision in paragraph 5.1.(b) allows Contracting Parties to require that primary closure devices be mounted directly on the container. If needed, manufacturers can choose to locate additional TPRDs in alternative locations on the container. However, any additional TPRDs should be connected directly to the containers by using supply lines that have demonstrated mechanical integrity and durability as part of qualification tests for CHSS ~~(paragraphs 5.1.1. and 5.1.2.)~~ **(paragraphs 5.1.1. and 5.1.2. excluding the drop test).** "

Part 1, paragraph 81. (c) (i), amend to read:

"81. These assumptions include:

(c) Severe usage: exposure to physical impacts

(i) Drop impact (para. 5.1.2.2.) – the risk is primarily an aftermarket risk during vehicle repair where a new storage system, or an older system removed during vehicle service, is dropped from a fork lift during handling. The test procedure requires drops from several angles from a maximum utility forklift height. The test is designed to demonstrate that containers **(without supply lines and valves)** have the capability to survive representative pre-installation drop impacts.

***Note*: Damage to supply lines or valves would be visible after a drop impact and, as a consequence, the devices would need to be replaced;**"

Part 2, paragraph 3.7., amend to read:

"3.7. "*Container Attachments*" are non-pressure bearing parts attached to the container that provide additional support and/or protection to the container and that may be only temporarily removed for maintenance and/or inspection only with the use of tools.

***Note*: The non-pressure bearing parts attached to the container that provide additional support and/or protection to additional TPRDs and supply lines are also considered as container attachments.**"

Part 2, paragraph 3.8., amend to read:

"3.8. "*Compressed hydrogen storage system (CHSS)*" is a system designed to store compressed hydrogen fuel for a hydrogen-fuelled vehicle, composed of a container, container attachments (if any), **supply lines for additional Thermally activated Pressure Relief Device (TPRD) (if any),** and all primary closure devices required to isolate the stored hydrogen from the remainder of the fuel system and the environment.

The supply lines for additional TPRD made of materials other than metal are not included in this regulation until specific requirements for such materials have been defined."

Part 2, paragraph 5.1., amend to read:

"5.1. Compressed hydrogen storage system

This section specifies the requirements for the integrity of the compressed hydrogen storage system.

(a) The primary closure devices shall include the following functions, which may be combined:

(i) TPRD;

(ii) Check valve; and

(iii) Shut-off valve.

(b) Each Contracting Party may, at its discretion, require that the primary closure devices shall be mounted directly on or within each container; [**If needed, manufacturers may choose to locate additional TPRDs in alternative locations on the container. However, any high-pressure supply lines for such additional TPRDs shall have demonstrated mechanical integrity and durability as part of qualification tests for the container (verification tests for baseline metrics in paragraph 5.1.1., hydraulic sequential test in paragraph 5.1.2. excluding the drop test;).**

***Note*: The post-crash fuel system integrity requirements in paragraph 5.2.2. also apply to supply lines for additional TPRDs.**]

…

Table 2
Overview of Performance Qualification Test Requirements

Requirement section	*Test article*
5.1.1. Verification tests for baseline metrics	Container or container plus container attachments, **and supply lines for additional TPRDs,** as applicable
5.1.2. Verification test for performance durability	Container or container plus container attachments, **and supply lines for additional TPRDs,** as applicable
5.1.3. Verification test for expected on-road performance	CHSS
5.1.4. Verification test for service terminating performance in fire	CHSS
5.1.5. Verification test for closure durability	Primary closure devices

"

…

Part 2, paragraph 5.1.1.1., amend to read:

"5.1.1.1. Baseline initial burst pressure

Three (3) new containers [**(as well as supply lines for additional TPRDs (if any) through appropriate adaptors; the same shall apply under this paragraph and paragraphs 5.1.1.2. to 5.1.2.8., 5.1.3.1., 5.1.3.4. and 5.1.3.5.)]** randomly selected from the design qualification batch of at least 10 containers, are hydraulically pressurized until burst in accordance with paragraph 6.2.2.1. The container attachments, if any, shall also be included in this test, unless the manufacturer can demonstrate that the container attachments do not affect the test results and are not affected by the test procedure. The manufacturer shall supply documentation (measurements and statistical analyses) that establish the midpoint burst pressure of new containers, BP_O. "

