COMMENTS ON THE GRPE DRAFT ECE COMPRESSED GASEOUS HYDROGEN (CGH_2) REGULATION Version 10 Dated 06.11.02 (NON GRPE/ISO HARMONIZATION)	GRPE - **003**	2003-01-08

GENERAL COMMENTS				
Paragraph/ Annex	**Organisation**	**Comments/Proposed Modification**	**Agreed**	**Final Modification Or Reason For Rejection**
General	JASIC	See “Components To Be Type Approved – JASIC’s View” at the end of this document.		
General/Annex 8	UTC	In Annex 8, components downstream the pressure regulators shall be pressure tested at a pressure sufficient to accommodate the Maximum allowable working pressure (MAWP) of the system e.g. the set pressure of the pressure relief valve – See the UTC proposal for MAWP. See “Comments to GRPE Relative To The Draft Of The Compressed Hydrogen Regulation” at the end of this document.		
General/Annex 8		Consider component test pressure relative to the set pressure of PRVs (also conflict between 14.1.17 & Ann.8: B5.2.6)		
General	RA	It is often used a wording like “a type of a *Specific Component*” (as in paragraph 7.1 for instance). Change to “a *Specific Component*”.		

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GENERAL COMMENTS				
Paragraph/ Annex	**Organisation**	**Comments/Proposed Modification**	**Agreed**	**Final Modification Or Reason For Rejection**
General	RA	i. When it is written, “Regulation and its Annexes” could this be reduced to “Regulation” as the annexes constitute a natural part of the regulation? Otherwise the document should be revised to make sure that references are made to “this Regulation and its Annexes” as opposed to “this Regulation”, wherever this would be appropriate. ii. (Only if the answer to i. is no) When it is written, “approved in accordance with this Regulation and its Annexes” could this be changed to “approved in accordance with this Regulation”?		
General	RA	Delete the unnecessary words “of (or to) this Regulation” whenever a reference is made to other parts of the document.		
General	-	Agree detail of the PSA removable container proposal: See original proposal at the end of this document		
1 Scope	RA	Delete 1.2 and 1.3. There is no need for the title to be repeated in the scope.		
2	RA	Based on our comments to paragraphs 2.2 and 2.3 below, paragraph 2 should be renamed “Definitions”, i.e. existing paragraph 2.1. Paragraphs 2.2 and 2.3 should be moved to section 6 and paragraph 2.4 should be moved to a new		

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Paragraph/ Annex	Organisation	Comments/Proposed Modification	Agreed	Final Modification Or Reason For Rejection
		paragraph 3 “Service Conditions”.		
2.1.1	RA	Delete this definition. “Approval of a vehicle type” is used only twice, and the part concerning “original equipment” should rather be incorporated into paragraph 12.1.		
2.1.26	DC	There shall be no requirement in a definition.		
2.1.47 (Specific components)	JASIC	2.1.47 "*Specific Component*": A *Hydrogen Component* that is subjected to type approval in accordance with this Regulation. Type approval should not be required of all of the "Specific Components", but limited to those to which Paragraph 3.3 is applicable. We propose to change the phrase "is subject to..." to "can be subject to...," while adding a phrase to the effect that type approval is required if Paragraph 3.3 is applicable.		
2.1.52	DC	Why is the “Working Pressure” defined by the design? The design of a component is based on much more than the working pressure.		

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Paragraph/ Annex	**Organisation**	**Comments/Proposed Modification**	**Agreed**	**Final Modification Or Reason For Rejection**
2.2	RA	Does not the classification of a container really belong under paragraph 6.2?		
2.2	GRPE Ad-hoc WG	*"In view of the common view expressed by all the national administrations against type 5, the Chairman suggests to put this subject between square brackets (type 5 and § 6.2.2.) to be reported to GRPE. The members agree to look for a reworded text that can be accepted as compromise. The Chairman commits himself to contact relevant parties to find out what compromise can be reached prior to the next GRPE session."*		
2.3	RA	Does not the pressure classification of a hydrogen component really belong under paragraph 6.1?		
2.3	RA	Tube" is not used elsewhere and a hydrogen component is not a system, hence change the text for each Class from "(…) components/systems including tubes and *Fittings* (…)" to "(…) components including *Fuel Lines* and *Fittings* (…)".		
2.4.4	DC	This "Gas Composition" is only for the tests regarding the tank system. This has to be mentioned very clearly.		
2.4.6 (Filling Cycles)	JASIC	We find the method of calculation of the number of filling cycles based on the life mileage of the vehicle (L) and the mileage based on maximum fuel capacity (R) more		

