# SGS 6 - 16

**Agenda Proposal For the**
**6th Meeting of the Subgroup on Safety (SGS)**
**of Hydrogen-/Hydrogen Fuel Cell Vehicles**

26-29 May 2009
Beijing, People's Republic of China

Place: Meeting Room 1, Meeting Hall, Friendship Hotel
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| Schedule: | | |
|---|---|---|
| | Tuesday, 26 May | 10:00 – 18:00 (agenda items 1-5) |
| | Wednesday, 27 May | 09:00 – 17:00 (draft GTR – item 6, except the storage discussion) |
| | Thursday, 28 May | 09:30 – 18:00 (storage system – item 7) |
| | Friday, 29 May | 09:30 – 12:30 (agenda items 8 and 9) |

On Thursday, Tsinghua University will bring the FC Bus to transport us to the University to visit the fuel call lab and to host a dinner. 30 minutes to get to the University. One hour tour of the lab, followed by dinner at the University. Return expected at 8:30pm or 9:00pm

Video equipment and wireless internet connection available

## AGENDA

Day 1 – Tuesday

1. Welcome and Introductions

Co-chairmen Narusawa and Koubek welcomed the attendees. Director Li from the Ministry of Industry and Information Technology gave welcoming remarks. China currently produces 10 million vehicles per year, with 70 million vehicles on the road in China. Vehicle ownership rates in Europe: 500-600/1000 people, US: 800/1000, world 120/1000 and China: 40/1000. Chinese auto industry predicts vehicle ownership rate of 120/1000 (equates to 200 million vehicles). Government has taken measures to increase efficiency and decrease pollution for conventional as well as developing (new energy) technologies (NGV, LPGV, HFCV, etc). Ministry of Finance is investing in modernization technologies in several cities. Director Martin Fang of CATARC gave an additional welcome as the host of the meeting.

Mr. Narusawa offered in his greeting a Chinese phrase by Lu Shen (spelling?) (pioneer of Chinese modern history – outspoken writer/critic). Rough translation: "There were no roads initially but because there were so many people walking in the same direction, a road was made." It is our hope that our efforts will result in a road to a hydrogen GTR.

Participation from: USDOT/NHTSA, Honda R&D, JASIC, German Federal Ministry of Transport, TUV, PATAC, SAIC, China Automotive Research Center, Tsinghua University, Tongji University,

CATARC, Korea, Transport Canada, USDOE, LANL, Volvo/OICA, GM/OICA, Mercedes-Benz, ISO TC197,

2. Logistical Arrangements

2.1 Meeting arrangements. Room 102-103, Building 1. Lunch at 12 – 1:30.

Agenda distributed, discussed, amended by adding a presentation by P. Adams and approved.

3. Approvals

3.1 Minutes/decisions of the 5th Meeting

Comments: none from contracting parties, or from industry/organization representatives. Approved/agreed – any additional comments will be considered when/if brought to the group.

Comment on the ISO list. There is list in the SGS-5 minutes but the cited documents are not actually in their final stage – some of these are not standards yet even though they are labeled as such. There should be a distinction made which ones are and which are not standards. All the documents that were provided by ISO are published documents (standards or technical specifications), and have gone through the ballot and approval process.
13985 – Liquid hydrogen fuel tanks
14687 – fuel quality for ICE engine
14687-1 – Hydrogen fuel product specification
14687-2 – fuel quality for fuel cell vehicle
15869 – fuel blends
17268 – Compressed H2 fueling connections
23273-1 – safety specification part 1: vehicle functional safety
23273-2 – safety specification part 2: protection against hydrogen hazards
23273-3 – protection of persons against electric shock
23828 – energy consumption measurement

3.2 Action Items from the 5th Meeting

See document SGS 5-8:

1. all presentations should be provided to the Secretary (Nha) and the Chairman (Narusawa).
2. post all documents (there are 15 posted as of May 26)
3. China will send an additional document on fuel cell engine. Crash test information will be presented but is confidential and will not be distributed in hard copy or electronically
4. SAE distribution of standards: will be distributed in hard copy but cannot be replicated and/or distributed further
5. OICA/BMW question: BMW provided written information – will be sent to the Secretary for distribution to the group.
6. OICA/BMW: see above
7. Japan work on EOS (citation) – written documentation provided
8. resolved
9. resolved
10. resolved
11. SAE: details on the French bus incident can be provided
12. resolved
13. resolved
14. resolved
15. resolved
16. resolved

