

Proposal for Supplement 2 to the 02 Series of Amendments to UN Regulation No. 134 (Hydrogen and Fuel Cell Vehicles)

Submitted by the Task Force amending UN Regulation No. 134 *

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 under the 1958 Agreement. 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/2024/27. The changes are highlighted in red.

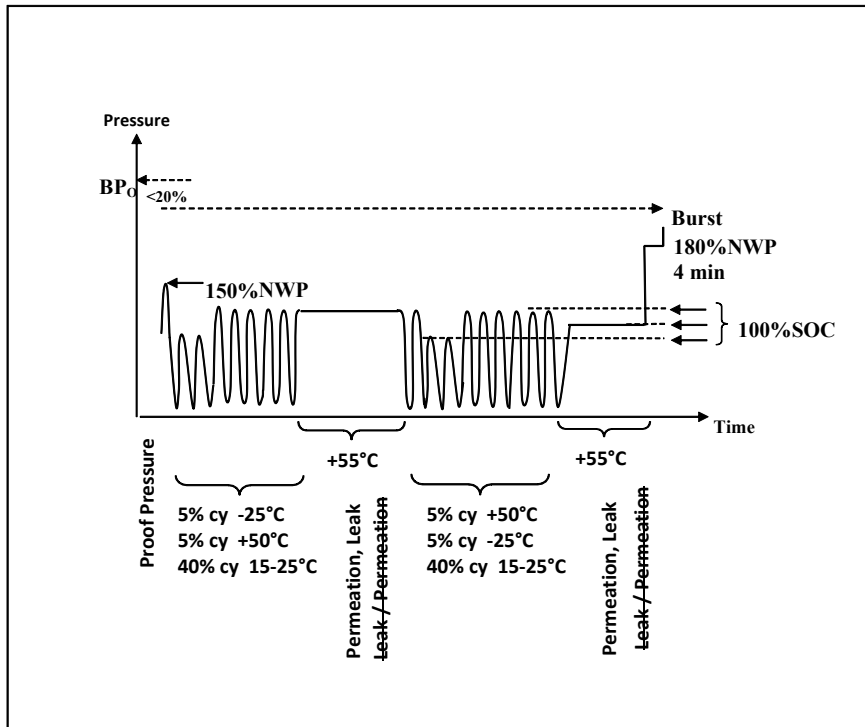
* In accordance with the programme of work of the Inland Transport Committee for 2024 as outlined in proposed programme budget for 2024 (A/78/6 (Sect. 20), table 20.5), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document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

I. Proposal

Figure 2., amend to read:

"Figure 2

Verification Test for Expected On-Road Performance (Pneumatic/~~hydraulic~~)



"

Paragraph 5.2., amend to read:

"5.2. Verification tests for performance durability (Hydraulic sequential tests)

~~If all three pressure cycle life measurements made in paragraph 5.1.2. are greater than 11,000 cycles, or if they are all within ± 25 per cent of each other, then only one (1) container is tested in paragraph 5.2. Otherwise, three (3) containers are tested in paragraph 5.2.~~

..."

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

The test shall be conducted in accordance with Annex 3, paragraphs 4.2. and 4.3.

The maximum allowable hydrogen discharge from the CHSS is 46 ml/hr/l water capacity of the CHSS. Any single point of localized external leakage measured in accordance with Annex 3, paragraph 4.3. shall not exceed 0.005 mg/sec (3.6 Nml/min). "

Paragraph 7.1.5., amend to read:

"7.1.5. Fuel system leakage

The hydrogen fuelling line 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 (per Annex 5, paragraph 5.5. ~~test procedure~~) **and meet the leakage requirements therein.**"

Paragraphs 9.2.1., amend to read:

- "9.2.1. Every container [~~or, upon agreement of the Type Approval Authority and Technical Service, every pressure bearing chamber,~~] of CHSS shall be pressurized smoothly and continually with a hydraulic fluid or gas to the target pressure of ≥ 125 per cent NWP until the target test pressure level is reached and then held for ≥ 30 seconds. Temperature variation during the test shall be taken into account. The quality variability of the products shall be assessed with a method defined by the manufacturer e.g., variability of elastic expansion, etc. **If applicable, upon agreement of the Type Approval Authority and Technical Service, as an alternative, every pressure bearing chamber and every high-pressure fuel line for a container consisting of multiple permanently interconnected chambers may also be subjected to the same test described above individually not resulting in leakage. Upon agreement with the Type approval Authority the test can be conducted on individual parts, or on a subsystem assembly.** When applying this separate testing option, the test article shall be connected to a hydraulic pressure source at one of its openings by use of appropriate hydraulic mating connections and the remaining openings, if any, shall be closed by use of appropriate means."