GENERAL COMMENTS

Paragraph/ Annex	Organisation	Comments/Proposed Modification	Agreed	Final Modification Or Reason For Rejection
		reasonable than that of NGV2 and ISO, because it reflects the way the vehicle is used as shown in the formula of calculation of the present draft. As stated in our comments to 8th draft, we think that the number of filling cycles should be determined by the manufacturer of the vehicle, since the life mileage depends on whether the vehicle is used for personal purposes or as a taxi, a bus, or a truck. The present draft defines the minimum number of filling cycles as 5,000. It is sufficient for a bus. It is more than sufficient for a personal-use passenger car. It allows for a good safety margin. On the other hand, NGV2 defines the number of pressure cycles at a finished container test as 750 filling cycles/year x 15 years (minimum), while ISO 15869 defines it as 1,000 filling cycles/year x years of use. This means that both of NGV2 and ISO 15869 consider that the number of pressure cycles at finished container test should be equal to that of filling cycles. Differently from such philosophy of NGV2 and ISO, however, the test conditions described in Annexes B9, B10, B14, B18 and B20 of the present draft specify the number of pressure cycles as 1.5 or 3 times the number of filling cycles.		

GENERAL COMMENTS

Paragraph/ Annex	Organisation	Comments/Proposed Modification	Agreed	Final Modification Or Reason For Rejection
		We therefore propose to delete the multiplier factors 1.5 or 3 given in B9, B10, B14, B18 and B20, Annex 7 of the present draft for the reasons that, as stated above, the 5,000 cycles of filling are sufficient for a bus, more than sufficient for a personal-use passenger car and allows for an adequate safety factor; and that we should think, in the same way as NGV2 and ISO, that the number of filing cycles equals the number of pressure.		
3.3.& 3.4 (Supplementary samples)	JASIC	3.3 "At the request of the Technical Service responsible for conducting approval tests, at least two samples of the *Container* and its *Pressure Relief Device(s)* and valves acting as shut-off devices in accordance with Paragraph 14.3. or other Hydrogen Components directly fitted to the Container, shall be provided unless otherwise stated in the Annexes to this Regulation." We propose to add "and a single failure of which is likely to cause a large amount of hydrogen leakage" to the end of "or other Hydrogen Components directly fitted to the Container". We propose to change "at least" to "at most". 3.4 "If the Technical Service responsible for the type approval tests carries out the tests for *Specific*		

GENERAL COMMENTS

Paragraph/ Annex	Organisation	Comments/Proposed Modification	Agreed	Final Modification Or Reason For Rejection
		Components other than those stated in Paragraph 3.3 of this Regulation, then at least two samples of the *Specific Component* shall be provided unless otherwise stated in the Annexes to this Regulation. ” We propose to delete Paragraph 3.4.		
5.4	RA	Change from “, to all Specific Components conforming to a type approved under this Regulation,” to “to all Specific Components” as the rest of it is obvious.		
6.1.8	DC	Add Container or Container Assembly		
6.2.3	RA	Delete “(for flexible fuel lines)”. If not, then change to “(for *Flexible Fuel Lines*)”.		
10	RA	Change a part of the 1st sentence from “for a type of component type approved” to “for a component that is type approved”.		
14.1.17	VTEC	Conflict between PRV activation pressure in 14.1.17 & Ann.8: B5.2.6		

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GENERAL COMMENTS				
Paragraph/ Annex	**Organisation**	**Comments/Proposed Modification**	**Agreed**	**Final Modification Or Reason For Rejection**
14.2.3	DC	What are safety related parts? This wording is not known within the automotive industrie. Nevertheles this is wrong, the parts may be damaged, but their function has to be maintained.		
14.2.3 (Impulse test Container(s) including Safety Devices mounted)		"*Container(s)* including *Safety Devices* must be mounted and fixed so that the following accelerations can be absorbed (without damage of the safety related parts) when the *Container(s)* are full. No uncontrolled release of hydrogen is permitted." The wording "No uncontrolled release of hydrogen is permitted." is not appropriate in a legal text. The amount of leakage of hydrogen should be specified. The measuring point of acceleration G should be specified.		
14.2.4	JASIC	It should be proposed to GRSP of WP29 to add a specification on the admissible amount of hydrogen to ECE R 94 and ECE R 95 in the same way as the admissible amount of leakage of liquid fuel is specified in these provisions.		