17. done
18. group was asked to review existing GTR structures
19. ISO – will be presented during the storage discussion
20. test procedure for single failure conditions – test procedure not completely validated – see it as an alternative test (include during the discussion of the GTR)
21. Japanese test procedure provided; test data will be made available but cannot be distributed.
22. 3-second interval – open discussion in OICA, with SAE. Not finalized even within OICA. Will discuss in Agenda Item 6
23. Inclusion of references as appropriate, as a matter of course.
24. OICA – to be discussed
25. done
26. Finalization of timeline:
    a. Comments on proposal
    b. OICA
    c. Co-sponsors prepare draft
    d. Task manager statement
    e. Meeting in Germany of the Drafting Task Force
    f. SGS-6
    g. Informal paper to be prepared late May
    h. Feedback to WP.29 in June

Note: throughout the document:
Q = Question
A = Answer
C = Comment

4. Reports of UN Activities

4.1 147th Session of WP.29 in March 2009

Minutes are available on the website. Mr. Albus reported to WP.29 on the progress made by the group. He reported on plan for a Drafting Task Force meeting in Mainz, Germany in April. Approved by WP.29. Also announced SGE will resume work and will meet in June. Scope of GTR will be limited to passenger cars, with compressed gas and liquid storage only. Co-chair reminds the parties that we are focused on the compressed gas storage system and will include liquid hydrogen storage at a later date, when more technical information and additional rationale are available, as agreed earlier by SGS and BMW.

Q: What are the implications for delaying the inclusion of LH2?
A: Could impact the timeline for a draft GTR if we attempt to include both in the draft. BMW has agreed to provide information on LH2 that is consistent with the level of detail that we will have in the GTR for the compressed hydrogen storage system.
C: There is no similar document for LH2 as OICA presented at SGS-5 for compressed gas storage. Such a (more detailed with a different approach) document for LH2 will take some time. The nature of the BMW proposal is more conservative approach. If a similar approach for both is required, more time would be needed to develop such a proposal for LH2.
C: The design-specific nature of the BMW proposal is not acceptable. It does not meet the requirements of the GTR (performance-based, objective).
C: The co-chairs will discuss with Mr. Albus how the inclusion of both storage systems will impact the timeline, and then he will decide if/how to present to WP.29 (delay of timeline, or change to only include CH2).

C: It will be easier to include LH2 once we have gotten through the difficulties of writing a GTR that is acceptable to all contracting parties for CH2.

**ACTION: OICA will discuss with BMW the possibility of submission of a proposal for LH2 that mimics the structure and detail of the OICA CH2 proposal.**

5. Reports of other activities
   5.1 National/Regional

Canada:
Localized flame research in collaboration with US. Previously reported on this research. Testing at Powertech is complete and the report is forthcoming.

China: presentation will be posted.
Crash Test (this part will not be provided in the posted presentation). Video of frontal crash test. Road performance test, chassis test. Vibration test, Hydrogen leakage. Bonfire, gunfire, Data on the tests will be provided after the meeting

**ACTION: China will provide details of the tests performed on the tank and on the fuel cell.**

National Standard for fuel cell electric vehicles – safety requirements (handout ICS 43.020). The FCV has to meet the minimum (same) standards as conventional vehicles and electric vehicles. Also provided some detailed comments on various sections in SGS-6-02, and has made a proposal related to crash testing. Comments will be made in more detail during the appropriate agenda item at this meeting.

Q: When will the national standard be approved?
A: Perhaps by the end of 2009
Q: Regulation requirements or standards requirements are different from the ISO/IEC numbers. For example, Table 1 (voltage levels). Please explain.
A: Consistent with the China national standard for BEV.

The Chinese representative made also proposal regarding a leak test pressure and duration as well as possible revision/alternative text for 2.4 of the GTR

EC/EU activities:
The German delegate updated SGS on the activities within the EC. Regulation EC 29/1075 has been approved by Parliament and Council of Ministers. Working on the implementing measures (June), should be approved this year. Therefore will have EU regulations for FCV this year.

Japan:
Type approval is possible for three types of FCV.

Korea: presentation will be posted.
Research findings for leak test and rear impact test.
Simulation of driving mode leak. Hydrogen diffused by outside air flow. Localized high concentrations calculated. Sensors did not detect hydrogen except near leak.
Simulation of stop mode leak. Sensors placed throughout the vehicle. Test conditions reported. Hydrogen could enter the vehicle through holes etc. Conclude that some number of sensors (to be optimized) will need to be properly placed, including consideration of some interior sensors.

Rear impact test: No leakage detected. Tanks were damaged due to deformation of suspension, but did not leak.

Q: Was a frontal crash test considered or performed?
A: Not yet. Rear impact is more severe test, since storage tank is in the back.
Q: Stop mode – was it a simulation?
A: No, it is an actual test. Only the driving mode was a simulation.

