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Agenda item 4)

Submitted by the expert of the United States of America

[DRAFT Meeting Notes]

2nd Meeting of the Informal Working Group on Hydrogen and Fuel Cell Vehicles

Global Technical Regulation No. 13 (Phase 2)

5-7 February, 2018 – Torrance, CA USA

	Agenda Items	Presenters	Documents
0	**Welcome and practical arrangements**		--
1	**Organization** • Co-sponsors: EU, Japan, Korea • Co-chairmanship: N. Nguyen (US/NHTSA); M. Takahashi (JPN/METI) • Co-vice chairmanship: H. Seo (Korea); Absent: Y. He (China) • Secretary: Y. Fujimoto (JPN/OICA) • Attendees: See list of attendees in appendix	**N. Nguyen**	--
2	**Approval of the agenda**	**Members**	GTR13-2-01
3	**Approval of the meeting minutes of the 1st meeting** • No comments from IWG members	**N. Nguyen**	GTR13-1-27
4	**Review of Terms of Reference** • Address main technical items for Phase 1 • Goal: Conclude IWG activity by Sep 2020, submit for GRSP in Dec 2020	**N. Nguyen**	GTR13-2-15
5	**Update on ongoing and planned research and rulemaking activities** • EC (Broertjes) – New vehicle safety regulation will be adopted May 2nd. UNR134 will be referenced for hydrogen • Japan (Takahashi) – Continued efforts now includes new meeting entity to discuss reform. Academics, OEMs, customers to be represented • Korea (Seo) – Ongoing discussions regarding FC bus and material compatibility • USA (Hill) – DOE focus on early R&D areas for fuel cells and hydrogen generation/storage. Codes and standards to focus on station design • Canada (Hendershot) – Updating final rule for high voltage safety per similar provisions in GTR number 13 and EVS GTR.	**CP**	GTR13-2-16
6	**Activities Related to Hydrogen Storage Cylinders for FCV in PR China**	**J. Zhang (China)**	GTR13-2-03
	1. Type 3 Hydrogen Storage Cylinders - GB/T 35544-2017 a. Published: 2017-12-29; Implementation: 2018-07-01 b. Applies to 70MPa (max), 450L (max capacity) c. Aligns with GTR13: NWP, Service life, Sequential hydraulic and pneumatic tests, Other component tests (TPRD, check valve, shut-off valve) 2. National Standards for Material Compatibility a. Evaluation of metals in hydrogen (GB/T 34542.2) b. Test methods for embrittlement (GB/T 34542.3) 3. GTR 13 and ISO/DIS 19881: Concerns about Type 3's not included in Category B of ISO 19881.		
7	**SAE Update**	**G. Scheffler (SAE)**	GTR13-2-14
	1. SAE J2579 revision 3 (2018) at ballot. Includes material compatibility test methods. To be published by mid-2018. 2. SAE J2579 revision 4 to address items like localized fire, material compatibility, long term stress rupture, larger vehicles and liquified hydrogen systems. Goal is to be published by 2020 and used as basis for GTR proposal		
8	**TC 197 Update**	**A. Tchouvelev (ISO)**	GTR13-2-17