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Paragraph/ Annex	Organisation	Comments/Proposed Modification	Agreed	Final Modification Or Reason For Rejection
14. 4.5 (In the event of accidents)	JASIC	"In the event of accidents it must be ensured, so far as is reasonably practicable, that the *Pressure Relief Device* and the associated vent line remain capable of functioning." If this provision is meant to specify checking a vehicle involved in an accident, we propose to delete it because it is not suitable as a condition of vehicle type approval. If the provision remains, what kinds of preparations the automobile manufacturer would have to make for vehicle type approval? What kind of check the approving authority would make?		
14.7.1	RA	Change from "tubes" to "*Fuel Lines*".		
14.10.5	DC	Delete the last 2 sentences. If there is no leakage permitted they make no sense.		
18	RA	Change from "manufacture a type of Vehicle Type approved" to "manufacture a Vehicle Type that is type approved".		

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Paragraph/ Annex	Organisation	Comments/Proposed Modification	Agreed	Final Modification Or Reason For Rejection
Ann. 8: A1	RA	i. Delete: ISO 37, ISO 188, ISO 1307 (if Ann. 8: A3.2.3 is deleted), ISO 1402, ISO 1436 and ISO 4672, ii. Include ISO 7866 and ISO 9809-1.		
Ann. 8: A3.1.3	RA	What is meant by the last sentence ("If a *Specific Component* does not contain metallic sub-components the testing shall commence with the first applicable test.")?		
Ann. 8: A3.1.4	RA	Change to "The documentation and test reports shall be sufficiently detailed to enable an independent third party test facility to reproduce the tests." Is the paragraph needed, and if so does it rather belong in the main part (ref. 6.1.4)?		
Ann. 8: A3.2.2	RA	Change to: "The construction of a *Flexible Fuel Line* shall be such that any reinforcing interlayer is protected against corrosion, either by using a corrosion-resistant-material, e.g. stainless steel, for the reinforcement(s), or by a cover. If a cover is used the formation of bubbles between layers shall be prevented."		
Ann. 8: A3.2.3	RA	Delete. Why should this be required for the flexible fuel line only? If deleted, ISO 1307 should also be deleted from the list in Ann.8: A.1.		
Ann. 8: B2	RA	This oxygen-ageing test is only valid for vulcanised rubber. For (rubber) hose materials R110 has an ageing test acc. to		

GENERAL COMMENTS

Paragraph/ Annex	Organisation	Comments/Proposed Modification	Agreed	Final Modification Or Reason For Rejection
		ISO 188 (with higher temperatures than here), in which the requirements relate to changes in mechanical properties acc. to ISO 37 before and after ageing. In an amendment to R67 and in a proposal to come for R110 mechanical properties of thermoplastic materials are found using ISO 527-2 instead of ISO 37. R110 also has an ozone test according to ISO 1431/1, permeability test acc. to ISO 4080, burst test acc. to ISO 1402, low-temperature test acc. to ISO 4672 and n-pentane (lining) or n-hexane test (cover) acc. to ISO 1817.		
Annex 8, B5.2.3	EIHP2/Powertech	Replace the existing text with the proposal at the end of this document		
Annex 8, B5.2.4 i)	DC	Delete within the last sentence everything after 20ºC ±5°C .		
Annex 8, B5.2.6	VTEC	Conflict between PRV activation pressure in 14.1.17 & Ann.8: B5.2.6		
Ann.9: 1	RA	Delete “(defined in Paragraph 2 of this Annex)”. It is not.		
Ann.9: 2	RA	Delete this paragraph. What it says already applies to the whole document anyway.		

