Submitted by the IWG GTR13 PH2

Informal document **GRSP-62-26**
(62nd GRSP,12 - 15 December 2017, agenda item 4)

[DRAFT Meeting Notes]

1st Meeting of the Informal Working Group on Hydrogen and Fuel Cell Vehicles

Global Technical Regulation No. 13 (Phase 2)

17-19 October 2017 – European Commission, Brussels

	Agenda Items	Presenters	Documents
0	**Welcome and practical arrangements**	**P. Broertjes**	--
1	**Organization** • Leaders: EU, Japan, Korea • Co-Chairmanship: N. Nguyen (US/NHTSA); M. Takahashi (JPN/METI) • Co-vice chairmanship: Y. He (CHINA/ CATARC); S. Hyeong-Woo (Korea) • Secretary: Y. Fujimoto (JPN/OICA) • Attendees: See list of attendees in appendix	**N. Nguyen**	--
2	**Approval of the agenda**	**Members**	GTR13-1-01
3	**Informal working group mandate:** • Joint proposal by European Union, Japan and Republic of Korea • Phase 2: Address carryover issues from Phase I and other new items	**N. Nguyen**	GTR13-1-02 GTR13-1-05
4	**Terms of Reference – Revised**	**N. Nguyen**	GTR13-1-03 GTR13-1-17

The Terms of Reference (ToR) sets forth operating rules and procedures for the working group. It also provides goals and principles for the GTR which is to develop provisions that attain equivalent levels of safety as those of conventional gasoline powered vehicles. To the extent possible, the provisions shall be performance and data-based and not to restrict future technologies. The ToR was discussed and drafted during the meeting. Specifically, the two comments from OICA and Japan were agreed to and included in the revised ToR: (1) GTR should attain equivalent levels of safety as those for conventional gasoline powered vehicles; (2) additional items to the GTR scope shall be proposed by consensus.

To streamline the documentations, the following format for any new proposals was suggested:

1. Justification: Risk areas and safety needs; provide supporting field and test data, studies and analysis
2. Requirement(s) and Performance criteria
3. Test procedure(s)

5	**Update on ongoing and planned research and rulemaking activities**		
5a	**How GTR13 is Reflected in Japanese Regulations**	**H. Nakasato (JPN/MLIT)**	GTR13-1-11

1. Roles of Ministry of Land, Infrastructure, Transportation (MLIT), Ministry of ETI
2. MLIT → Motor vehicles; METI → Tanks
3. Re: Free Trade Agreement with EU regarding FCHV. Status is that there is agreement in principal, but details are not finalized yet (will be finalized in Tokyo). Agreement will not be on basis of mutual recognition.

5b	**JRC Update**	**P. Moretto (JRC)**	--

1. Organization: DG GROW (policy) → P. Broertjes (Brussels); DG JRC (science) → Acosta, Moretto (Pettens)
2. UN R134: Combination of EC79 and EC406. Type approval can be obtained via EU regulation or R134 regulation. They're not the same but safety level is equivalent
3. Material qualification is not included in R134 while is in EC79. Will have to improve to avoid misunderstanding
4. AFI directive: Focus on infrastructure; standards. Member states can decide if H2 is one of their alt fuel strategies. EV and NG are mandatory. H2 and LPG is optional.

5c	**Korea Update**	**K. Sinwook**	GTR-1-22

		(KATRI/Korea)	

1. Motor vehicle regulations: KSRCSS and KMVSS
2. CHSS: Planning to have EC79 equivalent and harmonization with GTR13 after Phase 2. UN R134 is also accepted.
3. Differences: Localized fire/bonfire not adopted. Sled test for fuel system is an additional requirement above GTR13

5d	**Canada Update**	**K. Hendershot (Transport Canada)**	--

1. Canada will adopt high voltage requirements based on recent NHTSA final rule to ensure harmonization.
2. Canada will conduct a series of tests based on GTR13 test procedures on 2 HFCVs. Environmental testing will also be included. The tests are expected to start in the fall 2018 and completed in 12 months.