Paragraphs 9.2.3.1. and 9.2.3.2., amend to read:

- "9.2.3.1. Burst test

The test shall be performed according to Annex 3, paragraph 2.1. (burst test). The burst pressure of each sample tested shall be at least BP_{min} and the average burst pressure recorded of the last ten tests shall be at or above BP_o - 10 per cent. ~~[For containers consisting of multiple permanently interconnected chambers, the test may be conducted separately on each pressure bearing chamber and interconnecting fuel line, or any sub-assembly thereof.]~~

- 9.2.3.2. Ambient temperature pressure cycling test in batch testing

The test shall be performed according to paragraph 2.2. (a) to (c) (hydrostatic pressure cycling test) of Annex 3, except that the temperature requirements for the fuelling fluid and the container skin, and the relative humidity requirement, do not apply. The container of the CHSS shall be pressure cycled using hydrostatic pressures ≥ 125 per cent of NWP, to 22,000 cycles in case of no leakage or until leakage occurs. The container of the CHSS shall not leak or burst within the first 11,000 cycles. ~~[For containers consisting of multiple permanently interconnected chambers, the test may be conducted separately on each pressure bearing chamber and interconnecting fuel line, or any sub-assembly thereof.]~~

Annex 3, Paragraph 3.2., amend to read:

- "3.2. Drop (impact) test (unpressurized)

The container and its container attachments (if any) is drop tested without internal pressurization, ~~or~~ attached valves. 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.

The test article shall be dropped in any one of the following four orientations, **the orientation chosen for the test shall be determined by the Technical Service in consultation with the manufacturers:**

Annex 3, paragraphs 4.2. and 4.3., amend to read:

"4.2. ~~Gas~~ Permeation test (pneumatic)

This test is performed after each group of 250 pneumatic pressure cycles conducted in accordance with Table 5a in Annex 3, paragraph 4.

...

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

This test is performed after each permeation test conducted in accordance with Table 5a in Annex 3, paragraph 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 on external leakage).

At the discretion of the Technical Service, 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 4.2. is less than or equal to 0.005 mg/sec (3.6Nml/min), the localized leak test is deemed to be fulfilled."

Annex 5, paragraph 5., amend to read:

"5. Compliance test for fuel line leakage

- 5.1. The power system of the test vehicle (e.g. fuel cell stack or engine) is warmed up and operating at its normal operating temperature with the operating pressure applied to fuel lines.

- 5.2. 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. **Any single point of localized external leakage shall not exceed 0.005 mg/sec (3.6Nml/min) (~~measured according to test procedure in Annex 3, paragraph 4.3.-(b)).~~**

- 5.3. Hydrogen leak detection is performed primarily at joints.

- 5.4. When a gas leak detector is used, detection is performed by operating the leak detector for at least 10 seconds at locations as close to fuel lines as possible.

- 5.5. When a leak detecting liquid is used, hydrogen gas leak detection is performed immediately after applying the liquid. In addition, visual checks are performed a few minutes after the application of liquid to check for bubbles caused by trace leaks. "

II. Justification

1. Permeation and leak test:

This proposal clarifies the order of the permeation and leakage tests in Figure 2 so as to be in line with the text, and also streamlines the wording for headings and text relating to these tests.

2. Localized leak test:

The leak test is not required if the permeation rate in test 4.2. fulfils the requirements of 4.3.

3. Compliance test for fuel line leakage for the fuel system:

The text does not specify a leakage threshold. The criteria for localized leakage is clarified in Annex 5, Paragraph 5.

Compliance test for fuel line leakage allows two measuring methods:

- ✓ Case 1: Using gas leak detector
Pass/fail criteria: localized external leakage \leq exceed 0.005 mg/sec (3.6Nml/min).
- ✓ Case 2: Using leak detecting liquid
Pass/fail criteria: visual check for bubbles caused by trace leaks. If bubbles are detected, OEM can ask to use gas leak detector method to measure leakage rate based on case 1.

~~The proposal clarifies that here the same limits apply as for any other localized external leakage as specified in Annex 3 paragraph 4.3. (b).~~ There is no change to the technical requirements.

4. Conformity of Production:

Allowing batch testing of individual parts or sub-assemblies of the multiple permanently interconnected chambers provides more flexibility to the approval holder without reducing the stringency of the requirements. It addresses the practicality of conducting hydraulic pressure tests, and in particular, to take account of the subsequent drying process that is necessary for containers consisting of more than one chamber and their interconnecting fuel lines.

5. Annex 3, paragraph 3.2:

In part I of UN Regulation No. 134, a drop test on the storage container is requested.

In the 01 series of amendment to UN Regulation No.134, the requirement was to drop one or more additional container(s) in each of the 4 orientations. The drop test procedure was then modified in GTR 13 amendment 1: it has been streamlined such that only one container will be dropped once (“The container shall withstand the one drop out of any impact orientations specified in the test procedure”).

This updated procedure was then transposed in 02 series of amendment to UN Regulation No. 134. But it is not specified in the test who choose this orientation. This is clarified in our proposal.