C: We will discuss these results in more detail as part of the discussion of the draft GTR. The co-chair asks that China and Korea email their presentations to the Secretary as soon as possible (today if possible)

Q: Please describe the damage to the container
A: Carbon fiber was damaged
Q: What hydrogen % was measured under the hood during the stop test?
A: 2% - prior to shutdown, with some areas rising to 4% (also under hood) but concentration dropped within one minute.
Q: In Drive Mode, why did the sensors not detect?
A: This is a simulation, not a real test.
Q: In the rear crash test, was hydrogen in the tank?
A: No. Helium was used.
Q: In the drive and the stop test, are the simulated leaks really possible?
A: For the Drive test (simulation) there is a leak point specified (and this is a potential leak point). For the Stop test, the leak points are related to the proposed single point failure.

**ACTION: Korea will provide test report in English at the next meeting**

US:
Update on the USDOT research plan – ongoing research, funding limitations.

Q: How do DOE and DOT coordinate their activities?
A: At DOT, research supports rule-making. Plan is focused. DOT works closely with DOE. The important difference is that DOE is focused on moving technology forward through research and development.
C: Countries are paying close attention to what the US is doing. Please explain the recent decision to reduce the budget for hydrogen technologies.
A: The new Administration is looking at near-term technologies. DOE is refocusing the fuel cell program to be technology neutral (not just on transportation). DOT remains focused on the GTR, with support from DOE.

5.2 ISO/SAE

ISO:
No separate presentation (will discuss later in the program)

SAE:
J2578 (recommended practice) and J2579 (technical information report - TIR) were both published in January. Working on fast-fill protocols (TIR) based on test results in SAE TIR J2601. J2799 (TIR) is the receptacle configuration for 70 MPa fill.

Q: Will the profile of the receptacle be in the fast-fill protocol?

A: No. J2600 is for the configuration of the hardware (being worked on) and J2601 (TIR) is the fast-fill protocol. Results of verification of J2799 will be used to revise J2600.

6. Discussion of Key Items for HFCV GTR/Report on the decisions of the Drafting Task Force – Revised Draft GTR

Decision was made at SGS-5 to call a small group of experts who represented the co-sponsors and technical experts. Meeting was held in Mainz, Germany on 14-16 April, and the results are now presented. Table in document SGS-6-02. Secretary then took these decisions and made a new draft of the GTR, which is found in the next version of the draft GTR: SGS-6-1 (this document needs a different number)

6.1 Revised Draft GTR

The Secretary will note the discussion within the draft GTR document.

*Part A*

It is important to have a strong rationale included in this section of the GTR. Sections in this part are included in the Table of Contents.

1. Introduction: drafted by Co-chair Koubek (see discussion below)
2. GTR Action Plan (cut-and-paste from the document)
3. Description of Compressed Hydrogen Fuel Cell Vehicle (see below)
4. Existing Regulations, Directives, and International Voluntary Standards (see below)
5. Technical Rationale (see below)
6. Discussion of Key Issues
7. Benefits and Costs

C: need to include a section on the safety concerns related to hydrogen or the fuel cell, either in each subsection (of Part A section 5) or in a separate section in Part A.

**ACTION: All should provide comments on Part A to Secretary as soon as possible but by June 30 at the latest**

1. Introduction

C: In the Introduction section, item 5 implies that the goal is to have a hydrogen fuel cell vehicle that has the “equivalent levels of safety” as the gasoline vehicle. This is a concern in China.
C: The goal cannot be to develop a goal. The wording for this section should be developed or edited in a smaller group.
C: The expectation for equivalent levels of safety is that this system does not pose a higher risk to the consumer or the public (including first responders).
C: Goal is to establish requirements for the HFCV so that it is as safe as a conventional vehicle.
C: This is more a matter of definition rather than wording

3. Description of CH2 FCV

C: simplification of the diagram and figure would reduce need for explanation that the figures are only examples of possible configurations, etc.

**ACTION: GS will suggest simplified diagrams and a section on LH2**

C: remove “permeation-resistant” from paragraph 15.
Q: should this section be specific to compressed gas and to fuel cells?
A: rename of this section to hydrogen fueled vehicle, with a subsection for compressed, liquid, fuel cell, and ICE.

4. Existing Regulations

**ACTION: ISO will provide descriptions as indicated.**
**ACTION: Korea will provide information on regulation for inclusion.**

C: EU regulation EC 70/2009 (it is not a directive) covers a number of these subsections and should be included.

5. Technical Rationale
Most of the text in this section is from the TUV proposal that was suggested to be moved to Part A during the drafting task force meeting. These are not requirements, but are explanations and the rationale, so the language needs to be modified to remove the implication that these are requirements. Suggest that a risk-based discussion be included in these explanations.
Table has been developed by Secretary, including preliminary writing assignments. Volunteers are welcome. Table will be distributed at the end of this meeting.