5e	**China Update**	**Y. He (CATARC)**	GTR-01-12

1. Codes and standards development is done by four National Standardization Technical Committees
2. GTR 13 Phase 1 now a Chinese mandatory standard. Fire test in GTR13 will not be completely adopted – China regulation has slightly different test.
3. FCVs must not only comply with FCV standards, but also those for HV, conventional vehicles → more than 50 standards total
4. FCVs must also undergo stack durability test (durability accelerated test), even though not safety related
5. TSG 21-2016: Supervision Regulation on safety technology for stationary pressure vessel. This is a special but mandatory regulation
6. Currently, Type 4 cylinders are not for 70MPa use, only low pressure use due to safety concerns. China is carrying out more tests (with IPAG)
7. TSG R0006-2014: Supervision regulation on safety technology for gas cylinders. For Chinese-made products, to check performance
8. Hydrogen compatibility: standards are taken from ISO TC104

5f	**US NHTSA Update**	**N. Nguyen (NHTSA)**	GTR-01-13

1. Alt fuel activities
    a. Hydrogen – NHTSA contracted test lab to conduct series of tank testing to validate GTR test procedures (need details for self-certification). Hydraulic, pneumatic, and fire test done last year. Developing language for NPRM with this information. Test report is available.
    b. CNG – Conducted GTR13 tests on CNG tanks. All passed hydraulic, some failure of fire test.
2. Rulemaking Status
    a. FMVSS 305 - Final rule published 9/27/2017. containing similar provisions of the draft EV-GTR
    b. NHTSA is working on adopting GTR13 provisions for hydrogen fuel system and pressure vessels. NHTSA also looking at the feasibility of adopting the GTR13 provisions for CNG vehicles.

5g	**ISO TC197 Update**	**A.Tchouvelev/ L.Gambone**	GTR-01-06

1. FCV safety depends on external environment
    a. FCV and HRS = Single system when fueling
    b. Safety aspects that must be considered: Fuel quality, Station requirements, Connector
    c. Fuel quality, station requirements under ISO

5h	**Audi Update**	**F. Hofmann**	--

1. Audi has lead in VW group for FCHV development
2. 5th gen vehicle: performance car concept (multiple tank sizes)

5i	**Toyota Update**	**A.Ryan**	--

1. Focus on mass production: reduce cost
2. Sales target: 30,000 in 2020's timeframe
3. Update on HRS infrastructure: Growth in CA and Northeast US

5j	**Honda Update**	**I.Yamashita**	--

1. Sales target: 2/3 of all sales from PHV, ZEV by 2030
2. HRS image: Small stations, not large (lower cost)

5k	**BMW Update**	**G.Gissibl**	**--**

1. GTR Phase 2 development priorities:
    a. Design flexibility
    b. Harmonization for homologation
    c. Same level of safety as for conventional vehicles

5l	**Ford Update**	**B. Hobein**	**--**

1. Latest FCV prototype in 2016 under AFCC (automotive fuel cell corporation) led by Daimler, with 50% Ford ownership
2. FCV: Type 4 tank, 70 MPa. Increase in tank costs offset by using existing vehicle platform

5m	**Hyundai Update**	**A.Pott**	**--**

1. Since launch of FCV (Asia, KOR, EU), no safety issues from field, though customers cite lack of infrastructure
2. Participating in Munich car sharing program

5n	**Volute Presentation**	**K.Chandraseker**	GTR-1-19

Volute presentation on conformable container:

1. Located in San Francisco, CA
2. Product: Conformable, Type 4 tanks, 70MPa. Can meet 85C temperature limit without precooling.
3. Testing:
    a. A subscale tank is currently undergoing GTR13 tests – has passed most GTR13 tests
    b. Performing analytics to better understand tank performance – thermal simulation/analysis
    c. No crash tests performed yet, no dynamic tests.
4. Already proposing qualification tests in NGV/HGV2 for 2018. Revision of current NGV2 as well as new tests like vibration and mechanical shock

6	**Discussion on GTR technical issues and proposals**

6a	**Requirements of Material Compatibility**	**Y. Ishizuka (JARI)**	GTR-1-07

JARI gave a presentation on the status of the material compatibility efforts of a SAE working group:

1. Requirements for material compatibility and hydrogen embrittlement
2. Material compatibility test methods (austenitic steels) – ongoing work at SAE from hydrogen compatibility experts (Sandia, MPA, Kyushu Univ).
3. Results from this work should be the starting point for GTR phase 2
4. Proposing fatigue life test for material compatibility, not SSRT (slow strain rate test)
5. Group comments:
    a. Some concern that tests may not cover all applications
    b. US commented that it is necessary to investigate the effects of high pressure hydrogen on aluminum alloys under different temperatures under high humidity.
    c. Polymer compatibility: CSA CHMC2 working group is developing test requirements for polymer compatibility in hydrogen.
    d. As a background, certain Contracting Parties (CP) mandates material compatibility requirements. However, in the U.S., NHTSA does not typically mandate material requirements. Instead, the responsibility is left to the OEMs.