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GENERAL COMMENTS				
Paragraph/ Annex	**Organisation**	**Comments/Proposed Modification**	**Agreed**	**Final Modification Or Reason For Rejection**
Ann.9: B15.3	RA	It says, "The Container shall achieve a Burst Pressure of 1.8 times Working Pressure." This is based on the wording in ISO 15869. The former acid environment test said 85% of WP times burst pressure ratio.		

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EDITORIAL COMMENTS				
Paragraph/ Annex	**Organisation**	**Comments/Proposed Modification**	**Agreed**	**Final Modification Or Reason For Rejection**
General	RA	A search for “vehicle” reveals that “vehicle” and “motor vehicle” are randomly used, even on the front page. The word “motor” is actually only used a few places: on the front page, in the headings of Part I and paragraph 14, and in paragraphs 1.1, 1.2 and 2.1.26. Is “motor” needed, and/or should it be introduced more places?		
General	RA	Use either “*Container* Type x” or “Type x *Container*”, but not both. Is it correct to capitalize “Type”?		
General	RA	There is a mix between “Hydrogen System” and “Hydrogen Systems”, e.g. in paragraphs 14.1.1, 14.1.2, 14.1.3 and 14.1.5. Should be in singular form only?		
General	RA	Capitalize “regulation”.		
General	RA	The reference to material temperatures should be identical (i.e. either 2.4.5 or 2.4.5.1).		
Contents	RA	Paragraphs 11 and 19 should read “Names and addresses of Technical Services responsible for conducting approval tests, and of Administrative Departments” BTW; the comma is only present in the paragraph 11 heading.		

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Paragraph/ Annex	Organisation	Comments/Proposed Modification	Agreed	Final Modification Or Reason For Rejection
Contents	RA	Rename paragraph 14, as it seems to be worded almost identically to Part II.		
Contents	RA	Annex 6 should not capitalize “hydrogen system”.		
Contents	RA	Annex 11 should be named annex 10 and should also consist of 1 sentence, not 2.		
1.1	RA	Delete “Compressed gaseous hydrogen systems for motor” and start with “Vehicles in which (…)”. Or “Motor vehicles in which (…)”.		
1.1	RA	Change from “or auxiliary power unit” to “and any auxiliary power unit”.		
2.3	RA	Indent 1st sentence.		
2.3	RA	Change from “3 MPa” to “3.0 MPa” for Class 0.		
2.4.6	RA	Write “paragraph” instead of “section”.		

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Paragraph/ Annex	Organisation	Comments/Proposed Modification	Agreed	Final Modification Or Reason For Rejection
2.4.6.1	RA	Change from “Paragraphs 2.4.6.2 & 2.4.6.3 of this Regulation” to “Paragraphs 2.4.6.2 and 2.4.6.3 of this Regulation”		
Part I and II	RA	To make them clearer, start the Part I and Part II headings with “Uniform provisions concerning the approval of”.		
5.4	RA	Change from “Paragraph 4.1” to “Paragraph 4.1 of this Regulation”.		
5.4.ii	RA	Change from “Paragraph i) above” to “1) above”.		
5.4.ii	RA	Change from “Paragraph 5.2 and Annex 4 of this Regulation” to “Paragraph 5.2 of this Regulation and Annex 4 to this Regulation”.		
6.1.4	RA	Change from “referred to in this Chapter and the relevant annexes, its equivalence” to “referred to in this Regulation, its equivalence”.		
6.2, 6.2.1, 14.2	RA	Write “Container” instead of “Hydrogen Container”.		
13.4.ii	RA	Change to “Paragraph 13.2 and 13.3 of this Regulation and Annex 6 to this Regulation”.		