**ACTION: Secretary will distribute table with assignments for contributions to the Technical Rationale section.**

*Part B*
Sections in this part are specified by the GTR requirements.
*Purpose*
Modification of language
*Application/Scope*
Category 1-1 vehicles (up to 8 passengers). Category 1-2 (more than 8 passengers, vehicle weight up to 10k lbs/4500 kg)
Inclusion of LH2 in addition to CH2
*Definitions*
Need definitions for a few terms:
Single failure: a failure caused by a single event including any consequential failures (resulting) from this failure (event).
Vehicle exhaust system: definition may not be needed, should be described in Part A.
Can remove definitions for LFL and UFL if these terms are not used in Part B (using 4% throughout Part B). There will be an explanation of these terms in Part A.
Enclosed and semi-enclosed space: can some additional specificity be added? As written, it may present enforceability or compliance concerns.
This section needs to be revisited after the requirements are established.
*General Requirements*
Boilerplate
*Performance Requirements*
Q: do we need to include a separate section for refueling?
A: may need to revisit after we complete the review of the storage system (had a section in the OICA proposal that was deleted at the Task Force meeting).
A: added as indicated in the table developed by the Task Force (added a new subsection)

*Storage System*
See Section 7 of the Agenda (below)
*Performance Requirements*
*Markings*

*Vehicle Fuel System Integrity*

Title changed to Vehicle Fuel System

*In-Use Requirements*

*Hydrogen Discharge Direction*

Discussion on the language to be used.
TPRD vent (better to use "hydrogen discharge outlet") protected from intrusion (ingress?) by water (rather than be specific with a list like foreign objects, ice, water, dirt, etc)
"Shall be covered" (design-specific?)
Continued discussion.
Suggested text remains in yellow highlight in the draft GTR text.

*Single Failure Condition*

OICA proposal and an additional proposal for language that is in the draft highlighted in yellow. Another proposal was sent for consideration (two-page document). After much discussion, suggestion was made to revert to the original proposed text (prior to the Mainz meeting). Unprotected ignition source text will be developed by a small number of participants and then proposed to the group.
The US will provide a proposal for telltale warning. Specificity will be a problem with OICA members. Japan cautioned that it prefers no specific symbol be required although some Japanese manufacturers currently use the symbol "H".

**ACTION: USDOT will develop a proposal for a telltale warning**

*Fuel cell vehicle discharge system (new subsection)*

Proposal for discharge system is in the two-pager (#3) – 12 second rolling average
Japan test data on discharge (document was used at the Mainz meeting). Additional confidential data were presented on the measurement of hydrogen concentration in the exhaust under various conditions. Note that this requires a very fast sensor response.

Q: What was the volume of the sample?
A: Only measured point concentration at the exhaust.
Q: What measurement method was used, as the results would be dependent on the method, including the sensitivity of the sensor?
A: Distance was set at 100 mm, but also measured at a number of other places within the exhaust and further from the exhaust. Beyond 100 mm, mixing with surrounding air is excessive.
Q; What is the response time of the sensor? Figure indicates that the instrumentation was relatively slow to respond (especially compared to laboratory equipment – $1/10^{th}$ of a sec)?
A: Catalyzed combustion sensor (time constant can be 3-10 seconds).
C: The response time of the sensor will be critical to the time interval in the measurement of the time-averaged concentration.

**ACTION: US (GS) will provide justification for increased time interval for measurement of vehicle exhaust**

**ACTION: OICA will provide justification for 3-second interval for concentrations exceeding 4%**

*Post-Crash Requirements*

*Fuel Leakage Limits*

China proposes a change in the length of time after crash (60 minutes is too long), but do not have a suggestion.

Japan uses 60 minutes because the cost of an accurate pressure sensor was too high. But wants to keep this at 60 minutes (very conservative) for Phase 1. When cheaper, accurate sensors are available, the time interval can be lowered (perhaps).

Open Items from the Task Force Meeting (see document SGS-6-02)

1.2.2: Source of heat including sunlight. Japan was asked to explain test results and has produced a document (distributed). It is a design-specific requirement in the Japanese regulation. Data shows significant heating from sunlight for roof-mounted tanks. The inclusion of heat from something other than sunlight is a problem.
C: this is really a recommended practice. In a gasoline vehicle, the fuel tank is made of plastic and would also have such a problem, but there is no requirement for protection from sunlight.
C: some experiments done by NASA showed fatigue related to failure due to exposure to ultraviolet radiation. Also, if a gasoline tank has a leak, the damage risk due to failure is not as severe as if a pressurized hydrogen storage tank fails due to fatigue.
C: would need a test procedure that permits compliance enforcement. Language would need to be more clear (other heat sources). Visual inspection is an appropriate test.
C: Japan is ok with only including the sunlight protection requirement in the GTR. Move the description for the protection from heat to Part A.