6b	**European Commission: GTR13 Phase 2 Items to be considered**	**P. Moretto, B. Acosta (JRC)**	GTR-1-20 GTR-1-04

EC and JRC gave a presentation on a recently concluded research effort:

1. Purpose of the presentation: This is a report what has been achieved by JRC in the last 4-6 years. The goal is to share research information. This is not a proposal from EC.
    e. Not all the points are to be discussed in GTR13.
    f. "Items to be considered" reflects only JRC's point of view, included as a discussion starter
2. FCH JU FireCOMP

a. Propose 2 tests: 1 without protection. Based on fire fighter feedback
b. Bonfire test: calibration of fire sources

3. Material qualification and hydrogen compatibility:
   a. Metallic components – MATHRYCE project considers standards for crack initiation and propagation. Propose compatibility requirements to other components like joints, valves, welds
   b. Polymers – Characterization of mechanical performance of polymers under hydrogen and the reversibility of these effects
   c. Consider including tests on resin. Consider revision of glass transition temp being at least 20C above max container temp
4. Various other proposals:
   a. (ex: initial burst pressure, burst test, temperature excursions >85C, surface damage, hydrogen sensor, etc.)
   b. See JRC presentation
5. Fire test discussion
   a. Currently fire test performance judged by TPRD vent, not how the tank withstands the test.
   b. Good practices exist but should not be regulation or in GTR. Need data/analysis to justify inclusion. In Phase 1, JARI performed vehicle tests, which is how we got the requirements.
   c. JRC may want to include as an option, and will propose with scientific data

6c Open issues of insuring safety of CPVs by strength testing **G. Mair (BAM)** GTR-1-21

Mr. G. Mair from BAM gave a presentation on the need to insure safety of CPVs through strength testing

1. Is strength defined by burst test? Could hydraulic burst test lead to false conclusions?
2. Production requirements (group discussion)
   a. Differences by region: US takes 1 vehicle to test, no production requirements for quality. EU has conformity of production requirements (but not always explicit)
   b. In GTR13 to R134, EU made detailed changes to be compatible with real production conditions. GTR does not have such requirements
   c. The U.S. suggested that new proposals such as this topic should be discussed among technical experts at the industry standard organizations such as SAE, ISO, etc. It was suggested that, perhaps, Dr. Mair's proposals belong at the component level (ISO) as a test requirement, not at GTR level

6d Revision of minimum burst pressure **H. Tamura (JARI)** GTR-1-08

JARI gave a presentation regarding the initial burst pressure requirement:

1. JARI's goal is to decide the appropriate initial burst pressure which correlates with 180% NWP EOL burst pressure
2. JARI's experiments sought out factors of both variation and degradation using actual cylinders that will undergo GTR13 hydraulic sequential test
3. Expectations from verification test: BP0+/- 10%; Degradation ratio within 10%; EOL variation does not change from initial distribution curve
4. Using the results will help determine appropriate initial BP which will correlate with 180% of EOL BP
5. Test data will be introduced at next IWG (Feb)

6e Proposal for rollover test requirement **K. Sinwook/KATRI** GTR-1-23

Korea gave a presentation introducing a roll-over requirement for buses:

1. Tanks on buses are mounted on the roof, increasing rollover possibility due to higher center of gravity
2. Rollover test showed damage to valves, resulting in gas leak
3. Leakage amount due to pressure drop exceeded GTR (118NL/min)
4. Need to consider bus rollover test in Phase 2 – Korea planning to further research the issue, including test methods
5. U.S. comment: Must consider the differences between light duty and heavy duty vehicles when developing the test procedures and performance criteria.

