GTR #13 (Phase 2)

Recommendations for Test Procedures
Task Force 3 Status

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TF 3 Objectives

- To correct editorial and technical errors in the original draft
- To make modifications to the test procedures based on industry experience
- To incorporate requirements for medium and heavy duty vehicles
- To incorporate requirements for new storage technologies

TF 3 Status

- Nearly completed addressing 111 pages of comments/proposed changes, with some exceptions (following slides)
- TF 0 currently entering revisions to the draft of the regulation, incl. rationale into Section I
- Next TF 3 meeting scheduled for April 8, 2021

TF 3 Open Items

- HRS Risk Assessment (EIGA/Shell/WG 24)
  - Pressure ramp rate control failure could result in high flow and as a consequence, overheating of the hydrogen tank (up to 120°C liner temperature)
  - TF 3 undecided as to the validity of the failure mode
  - International CRADA proposed by Jay Keller, “Multi-lateral campaign to investigate type IV response to an HRS one-time fault”
  - Results not likely available until next phase of GTR
- Pressure Ramp Rate for Pneumatic Sequential Test
  - Pressure ramp rate for fueling to be harmonized with SAE J2601 rates in consideration of LD and HD containers

TF 3 Open Items

- Reduction of Test Container Volume for Pneumatic Sequential Test
  - As test container volume increases in size due to HD applications, test timing will be negatively impacted
  - Consider the use of filler material to reduce the volume of the test container
  - Rationale required as to what percentage volume reduction provides equivalent performance, plus filler material cannot adversely affect the container
- Test Parameter Tolerances
  - Pressure, temperature and other test parameters currently specify ≥ and ≤ values as determined by the manufacturer, “test requester” (TBD)
  - Suggested tolerance limits will be included in a table in the annex

Container Change of Design Table Subgroup

- Container Change of Design Table Subgroup Established
  - Concept allows for container designs that are sufficiently similar to an existing qualified design to be qualified through a reduced test program
  - The change of design table covers a wide range of possible container alterations including changes in diameter, length, fiber manufacturer, liner material, nominal working pressure, end boss design, fire protection system, etc.
  - Following text included in Section I:

    Under the EU 406/2009 regulation designs that are sufficiently similar to an existing fully qualified design may be qualified through a reduced test program Table IV.3.11.). Design changes not falling within the guidelines are qualified as a new design. While accepted in European regulation and industry standards like ANSI NGV2 and HGV2, there is no change of design provision in GTR 13 (ECE R134). While this concept may not be accepted by all Contracting Parties, a change of design table is included here for those who can adopt it. Based on Table IV.3.11 in EU 406/2009, the change of design table here has been modified to adopt the GTR13 concept of sequential performance tests rather than discrete tests, as found in the EU 406/2009 and industry standards.

Container Change of Design Table Subgroup

Changed Item		Required Tests
Metallic container or liner material		- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test
Plastic liner material		- Initial pressure cycle life - Sequential hydraulic tests - Sequential pneumatic tests - Fire test
Fiber material [4]		- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test
Resin material		- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test
Diameter	≤20% [1]	- Initial burst, Initial pressure cycle life
	>20% [1]	- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test
Length	≤50%	- Initial burst, Initial pressure cycle life - Fire test [3]
	>50%	- Initial burst, Initial pressure cycle life - Sequential hydraulic tests - Fire test [3]
Nominal working pressure	≤20% [1]	- Initial burst, Initial pressure cycle life
Coating		- Sequential hydraulic tests - Fire test [6]
Boss	Material, geometry, opening size	- Initial burst, Initial pressure cycle life
	Sealing (liner and/or valve interface)	- Sequential pneumatic tests [2]