**ACTION: US (CS) will provide text describing the risk-based assessment in support of sunlight protection for hydrogen tank but not gasoline tank (1.2.2)**

1.3.1: Automatic shutoff device. Japan showed data on collision direction and frequency (handout). Based on their analysis of the data, they do not think that the crash test covers all potential crash positions and would not necessarily "prove" that the system will not leak during a real-world crash. They are proposing that one shutoff valve be attached to each gas container.
Q: what is the conclusion that was made from these data?
A: Japanese regulation includes language that requires each gas container to have a main shutoff valve. A document with additional detail is posted as SGS-6-06.
C: OICA proposes one shutoff valve per assembly system. The Japanese justification depends on the design of the system and how the storage system is installed in the vehicle. It is possible to place multiple containers or assemblies in the vehicles to make the system safe(r) while still using only one shutoff for the assembly. Testing is on the storage system as it is used on the vehicle, and the level of safety is equivalent for all systems that pass the test procedures.
C: Japan does not agree. How can one shutoff valve for multiple tanks be as safe as one per container?
C: Probability (frequency) of failure is reduced if there is only one shutoff valve, rather than multiple valves (all with the same likelihood of failure).

**ACTION: OICA will discuss issue and consider the proposal for multiple shutoff valves (1.3.1)**

1.4.1: Overpressure protection. US counterproposal is to exclude the low pressure portion (see two-page paper).
Q: How do you ensure that the low-pressure system is always at low pressure?
A: Not implying that it should not be protected, just that it should not be in the regulation.
C: Pressure Equipment Directive only states that the low pressure parts do not have to be tested. With the OICA proposal, burst is not included, only leakage.
C: Should be in Part A, as a best practice, but not as part of the regulation.
C: In a vehicle, there is always a risk of burst (e.g., filling tires with air).

C: An appropriate hazard analysis would indicate that there are systems on the vehicle that do not need overpressure protection.
C: Overpressure protection is in European regulations already. It is not a recommended practice, it is in the regulation. The GTR cannot have lower safety than an existing regulation.
C: Japan agrees with the TUV proposal but asks for a justification paper.
C: The European regulation is very design restrictive and may or may not result in a safer system.
C: There are no requirements in the NGV regulations, so we would need appropriate rationale to regulate this in a hydrogen system.

**ACTION: TUV to provide technical justification for overpressure protection of the low-pressure section (1.4.1).**

C: This issue should be raised to AC.3 since this is in conflict with the EC regulations, and there is no consensus in the group.
C: A contracting party must present this issue

**ACTION: Germany (GK) will check with the EC representative to see if the EC will present the overpressure protection issue to the AC.3 (1.4.1)** (Secretary has a more specific action item)

Q: Can Mr. Albus as the project manager bring this to the AC.3?
A: Normally have to identify the contracting party – this is the normal process, so it has to be done this way.

1.5.1: Language proposed by SAE, OICA, and TUV discussed.
C: Japan opinion: original TUV language was better and is preferred
C: US is concerned about hydrogen under the hood
C: the test procedure will be adapted to meet this new requirement

1.7.1: Safety instrumented system (note added to the storage system).
C: “Unpowered closed” should be used rather than “normally closed” (power could be electrical, hydraulic, or pneumatic, but should not be specified)

2.2.1: Air-tightness requirement
Q: What is the added safety that we get with this test? What are we trying to prevent?
A: We are testing for gas tightness. Testing of the component installation proves that the system is gas tight when installed in the vehicle.
C: It is not regulated in gasoline vehicles.
C: It is regulated (tested?) in gaseous-fueled vehicles.

**ACTION: Japan and TUV will prepare and submit a test procedure for air-tightness test (2.2.1)**

Q: what are the safety advantages that passing this test would afford to the vehicle? Would rather see the technical justification than a test procedure.
C: This is a production quality test, not a safety-related test.

The group proceeded to discuss the progress made by the Electric Safety Subgroup. German and US delegates reported. Chinese delegate asked for web addressed to access the information on ELSA activities.

*Electric Safety*
*Purpose*
*In-Use Requirements and Test Procedures*
*Performance Requirements*
*Post-Crash Requirements and Test Procedures*
*Performance Requirements*
*Markings*

*Test Conditions and Procedures*

Key issue in this section is validation of test procedures.