Part 2, paragraph 5.1.2.2., amend to read:

"5.1.2.2. Drop (impact) test

The container with its container attachments (if any) is dropped once in one of the impact orientations specified in paragraph 6.2.3.2. **This test does not apply to supply lines for additional TPRDs.**"

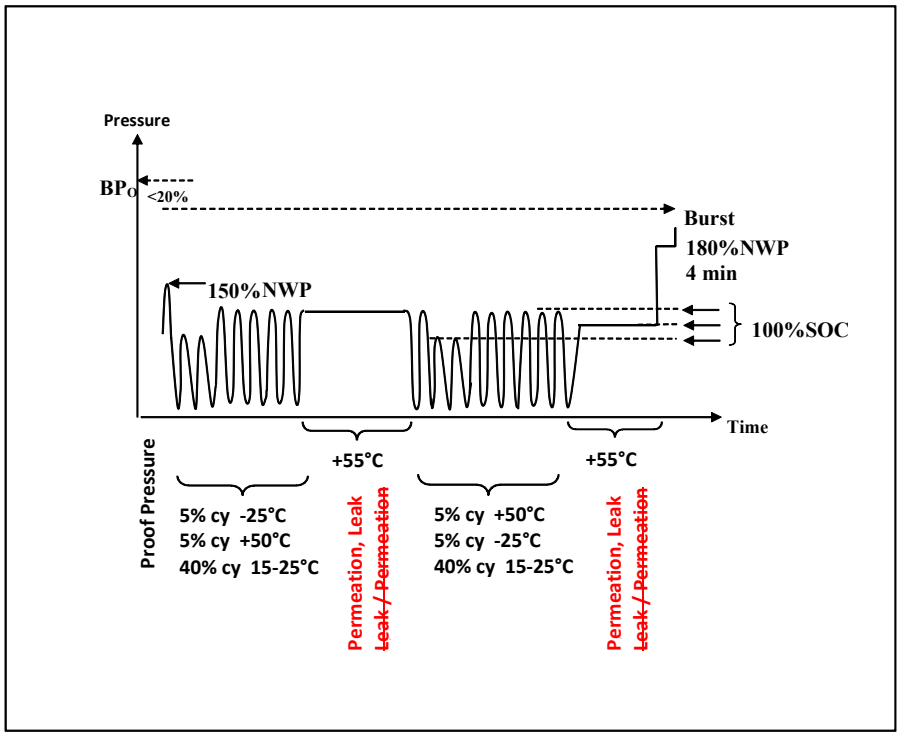
Part 2, paragraph 5.1.3., amend to read:

"5.1.3. Verification test for expected on-road performance (Pneumatic sequential tests)

A CHSS shall undergo the following sequence of tests, which are illustrated in Figure 2. Specifics of applicable test procedures for the CHSS are provided in paragraph 6.2.4.

The CHSS shall not leak and the primary closure devices shall maintain functionality during the test.

Figure 2
Verification Test for Expected On-Road Performance (Pneumatic)



"

Part 2, Paragraph 5.1.3.3., amend to read:

"5.1.3.3. Extreme temperature static ~~gas pressure leak/permeation test~~ **permeation test and localized leak test** (pneumatic).

The test shall be conducted in accordance with paragraphs 6.2.4.2. and 6.2.4.3.

The maximum allowable hydrogen discharge from the CHSS is 46 mL/h/L water capacity of the CHSS.

Any single point of localized external leakage measured in accordance with paragraph 6.2.4.3. shall not exceed 0.005 mg/sec (3.6 Nml/min)."

Part 2, Paragraph 6.2.2.1., amend to read:

6.2.2.1. Burst test (hydraulic)

The burst test is conducted at ambient temperature using a hydraulic fluid. The rate of pressurization is ≤ 1.4 MPa/s for pressures higher than 150 per cent of the nominal working pressure. If the rate exceeds 0.35 MPa/s at pressures higher than 150 per cent NWP, then either the container [**(as well as supply lines for additional TPRDs (if any) through appropriate adaptors; the same shall apply under this paragraph and paragraphs 6.2.2. to 6.2.3.4., 6.2.3.6. and 6.2.5.1.)]** is placed in series between the pressure source and the pressure measurement device, or the time at the pressure above a target burst pressure exceeds 5 seconds. The burst pressure of the container shall be recorded.