6f Improvements to GTR13 fire testing **V. Molkov (Ulster)** GTR-1-24 GTR-1-09

Professor Molkov presented a presentation on fire safety and proposed new requirements for consideration:

1. Proposals to improve fire testing based on interviews with first responders
2. Improve reproducibility via: Constant HRR >350kW; Heat flux input of minimum 100 kW/m^2
3. Fire test without TPRD (fire test until rupture) → development of explosion-free tanks to avoid burst in fire
4. Group discussion about safest way in a fire:
    a. Vent quickly via TPRD or "explosion-free" tanks.
    b. Work already being done in ISO TC58 (no OEM participation though as its scope does not include vehicles).
    c. Molkov raised TPRD's reliability issues. N. Nguyen request for TPRD failure/malfunction/reliability data. Gambone stated that CSA HPRD1 contains the latest requirements for TPRD.
5. The U.S. comment:
    a. Unlike voluntary industry standards, regulation is mandatory so provisions must be justified. Cost/benefit must be considered. Supporting data/analysis is needed to justify the "more stringent" fire requirements.
    b. Proposal on fire parameters, as presented by professor Molkov, could be discussed to make the fire test more reproducible . Other technical items should be discussed and agreed at the ISO and/or SAE working groups before being proposed to IWG for consideration.
    c. Canada, Japan, EU agree

6g Comments on GTR13 Phase 1 — **L.Gambone (CSA)** — GTR-1-10

CSA submitted a document outlines several editorials and proposed changes to the current test procedures in GTR13:

1. Proposed changes based on 8 years of experience in testing to SAE J2579, CSA HPRD1
2. More information will be presented in February
3. Plan is to take GTR requirements to HPRD1 to harmonize

6h EC Amendments to GTR13 — **P. Broertjes (EC)** — GTR-1-15, GTR-1-16

EC also submitted a UN proposal containing editorials and clarifications to the GTR13:

1. These changes were incorporated in the UN R134 and previously submitted at GRSP to amend GTR13. However, the GTR amendment was held up as other CPs also have similar list of editorials. It was suggested to combine all editorials in one GTR amendment for submission.
2. Discussion needed on what is editorial vs. technical
3. One possible plan is to make changes at the end of GTR13 Phase 2 and adopt at once

7 Action Items — **CP, Std Org** — GTR-1-03, GTR-1-18

1. All members to provide comments on Terms of Reference (GTR-1-03) – Due to Y.Fujimoto by 11/10
2. Review/update national regulations and industry standards (GTR-1-18) – CP, Standards Organizations to send to Y. Fujimoto by next IWG
3. Next meeting announcement and invite – IWG secretary to send by Nov 13

8 APPENDIX: Attendees List

A.Borger (VW)	G.Yoo (ILJIN Composites Korea)	K.Sinwook (KATRI/Korea)	P.Moretto (EC-JRC)
A.Ryan (Toyota/OICA)	H. Yuntang (CATARC)	L.Ballaux (Honda Europe)	P.Broertjes (EC)
A.Tchouvelev (ISO TC197)	H.Nakasato (MLIT Japan)	L.Gambone (CSA Group)	S.Pfeifer (VDA/OICA)
A.Pott (Hyundai Europe, OICA)	H.Tamura (JARI Japan)	M.Matsue (KHK)	S.Schmidt (Alliance Auto Mfr)
A.Ishizuka (Honda, OICA)	H.Shinohara (KHK)	M.Takahashi (METI/Govt of Japan)	S.Morita (JASIC Japan)
B.Acosta (EC-JRC)	I.Yamashita (Honda R&D/OICA)	M.Hackh (Daimler AG/OICA)	T.Takehana (KHK)
B.Hobein(Ford)	J.Eihusen (Hexagon)	N.Nguyen (US/NHTSA)	V.Molkov (U.of Ulster)
F.Hofmann (Audi/OICA)	J.Yamabe (Kyushu Univ)	N.Hart (ITM Power/ISO TC197/UK)	W.Ji (Hyundai R&D/Korea)
G.Gissibl (BMW/OICA)	K. Hendershot (Transport Canada)	P.Breuer (Hexagon)	Y.Fujimoto (OICA/Toyota)

G. Mair (BAM/Germany) K.Chandraseker (Volute) P.Heggem (Hexagon)