**ACTION: OICA to modify the text on the test condition and procedures, to be consistent with current requirements so that the procedures can be modified.**

*Demonstration of Fuel System Integrity Crash and Compliance*
*Demonstration of Compliance for Single Failure Condition*
*Demonstration of Compliance for Fuel Cell Vehicle Exhaust System*

Day 3 – Thursday

Before starting the discussion on Agenda Item 7 (Hydrogen Container portion of the GTR), co-chair summarized the discussion from the previous day. Specifically, he mentioned: H Gas discharge; development of telltale warning provision; proposal to reconsider 3-second average interval requirement, issue of sensor responsiveness (Japan and US asked to see more test results); heat/sun light protection – concern over system's exposure to UV; Japan's presentation on crash analysis; the issue of one shut-off valve per container vs. one shut-off per fuel system; question regarding adequate safety justification for requiring tightness test; and report on ELSA.

7. Hydrogen Storage System

7.1 ISO Presentation "Comparison of hydrogen containers requirements"

Two handouts (comparison table and proposal) and presentation
Five documents JARI S001 (Type 3 and 4, MWP is 35 MPa), ISO 15869 (Type 1, 2, 3, and 4 containers with definitions, no limit on working pressure), SAE J2579 (NWP up to 70 MPa), OICA proposal, EC Regulation 79/2009 (Types 1, 2, 3, and 4)
Recommendation by ISO: Tank type specification (to ensure that tests that are not appropriate for a particular type of tank)

C: China does not allow Type 4 tanks (no tanks with plastic liners) – reaction to a CNGV accident. The government reacted to protect the public because there are so many CNG vehicles and tanks on the road (not clear if the tanks met a standard, which points to the importance of certification). US delegate asked for information on this accident.

NWP – use nominal working pressure with a consistent definition (most use this definition), and let it be specified by the manufacturer (that is, do not specify)
Maximum filling pressure – recommend that it not be used in the GTR (only used in the testing program)
Internal capacity – should not be included or specified
Design temperature – ISO recommends a range of -40C to 85C

C: Design temperature range could easily be exceeded when in use and materials other than the tank would need to be able to handle more extreme temperatures.

Service life and filling cycles – 5500 filling cycles for personal vehicle with a counter. Commercial vehicles would be at 11k cycles (but we are not considering heavy duty commercial vehicles in this GTR).

C: Need to understand the real safety criteria. Building in excess that is not necessary for safety is going to make commercialization more difficult. 5500 cycles would have to be full fills to really matter from a safety perspective, and this equates to over 1 million miles of driving – way more than any vehicle will ever reach.
C: Taxis might get close(r) to this number of fills – twice a day – but rest of the vehicle would not last long enough to get to this level of cycles.

Burst pressure – ISO is recommending that the "beginning of life" numbers (which are much higher than the "end of life" numbers) be used. Degradation and aging mechanisms are different for each type of tank. Co-chair asked which test tests for worse/worst case scenario. ISO replied that perhaps the sequential test is the more stringent. The test where new container is used for each test does not necessarily mimic the likely degradation mechanisms.

C: The table does not include that the SAE limits also include the added requirement that the burst pressure does not vary over the cycle life by more than 20% - SAE includes this concept. The table is showing (for SAE and OICA) the "end of life" burst pressure ratio in the test sequence (this is also a requirement of the EC regulation). The "end of life" number is the important one.
C: OEMs do not commonly share the idea that the ISO recommendation results in a safer tank.
Q: will test data in support of these ISO recommendations be provided?
A: participants in the ISO Working Groups may have the data, but it would have to be collected.

Stress ratio – ISO Technical Specification is the only document that includes this concept, and ISO is recommending that this concept be included in the GTR.

C: Our goal is to develop performance-based tests, and if you design a proper test, you will see the degradation.
C: Documents that are "final" should not given higher standing, as it could be that the draft documents are more likely to include the latest information and data.
C: The draft ISO standard was circulated for voting and was not approved, and was therefore published as a technical specification

Material – most documents specify material requirements and this should be included in the GTR (no comments)

First Series of Qualification Tests – ISO recommends that the ISO test series be included.

C: One of the main differences is that the ISO and JARI tests are performed in parallel and OICA and SAE tests are done in series. In addition, hydrogen is used in only the OICA and SAE test (much more severe test). Tanks that will pass the ISO/JARI tests may not pass the series of tests that use hydrogen at higher pressures.
C: SAE is looking at developing alternatives to simplify testing, but will not move back to the ISO testing procedures. This will only be done if it preserves the safety of the system.

Second Series of Qualification Tests – members expressed concerns about two of the tests

C: Very similar sets, except that OICA and SAE requiring the tests to be performed in sequence. Performing these tests in sequence is more severe.
C: LBB – not necessary (only gives a false sense of security)
C: boss torque test – protecting from an action by mechanics that would never be possible (seems to be a remnant of the retrofit industry associated with CNG vehicles)

Third Series of Qualifications Tests – ISO recommendation is that these should be included in the GTR

C: tests are very similar.
C: SAE looking to develop a more challenging test than the engulfing fire test. A localized fire test, where the PRD may or may not be activated because it is not in the fire, is being considered (see previous materials provided by Canada on the localized fire test).
C: the USDOT position is that DOT is inclined to oppose the inclusion in the GTR of the penetration (gunfire) test and others such as the drop test, since the crash test covers dynamic behavior of the whole vehicle.