Part 2, paragraph 6.2.3.2., amend to read:

"6.2.3.2. Drop (impact) test (unpressurized)

The container and its container attachments (if any) is drop tested without internal pressurization**,** ~~or~~ attached valves **or supply lines (if any)**. The surface onto which the test article is dropped shall be a smooth, horizontal concrete pad or other flooring type with equivalent hardness. No attempt shall be made to prevent the test article from bouncing or falling over during a drop test, but the test article shall be prevented from falling over during the vertical drop test.

… "

Part 2, paragraph 6.2.3.3., amend to read:

"6.2.3.3. Surface damage test (unpressurized)

…

The test proceeds in the following sequence:

(a) Surface flaw generation: A saw cut at least 0.75 mm deep and 200 mm long is made on the surface specified above.

If the container is to be affixed to the vehicle by compressing its composite surface **or container attachments for additional TPRDs and/or supply lines are attached to composite surface of the container**, then a second cut at least 1.25 mm deep and 25 mm long is applied at the end of the container which is opposite to the location of the first cut;

…"

Part 2, paragraphs 6.2.4.2. and 6.2.4.3., amend to read:

"6.2.4.2. ~~Gas~~ **P**ermeation test (pneumatic)

This test is performed after each group of 250 pneumatic pressure cycles in accordance with paragraph 6.2.4. Table 7a.

The CHSS is fully filled with hydrogen gas to ≥ 100 per cent SOC and soaked for a minimum of 12 hours at 55 °C to 60 °C in a sealed chamber prior to the start of the test. The test shall continue until the permeation rate reaches a steady state based on at least three consecutive rates separated by at least 12 hours being within ±10 per cent of the previous rate, or 500 hours, whichever occurs first.

6.2.4.3. Localized ~~gas~~ leak test (pneumatic)

This test is performed after each permeation test conducted in accordance with Table 7b in paragraph 6.2.4.

A bubble test may be used to fulfil this requirement. The following procedure is used when conducting the bubble test:

(a) The exhaust of the shut-off valve (and other internal connections to hydrogen systems) shall be capped for this test (as the test is focused ~~at~~ on external leakage).

At the discretion of the manufacturer or test laboratory, the test article may be immersed in the leak-test fluid or leak-test fluid applied to the test article when resting in open air. Bubbles can vary greatly in size, depending on conditions. The tester estimates the gas leakage based on the size and rate of bubble formation.

(b) For a localized rate of 0.005 mg/sec (3.6 NmL/min), the resultant allowable rate of bubble generation is about 2,030 bubbles per minute for a typical bubble size of 1.5 mm in diameter. Even if much larger bubbles are formed, the leak shall be readily detectable. For an unusually large bubble size of 6 mm in diameter, the allowable bubble rate would be approximately 32 bubbles per minute.

If the measured permeation rate during the permeation test under paragraph 6.2.4.2. is less than or equal to 0.005 mg/sec (3.6Nml/min), the localized leak test is deemed to be fulfilled."

II. Justification

1. UN GTR No. 13, amendment 1 includes contradictory wording in Parts 1 and 2, which lead to different interpretations among the contracting parties.

2. This proposal does not introduce new requirements but clarifies the rationale and test requirements for the mechanical integrity and durability tests for supply lines for additional TPRDs. Part 1 stipulates that supply lines for additional TPRDs need to show mechanical integrity following tests 5.1.1. and 5.1.2. in Part 2. The test procedure in 6.2.3.2. in Part 2 includes drop testing of the container and its container attachments without pressurization or attached valves.

3. UN GTR No. 13, amendment 1, therefore, needs clarification regarding the test requirements in 6.2.3.2. in Part 2 and the exclusion of supply lines for additional TPRDs from the drop test.

4. Damage to supply lines or valves would be visible after a drop impact and, as a consequence, the devices would need to be replaced.

5. In the definition of section 3.8., it is clarified that the supply lines for additional TPRDs are part of the Compressed Hydrogen Storage System (CHSS).