Container Change of Design Table Subgroup

Changed Item	JAMA JARI required tests	HMC required tests	HMC required tests revision	Any differences?
Change in manufacturing process	- Initial burst, Initial pressure cycle life	- Initial burst, Initial pressure cycle life	- Initial burst, Initial pressure cycle life	Not accept Hex feedback. (keep EU 406 base)
Fire protection system	- Fire test	- Fire test	- Fire test	Same
~~Valve Change~~ (5)	~~- Sequential pneumatic tests~~ ~~- Fire test~~		~~HEX: should only require to rerun fire test~~ ~~and sequential pneumatic tests~~	Remove (keep EU 406 base) Irrelevant to tank design change
~~Manifold change~~ ~~(if any)~~	~~- Initial burst, Initial pressure cycle life ※~~ ~~- Sequential hydraulic tests ※~~ ~~- Sequential pneumatic tests ※~~ ~~- Fire test ※~~	~~[Not mentioned]~~		SAME
Container Attachment material, geometry※ (if any)	- Sequential hydraulic tests	[Not mentioned]	- Sequential hydraulic tests	Accept JAMA opinion

(1) Only when thickness change is proportional to diameter or pressure change.
(2) A hydrogen cycle test is not required if the stresses in the neck are equal to the original or reduced by the design change (e.g. reducing the diameter of internal threads, or changing the boss length), the liner to boss interface is not affected, and the original materials are used for boss, liner, and seals.
(3) Fire test is not required, provided safety relief devices or device configuration passed the required fire test on a container with equal or greater internal water volume.
(4) Change of fiber type, e.g. glass to carbon is not applicable. Change of design applies only to changes of materials properties or manufacturer within a fiber type
(5) Alternative valve need to be approved in accordance with GTR/R134…..
(6) Fire test required if coating affects fire performance

Next meeting scheduled for March 29, 2021

Conformable Tank Subgroup

- New definition for “Container”
  - **"Container"** means the pressure-bearing component on the vehicle that stores the primary volume of hydrogen fuel in a single chamber or in multiple permanently interconnected chambers.

- Introduce new definition:
  - **“Container Attachments”** means non-pressure bearing parts attached to the container that provide additional support and/or protection to the container.

- New definition for “Compressed Hydrogen Storage System (CHSS)”
  - **“Compressed hydrogen storage system (CHSS)"** means a system designed to store compressed hydrogen fuel for a hydrogen-fuelled vehicle, composed of a container, container attachments (if any), and all primary closure devices (such as shut-off valve, check valve, and TPRD) required to isolate the stored hydrogen from the remainder of the fuel system and the environment.

Conformable Tank Subgroup

- **Revised 5.1**
  - 5.1 Compressed hydrogen storage system

This section specifies the requirements for a compressed hydrogen storage system (CHSS):

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

(i) TPRD;

(ii) Check valve; and

(iii) Automatic Shut-off valve

……

(c) Temporary removal and reinstallation of container attachments shall require the use of tools

……

(e) The CHSS shall meet the performance test requirements summarized in Table 1. The corresponding test procedures are specified in paragraph 6