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Paragraph/ Annex	Organisation	Comments/Proposed Modification	Agreed	Final Modification Or Reason For Rejection
13.4.ii	RA	Change from “Paragraph” to “Paragraphs”.		
14.1.2	RA	Mark “Part I” in yellow.		
14.6.4	RA	Change from “At the fixing points the fuel line, flexible or rigid, shall be (…)” to “At the fixing points *Rigid Fuel Lines* and *Flexible Fuel Lines* shall be (…)”.		
14.6.7	RA	Change from “Paragraphs” to “Paragraph”.		
Ann.8: B5.2.1	RA	Change from “Paragraphs B6 & 7” to “Paragraphs B6 and B7” (3 times)		
Ann.8: B5.2.4	RA	Change from “Paragraphs B6 & B7 of this Annex” or “B6 & B7” to “Paragraphs B6 and B7 of this Annex” (6 times)		
Ann.8: B5.2.5i	RA	Change from “Paragraph B6 of this Regulation” to “Paragraph B6 of this Annex”		
Ann.9: 3.1	RA	“Verification Process” should not be capitalized.		

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Paragraph/ Annex	Organisation	Comments/Proposed Modification	Agreed	Final Modification Or Reason For Rejection
Ann.9: 3.4.3	RA	"Technical Authorities" and "High Level Function" (whatever that is?) should not be capitalized.		
Ann.9: 3.4.4	RA	"Type Approval" should not be capitalized.		
Ann.9: 4.1.2	RA	"Type Approval Authority" should not be capitalized.		

Components to be Type Approved - JASIC's View

<TUV>
Class 0+Safety related components (Class 0, 1 or 2), e.g. those functions covered by 14.1.15 (excess flow system), 14.1.17 (over pressure protection), and 14.1.20 (safety system for failure of interfaces of hydrogen circuit with other circuits).
<JASIC>
Container, automatic valve, non-return valve, pressure relief device + other components directly fitted to the container.

1. Summary

(1) Full technical discussions on pressure range for type approval are necessary as explained below. If necessary, data collection methods should be examined also.
(2) If (1) is not agreed upon, the issue may only be solved by political settlement by considering the position of each country. If this is the case, we will submit proposal made by JASIC. Please refer to the attached amendments to ver10.
(3) Certifications for safety systems, not for each component of the system, are necessary. It is necessary to discuss which system or how they are certified.

2. Reasons

(1) Principle
Fundamental requirements for design are that "Single failure should not become unreasonable safety risk". The principle is same as described in SAE2578.
"4. Technical Systems Safety Guidelines
4.1.1 DESIGN FOR SAFETY—The vehicle and associated subsystems should be designed with the objective that a *single-point hardware or software failure should not result in an unreasonable safety risk to any person or uncontrolled vehicle behavior."*

(2) Components to be guaranteed by regulation
Based on the principle described above, JASIC is proposing the components and system to be type approved as follows.
(i) The components that are not protected by any systems from single-point failure resulting in unreasonable safety risk.

(ii) The systems to protect components from single-point failure resulting in unreasonable safety risk.
JASIC define “unreasonable safety risk” as follows.
(a) Leakage resulting in uncontrollable hydrogen outflow from the container
(b) Bursting at container pressure
JASIC is proposing such components that apply to (i) and have the safety risks of the both (a) and (b) should be type approved.
As for the systems relevant to (ii) there are descriptions regarding performance requirements in the draft.

3. Discussion Issues

(1) Pressure range for type approval

In terms of leak, it has already been agreed upon its meaning as the “mass leak” where hydrogen’s uncontrollable outflow from the container. Therefore, the concern here is how we set the level of “high-pressure” as of in “high-pressure burst”.
While JASIC proposal recommend establishing type approval requirements for the burst at container pressure, TUV proposal suggest setting up of requirement for Class 0. The difference between JASIC and TUV proposals is the level of pressure regulated against bursting risks. Since there is no data available, there is no definitive answer. To determine the appropriate pressure level, we need data below:

+In what way, the burst can happen?
+How often the burst might occur?
+What range of the pressure can cause dangerous burst?

If we conform to the idea that ” the ad hoc is a place where technical discussion should takes place”, our discussion should be based on data listed above. If a decision has to reach under time pressure, we need political decision to draw line in pressures of the burst risk.

(2) Certification of safety systems

As above described, there are description regarding several safety systems. However we have not discussed on certification for the systems.

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1 COMMENTS TO GRPE RELATIVE TO THE DRAFT OT THE COMPRESSED HYDROGEN REGULATION

The following comments relate to concerns with the current draft of the GRPE regulation and recommend changes. Please note that there were a few minor updates to the letter that was prepared on 11-7-02.