	1. Plenary in China (Dec 4-7, 2017) – Well attended. Included tour of FC bus factory tour.		
9	**CSA CHMC2 Update**	**M. Veenstra (Ford)**	GTR13-2-09
	1. CHMC2: Test methods for evaluating material compatibility in compressed hydrogen applications – Polymers 2. Activity started in 2017 to address lack of test methods for evaluating polymers. Goal to develop test methods to be able to compare materials in hydrogen. Groups formed for various high priority test areas. 3. Goal is to ballot by end of 2018. Committee is open to additional participants.		
10	**Vehicle Classes / Heavy Duty Vehicles**	**A. Ryan (TMNA)**	GTR13-2-12
	1. Presentation regarding EVS-GTR treatment of heavy duty (HD) vehicle. While both light duty (LDV) and HDV are in the scope of EVS-GTR, the HDV tests and requirements will be defined by a separate task force at a later time. 2. CP emphasized need to include truck experts / bus manufacturers in regulation-making. Also need to clarify scope/classes of HDV. 3. Action items: **Taskforce #1 for Heavy Duty Trucks**: Led by Korea (name tbd at later time). Alliance to contact EMA (Truck and Engine Manufacturers Association); OICA to contact truck manufacturers to participate.		
11	**Other items**		
	1. Post crash safety, High voltage safety a. Currently not issues at this time. b. High voltage safety section to be removed and reference EVS-GTR 2. Static rollover: No update from Korea at this time		
12	**Scope of GTR13: Receptacle**	**A. Ryan (TMNA)**	GTR13-2-13
	1. No agreement in Phase 1 on how to regulate receptacle. Differences among countries (Korea, EU – regulated vs. Japan). ISO 17268 is most recent standard with design and tests, although SAE J2600 will be open soon. 2. Some discussion among regulators on whether or not this should be regulated (at component level? Safety concerns? Keep as standard?). If regulated, what aspects should be specified such that it's not design restrictive? 3. Action item: **Taskforce #2 for Receptacles**: Led by ISO (L. Gambone) and SAE (G. Scheffler). Discuss proposal at next IWG meeting.		
13	**Long Term Stress Rupture**	**G. Scheffler (SAE)**	--
	1. SAE J2579 – version 4 (2020) will finalize stress rupture to include a performance-based test 2. Burst test is not good way to judge stress rupture capability. While stress ratios are prescribed for certain fibers, they are not performance based. Concern about glass fibers, not carbon fiber. 3. SAE proposal for modifying hydraulic test based on analysis/calculations; no testing to date to verify. 4. Action item: SAE to discuss proposal at next IWG meeting.		
14	**Liquid Hydrogen**		--
	• No proposals discussed. However, will likely be included as part of HD scope.		
15	**Proposed Test Method to Establish Hydrogen Compatibility of Materials for FCV**	**C. San Marchi (Sandia NL/SAE)**	GTR13-2-04
	1. Material experts provided based tests to qualify material for basic strength requirement for design. It is not meant to generate design data. 2. Some degradation in properties can occur but is acceptable as long as the material still meets specified minimums. 3. Tensile testing (SSRT) in hydrogen demonstrates that materials satisfy the specified minimum properties consistent with pressure application 4. Currently SAE J2579 has table of approved materials. The table will be updated to reflect materials qualified under this test method. References to be published data will likely be included (when available) so designers can use the data to establish allowable design stress levels 5. SAE J2579 revision 4 (2020) to include draft of stress corrosion test for aluminum, welds, verification of FLT temperature, aluminum testing criteria 6. Action item: Korea and China to consult with SAE material experts to confirm results. SAE to make proposal at next meeting.		