Sampling (Batch) Tests – ISO recommendation is that these should be included in the GTR

C: tests are very similar
C: these are manufacturing quality tests.
C: USDOT does not require batch testing on any components in CNG vehicles. Will consider it for hydrogen tanks if convinced it is necessary.

Routine (Production) Tests – ISO recommendation is that these should be included in the GTR

C: similar in most of the documents that are being compared here.

General conclusion (as presented by ISO): ISO and EC documents are very similar. Safety margins in the ISO document result in a safer tank. In closing, ISO made a recommendation that the ISO proposal be used as the basis for the GTR text. SGS recalled that it was agreed in Budapest that OICA's revised proposal would be used as a starting point for the discussion of hydrogen container. SGS however welcomes ISO's work and effort it put in preparing its presentation on the comparison of hydrogen container standards.

**ACTION: ISO will provide presentation slides for posting.**

C: Stating that a particular approach has a reduced level of safety, when in reality it is only another approach, is cautioned against. SAE and OICA test proposals are based on a good deal of technical data. A paper by Chris Sloane has been distributed (SGS-5-15) and should be studied by the group. The question also arose on the policy for posting copyrighted documents on the SGS website. Since the website is accessible by public at large, such documents cannot be posted without a prior permission by the copyright owner. SGS was urged not to share this and other copyrighted documents outside the SGS and/or for any other purpose than to develop a GTR under SGS/WP.29.

C: Tanks built to either the ISO or the SAE standard would need to have equivalent safety. Need to see data that confirms the opinion that tanks that pass one set will not (necessarily) pass the other set.
C: Consideration has to be given to the consequences of failure.

7.2 OICA Proposal (SGS-6-03)

As SGS recalled earlier, OICA had prepared this proposal for the meeting in Budapest. Due to the late distribution and additional changes to the proposal, it was agreed at the time of Budapest meeting, to let OICA revise the document and distribute it in Beijing where it would serve as a strating point for the discussion on this issue. Slightly revised version from the Budapest meeting (changes to the references, technical content has not been altered) has been distributed.
(NOTE: comments and concerns were incorporated in the proposal as it was reviewed)
General Comment: make sure that consistent titles are used for the names of the tests in the table and in the text.

5.2.1 – scope of the document
C: need to include definitions of terms
C: the numbering sequence used in the draft was consistent with an earlier version of the GTR, and may now need to be renumbered to fit properly in the draft GTR.

5.2.2 – tests for design qualifications (alternatives – proposed by Japanese member of SAE and accepted by the OICA members – are shown in the table). Reduction in the testing time is being considered by SAE and may be incorporated into this proposal in the future (July or later). Equation for the determination of the number of cycles required is given.
Q: Is there a limit of the lifetime (for example, no more than 15-20 years)?
A: No limitation in this proposal. Storage lifetime is related to the vehicle lifetime.
Q: Is using the tank in a second vehicle allowed?
A: No – it should be specifically stated that this is not allowed. Have not determined how to enforce, but are working on this issue.
C: Agree that tanks would need to be marked with date of manufacturing and perhaps end-of-life date also.
C: Any consensus decision by this group would have to be on the tests, and not on the alternatives (until they are accepted tests – might not be possible in the timeframe).

5.2.2.1 Pneumatic Performance Tests
Series of tests that are to be performed in sequence.
Q: where is the description of the fast fill?
A: the full text of the test procedures (found in an appendix of J2579) is to be included, but the language is not included in this proposal. That text will be pulled into this document.
NOTE: SAE J2579 has been provided to the group's use only (not to be distributed outside of the group)
C: The DOE document related to the testing procedures can be distributed.

**ACTION: DOE will distribute pneumatic performance testing document (OICA proposal)**

Q; what does "full function" mean?
A: all of the components of the system must still be operating at the end of the test (PRD, shutoff valve, check valve, etc)

Q: In sections 5.2.2.1.1 a & b: Manufacturer's specified lower temperature – how to police this?
A: The vehicle manufacturer would have to be able to constrain its operation at the lower temperature (some kind of control unit that would sense temperature if the ambient temperature were below the allowed temperature and prevent the operation of the vehicle).
C: still concerned – what if someone figures out how to deactivate that sensor? Can/should SGS try to regulate for 'misuse' or 'tampering'?
C: the areas that actually experience the cold extremes are pretty limited. For much of the world, these temperatures will never be experienced. The vehicles would therefore (possibly) have materials that function appropriately at moderate temperatures, but that are known to fail or have problems at the very low temperatures.
C: US and Canada do not want to have a regulation that allows the manufacturer to specify the range.
C: Most stressful procedure is the full fill – how to account for this in the GTR?
C: Yes, that's a valid point.