1. PRESSURE EQUIPMENT NOMENCLATURE IN CLASS 1 AND 2

PROBLEM:

The compressed tanks and equipment in the Class 0 area are being rated based on *working pressure*. The *working pressure* is the settled pressure of a full tank on a 15 degC day and not indicative of the pressures of hot days and during fast fills of the tank. While the ratio between maximum pressure and working pressure is understood for the Class 0 compressed hydrogen tanks, this relationship does not generally apply to process equipment in the Class 1 and 2 areas.

PROPOSAL:

The simple solution would be to limit the current draft regulation to the Class 0 Compressed hydrogen storage systems (as being proposed by the Japanese) as the current draft regulation is being dominated by compressed tank expert's viewpoints and terminology. If this approach is not accepted then the proposal described below should be considered.

The following proposal was developed to minimize interference with the ISO compressed tank experts while providing a robust method of rating downstream pressurized equipment in Class 1 and 2. **The proposal is based on standard process equipment and has already been adopted in the draft of the liquid hydrogen regulation.**

a. **The equipment in the Class 1 and 2 systems should be rated and qualified based on the Maximum Allowable Working Pressure (MAWP).** Such flexibility allows the process designer to select the MAWP that provides adequate margin for process operation with consideration of over-pressure protection by relieving devices.

b. Equipment in Class 1 and 2 systems should be protected by pressure relief valves (or other suitable method for fail-safe over-pressure protection) that are set to actuate at (or below) the MAWP of the equipment in the system.

c. **Equipment in Class 1 and 2 systems should be marked with the MAWP** and associated pressure relief valves should be marked with the set pressure for actuation. This is the normal practice of the process industry and enables rapid inspection of the system for over-press protection and straight-forward replacement of parts.

In a manner similar to the markings recommended in SAE J2600 for Class 0 fuel nozzles, the information could be coded to minimize space and avoid confusion. For example, a vessel designed for a MAWP of 35kPa could be labeled "35k MAWP".

2. PRESSURE RATING FOR EQUIPMENT IN CLASS 0 COMPRESSED HYDROGEN SYSTEMS

PROBLEM:

It is currently assumed that the pressure capability of equipment in the Class 0 compressed hydrogen systems is 1.25 X *working pressure*. These systems are reliant on over-pressure protection from the fuel station during fill. In conventional processes, the MAWP of equipment is equal to (or greater than) the settings of over-pressure protection devices, but this is not clear with the present situation.

PROPOSAL:

a. **Confirm that the over-pressure protection of the station is consistent with the pressure capability (of 1.25 X *working pressure*) for equipment in the compressed hydrogen system.**

The preliminary assessment at SAE December meeting by fuel station experts is that the pressure capability of the Class 0 system should increase by 10%. In other words, 1.10 X 1.25 X *working pressure* for the over-pressure safety relief valves on the filling station to provide proper protection without inadvertent relief valve actuations and hydrogen releases.

b. In order to avoid confusion with regards to the pressure capability of equipment (other than tanks) in the Class 0 system, **determine the MAWP for equipment (other than tanks) and base qualification requirements for the equipment on this MAWP**. This provides consistency with general process industry and with the proposal for Class 1 and 2 equipment.

c. **For consistency with existing standards, the tank should be hydrostatically pressure tested to 1.3 times the pressure where the over-protection actuates (in Item "a".** Presuming that SAE information in Item "a" is correct at 1.10 X 1.25 X *working pressure*, the hydrostatic test pressure should be increased from 1.5 X *working pressure* to 1.79 X *working pressure*.

3. LABLEING OF VEHICLES AND CLASS 0 EQUIPMENT

PROBLEM:

There was a discussion at the GRPE/ISO meeting as to "why tank manufacturers rate tanks for *working pressure* rather than MAWP?". One of the answers was "to avoid overfill of tanks during manually-performed slow fills". This is a reasonable response, but customers in reality don't read tank labels when they re-fuel vehicles.

PROPOSAL:

a. **Labels should be added to the vehicles at the fill location on the vehicles** to define the working pressure and not to over-fill the tanks.

b. Class 0 equipment should be marked based on working pressure (for consistency with the compressed gas tank nomenclature). **To minimize space and avoid confusion by non-experts, the mark could be coded as described in SAE J2600 for hydrogen fueling nozzles.** For example, a 35 MPa hydrogen nozzle is marked "H35".