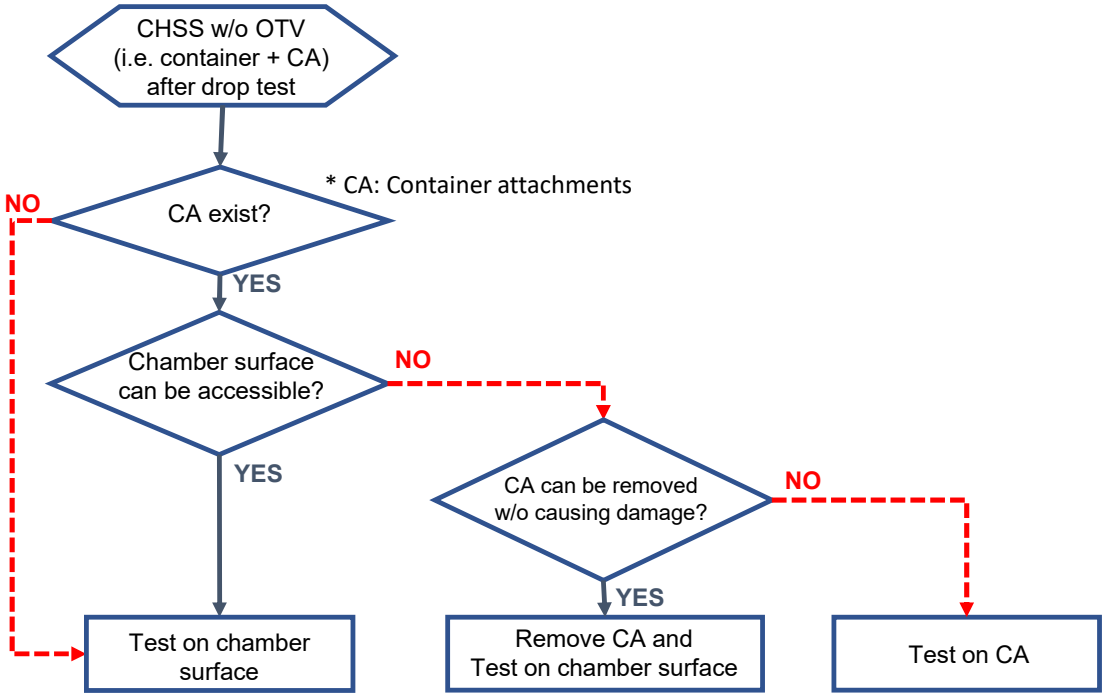
Conformable Tank Subgroup

- **New description for "Surface damage test (unpressurized)"**

The surface damage tests and the chemical exposure tests (para. 6.2.3.4.) shall be conducted on the surface of the pressure bearing chamber of the container as long as it is accessible regardless of the existence of the container attachments.

If the container attachments can be removed in accordance with the process specified by the manufacturer, then the container attachments shall be removed and the tests shall be conducted on the surface of the pressure bearing chamber of the container.

Otherwise, the tests shall be conducted on the surface of the container attachments as indicated in the flow diagram.



Conformable Tank Subgroup

- **New description for "Surface damage test (unpressurized) –continuation-"**

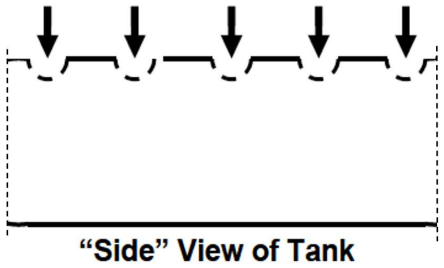
The test proceeds in the following sequence:

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

If the container is to be affixed by compressing its composite surface then a second cut at least 1.25 mm deep and 25 mm long is applied at the location of this mounting interface.

(b) Pendulum impacts: A surface of the container opposite to the surface specified above or a surface of a different chamber, in the case of a multiple permanently interconnected chambers container, is divided into five distinct (not overlapping) areas 100 mm in diameter each (see Figure 6). Immediately following a minimum of 12 hours preconditioning at ≤40 °C in an environmental chamber, the centre of each of the five areas sustains the impact of a pendulum having a pyramid with equilateral faces and square base, the summit and edges being rounded to a radius of 3 mm. The centre of impact of the pendulum coincides with the centre of gravity of the pyramid. The energy of the pendulum at the moment of impact with each of the five marked areas on the container is 30 J. The container is secured in place during pendulum impacts and not under pressure.

- **New Figure 6**



Conformable Tank Subgroup

- **Proposal of amendment to 5.1.2.1.**

5.1.2.1. Proof pressure test

The container is pressurized to ≥ 150 per cent NWP and held for at least 30 sec. (para. 6.2.3.1. test procedure). 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 [or are not affected by the test procedure]. The container that has undergone a proof pressure test in manufacture is exempt from this test.

Proof pressure test will be carried out during manufacturing and depending on the manufacturing process, it could be before or after the installation of the container attachments.
GTR20 sets a precedent for allowing manufacturer to demonstrate compliance.