Note: there was a subsequent discussion between the questioner and the respondent that resulted in a better understanding of the question, and therefore a revised response. The original question and the revised response are given here:
Q: In sections 5.2.2.1.1 a & b: Manufacturer's specified lower temperature – how to police this?
A: The storage system is tested as installed in the vehicle. If the storage system includes a heating device to prevent internal temperatures below -40C during defueling, that heating system would be operative during the testing.

**ACTION: OICA to discuss removal of the temperature range specification provision from the OICA proposal**

C: section 5.2.2.3.1 – bonfire test – want a comment added that a localized fire test is being considered.
C: section 5.2.2.3.2 – penetration test – what is the rationale for this test?
C: section 5.2.2.3.3 – the equation is complicated and not consistent with the other parts of the proposal (10% here and 20% elsewhere).
Note: there is no error. Two separate concepts are covered by the two equations. Simplification of the concepts covered will be considered.
C: The 10% number is a quality control number (conformity of product) and it is an indication of the variation of the new-tank burst pressure. The degradation of the tank by the end of the tank series can only be 20%.
C: recommendation that the text should be formulated in a more simplified manner (proposed text provided to OICA for consideration).

C: ISO submitted a proposal earlier, and both documents should be given equal consideration at the next meeting.
C: it is much easier to use a single document and it would be best if we could incorporate comments into the OICA document (Note: it was decided at SGS-5 to use the OICA document as the starting point/discussion paper, and to modify it as needed)
C: Perhaps a drafting task force could be established and work in the same manner as the Mainz task force meeting.
C: Secretary proposes to incorporate the differences in the two proposals into the GTR.
C: ISO should be afforded an equal opportunity to allow for a fully-vetted proposal. Wants to keep the documents separate for the moment, and to make the effort to make a single document in a task force meeting.

**ACTION: Send comments on the ISO proposal and the OICA proposal by June 30th to co-chair (ALL)**

Proposal by the co-chair: Drafting task force to be organized for mid to late July to modify the OICA document so that it combines the two proposals into a single document. It was strongly encouraged that ISO and OICA draft such a combined document in anticipation of the task force meeting. This will then be incorporated into the next version of the draft GTR.
Q: Where should the meeting be held?
A: Germany has offered to host the meeting. US may have travel issues, in which case US would like to host.
Q: When will the meeting be held?
A: First week of August would be best for ISO, although last week in July would also work.

8. Electric Safety

8.1 Report on April 2009 Meeting of ELSA

Finalized the informal document for the amendment of R100 to cover all high-voltage vehicles. Will have another meeting in September 2009, focusing on in-use and post-crash requirements. US is in rule-making process and cannot officially comment on the draft until the rule-making process is complete.

8.2 Discussion

Q: When will the rule-making be complete? Will it impact the timeline by a delay in the inclusion of the electrical safety sections of the GTR?
A: Unknown – working to make sure there is no impact.

9. Miscellaneous Administrative Items

9.1 Approval of Decisions and Action Items of the 6th Meeting

Will be distributed later

9.2 Next Meeting

SGS-7: Ottawa, Canada on 21-23 September 2009.

9.3 Other Issues

Allowable Hydrogen Permeation Rate for Automotive Applications (presentation)

Meeting of the Drafting Task Force on the hydrogen storage may again be an effective way to make progress on this issue. There is a possibility of such meeting in July in the United States or Europe (Germany?). Co-sponsors will discuss and inform the group of the decision. Korea would like to be also involved.

Update on the SGS-5 presentation. Justification document provided to the co-chair and will be posted. NOE (network of excellence) HySafe is now finished, but the work will continue as HySafe. Main focus of the work is allowable permeation rates in domestic garages. Maximum ambient temperature is 55C. Ventilation rate is 0.03 air changes/hr as the minimum value (even with a very-well-sealed garage, still see 0.01 ac/hr). Very small garages are actually available in Europe and elsewhere, so it might be more realistic to use this garage size, rather than a more spacious garage typical of North America (SAE assumed a minimum garage size that is larger than the potentially-available garage). Table comparing the current numbers in a variety of standards and regulations was shown.

C: permeation rates change with temperature, and the test should be done at the maximum temperature (55C), rather than testing at a different temperature and extrapolating to 55C.

Aging needs to be accounted for, either by measuring a reasonably “aged” tank or adjusting the measured permeation from a new tank for some estimated aging process. There are currently no data available where permeation rates were actually measured from an aged tank.