16	**Material Compatibility Test for Austenitic Stainless Steels**	**T. Iijima (AIST)**	[confidential]
	1. SSRT and FLT (fatigue life test) of JIS SUS304, SUS316, SUS316L with smooth specimens 2. Test at high pressure in room temperature of both air and hydrogen 3. SSRT shows: (1) yield strength comparable in hydrogen and air; (2) yield strength at low temperature hydrogen higher than at room temp; (3) Elongation in hydrogen shown in both room temp and low temp 4. FLT results: (1) Fatigue strength at low temperature is higher than at room temp; (2) Stress amplitude of fatigue limit in 100 MPa hydrogen is comparable to air; (3) Measurement frequency does not affect FL in hydrogen 5. FLT results show differences in SUS304 and SUS316. Also fatigue limits is >1/3 Su (ultimate tensile strength)		
17	**Humid Gas- Stress Corrosion Cracking (HG-SCC) for Aluminum Alloy**	**A. Ishizuka (OICA/Honda R&D)**	GTR13-2-06
	1. Presented full text of HG-SCC test method from Japan's HPI (High Pressure Institute) and introduction of Japanese test data. 2. There are aluminum alloys susceptible to SCC (e.g., A7075, A6082) while others (e.g., A6061) are not. 3. 18 alloys tested with varying levels of Cu. Those with "balanced" composition of Si to Mg had good HG-SCC characteristics while those having excessive Si had poor HG-SCC characteristics. 4. Regulators comments: US does not have regulation for material testing (just one FMVSS for brake hose material). There are other failures due to sustained load cracking which ISO standard includes test for. Make sure testing covers all relevant materials. Future discussions should be conducted with care to prevent unnecessarily stringent limitation on material selection, considering not only HS-SCC characteristics but also hydrogen material compatibility. 5. Action item: Propose to keep on agenda and continue the discussion and address regulator comments.		
18	**Material Compatibility – Korea**	**KRISS**	[confidential]
	1. Fatigue test should be carried out to determine hydrogen compatibility. 2. LCF in hydrogen is very difficult.		
19	**Material Compatibility Wrap-up**		
	• Do CP need to regulate materials and if so, how to not hinder the innovation of technology? Continue to discuss at the next meeting. • IWG members encouraged to participate in the SAE and ISO meetings to discuss.		
20	**Initial Burst Pressure Requirement**	**H. Tamura (JARI)**	[confidential]
	1. Follow up presentation to Oct IWG meeting. Determine the initial burst pressure which will correlate with 180% NWP EOL pressure at end of sequential hydraulic tests. CFRP Type 4 cylinders used. 2. JARI Results: 5% decrease from initial to EOL burst pressure. Variation in burst pressure from 7% at BP0 to 16% at BP(EOL). 3. Because BP0 met requirement of +/- 10% BP0 and EOL BP met requirement of >180% NWP and >80% BP0, then change 225% → 200% NWP as initial BPmin 4. JARI not proposing any changes to glass fiber (BPmin still 350% NWP) 5. Action item: Japan to prepare proposed text for minimum burst pressure at next meeting.		
21	**Review of National Standards**	**Y. Fujimoto**	GTR13-1-18
	• Reminder for CP to review and update their standards in current GTR13		
22	**Comments on Test Procedures Amendments**	**L. Gambone (CSA)**	GTR13-02-23
	1. Suggestions to improve tests: tolerances, other specifications, point to recognized standards (SAE J2601), fire test 2. Action item: **Taskforce #3 Recommendations for Test Procedures**: CSA and NHTSA to consolidate recommendations. Merged document will be sent to IWG for review.		
23	**Comments on EC Amendments (editorial)**	**P. Broertjes (EC)**	GTR13-02-21
	1. Some modifications of wording to make UN document more comprehensive and clear. 2. US has changes as well. Group agrees to discuss technical comments first and then editorial ones.		

24	**Conformable Tank**	**K. Chandraseker (Volute)**	
	• Same presentation as Oct IWG. Update: Completed 45,000 cycles (ambient, per EC79).		
25	**Fire Test: Heat Release Rate vs. Heat Flux**	**V. Molkov (Ulster)**	GTR13-2-10
	1. Proposed HRR/A (heat release rate per area) value of 1MW/m2 to exclude effect of tank size and burner length requirement be relaxed for larger tanks. Temperature is not sufficient. 2. Data shows heat flux on tank surface is constantly changing, not practical to keep above 100 kW/m2 at all times 3. Action item: **Taskforce #4: Fire Test**: G. Scheffler (SAE) to lead taskforce to propose ways to improve reproducibility of fire test.		
26	**Fueling Protocol**	**V. Molkov (Ulster)**	GTR13-2-10
	• Presented fueling modeling tool (with validation results) whose applicability range is based on but not limited to SAE J2601 • IWG comment: Fueling protocol topic is out of scope of GTR13. Better discussed at other standards organizations.		
27	**GTR13- ISO TC 197 Harmonization**	**A. Tchouvelev (TC 197)**	GTR13-2-22
	1. TC 197 presented some examples that can be improved with text from ISO TC 197 standards 2. Also Type 3 tanks excluded from Category B in ISO 19881. If GTR13 specifies fiber stress ratio or includes long term stress rupture test, then ISO 19881 can be revised to include Type 3 tanks into Category B 3. Action item: **Taskforce #5: ISO TC197 Recommendations**: A. Tchouvelev to lead taskforce to propose changes based on ISO TC 197 documents.		
28	**Action Items**	**N. Nguyen**	GTR13-2-25
	Five task force teams identified to work on specific technical items. All interested members are welcome and encouraged to participate. Please feel free to contact the TF leaders: 1. **Task Force #1 - Heavy duty vehicles and buses**: Korea Lead (name to be announced later); email: hugeseo523@korea.kr 2. **Task force #2 - Fueling receptacle requirements**: Livio Gambone; email: Livio.Gambone@csagroup.org 3. **Task force #3 - Recommendations for test procedures**: Livio Gambone; email: Livio.Gambone@csagroup.org 4. **Task force #4 - Fire test**: Glenn Scheffler; email: gwssol@aol.com 5. **Task force #5 - Recommendations from TC197**: Andrei Tchouvelev; email: atchouvelev@tchouvelev.org		
29	**Next meeting**		
	• June 26-29: Seoul. Korea to finalize • October 16-19: Europe/TBD. EC to finalize		
30	**APPENDIX: Attendees List**		GTR13-2-24

A.Harris (Air Liquide)	H.Tamura (JARI Japan)	M.Watanabe (OICA/Toyota)	S. Mathison (OICA/Honda R&D)
A.Ryan (Toyota/OICA)	H. Seo (MLIT/Korea)	M. Leavitt (GM)	S. Cho (Korea Gas Safety Co.)
A.Tchouvelev (ISO TC197)	I.Yamashita (OICA/ Honda R&D)	M.Takahashi (METI/ Japan)	T. Iijima (AIST)
A.Pott (OICA/Hyundai Europe)	J. Birdsall (OICA/ Toyota)	M.Weber (Air Liquide)	T. Smutny (Powertech Labs)
A.Ishizuka (OICA/ Honda R&D)	J. Keller (Zero Carbon Energy Sol.)	M.Haeckh (OICA/ Daimler AG)	T. Takehana (KHK/Japan)
B.Acosta (EC-JRC)	J. Zheng (Zhejian University)	M.Veenstra (Ford)	T. Schaefer (OICA/Audi)
C. Collins (Volute)	J.Eihusen (Hexagon)	N.Nguyen (US/NHTSA)	T. Shuetz (OICA/Audi)
C. (Will) James (DOE)	J.Yamabe (Kyushu Univ)	N.Hart (ITM Power/UK)	V.Molkov (U.of Ulster)
C. San Marchi (Sandia Nat Labs)	K. Hendershot (Transport Canada)	P.Breuer (Hexagon)	U. Baek (KRISS/Korea)
F.Hofmann (OICA/Audi)	K.Chandraseker (Volute)	P.Heggem (Hexagon)	W. Kim (Korea Gas Safety Co.)
G.Gissibl (OICA/BMW)	K. Sato (JASIC Washington)	P.Broertjes (EC)	W. Ji (Hyundai R&D/Korea)
G. Scheffler (GWS/SAE)	K. Hwang (Hyundai)	S.Schmidt (Alliance Auto Mfr)	Y. Zhang (CATARC)
G.Yoo (ILJIN Composites Korea)	K. Stone (Volute)	S. Kuppa (US/NHTSA)	Y. Hou (Tongji Univ)
H.Shinohara (KHK)	L. Hill (DOE)	S. Kwon (KATRI)	Y.Fujimoto (OICA/Toyota)
H.Nakasato (MLIT Japan)	L.Gambone (CSA Group)	S. Quong (QAI)	