SUMMARY

DEFINITIONS OF PRESSURE TERMINOLOGY:

- Working Pressure – Operating pressure of a component in the system when a full fuel tank has settled to 15 degC.
- Maximum Allowable Working Pressure (MAWP) – Highest pressure of a component in the system during normal operation before primary safety protection against over-pressure protection is set to actuate.

IMPLEMENTATION OF TERMINOLOGY IN THE REGULATIONS:

The following table summarizes the proposals. Changes from the current draft are shown in **bold type**.

	Class 1 and 2 Hydrogen Gas Systems	Class 0 Compressed Hydrogen Gas Systems
MAWP	**Greater than or equal to the pressure where over-pressure protection is set to activate.**	**1.10 X 1.25 X Working Pressure for all equipment except tanks.**
Marking (Labels) • Filling location • Compressed gas tanks • All equipment (except tanks)	*Not applicable.* *Not applicable.* **Indicate MAWP (or code).**	**Indicate working pressure.** Indicate working pressure. Indicate working pressure **(or code)**.
Hydraulic Pressure Cycle Test • Compressed gas tanks • All equipment (except tanks)	*Not applicable.* **MAWP**	1.25 X Working Pressure **MAWP**
Over-pressure Protection	Pressure Relief Valve (or Other Approved Method)	Pressure Relief Valve (PRD).
Hydrostatic Pressure Test • Compressed gas tanks • All equipment (except tanks)	*Not applicable.* **1.3 X MAWP**	**1.79 X Working Pressure** **1.3 X MAWP**

COMMENTS ON THE GRPE DRAFT ECE COMPRESSED GASEOUS HYDROGEN (CGH_2) REGULATION Version 10 Dated 06.11.02 (NON GRPE/ISO HARMONIZATION)	GRPE - **003**	2003-01-08

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PROPOSAL FOR ADDITIONAL CRITERIA CONCERNING CONTAINER (s) INSTALLED IN A REMOVABLE SUPPORT

2.1. DEFINITIONS

Insert a new definition :

2.1.48 *"Frame/rack"* : A resistant and removable structure of a vehicle providing the housing and protection to one or several containers and various components related to the *hydrogen system.*

14.2 INSTALLATION OF A HYDROGEN CONTAINER ON-BOARD A VEHICLE

14.2.1 *Container (s)* shall be permanently installed on-board the vehicle and may only be removed for maintenance. *Container (s)* shall not be installed in the internal combustion engine compartment.

Insert the following paragraphs :

14.2.2. Notwithstanding paragraph 14.2.1, it is acknowledged that the container(s) is/are installed in a permanent way within a *frame/rack* which can be removed from the vehicle.
In this case, the separation of the hydrogen circuit can only be carried out in a section of the circuit where the working pressure is lower than or equal to 1.0 Mpa.

14.2.2.1. The installation and removal operations for this *frame/rack* must be sufficiently simple to avoid accidental misuse.

14.2.2.2. The *frame/rack* must protect the container (s) and associated equipment from shocks during normal handling operations necessary to their installation, removal and storage.

14.2.2.3. At the time of disconnection of the hydrogen circuit, the volume of hydrogen released into the atmosphere should not be greater than [xx] cm^3 nor be released near a source likely to ignite it.

14.2.2.4. The connection of the hydrogen circuit between the *frame/rack* and the vehicle may be carried out automatically or manually using fittings that require no tools.

14.2.2.5. The part of the connector fixed to the vehicle cannot be of the same type as the connections used normally on the vehicle for connection at the filling stations.

14.2.2.6. The fittings used for the connection between the *frame/rack* and the vehicle must be approved according to the requirements of annex 8D.

14.2.2.7. The implementation of the *hydrogen system* and in particular the opening of the *container(s) automatic valve(s)* should not be possible when the hydrogen circuit is not connected.

14.2.2.8. The disconnection of the hydrogen circuit must be made impossible if the power supply to the *container(s) solenoid valve(s)* is not cut off.

14.2.2.9. A partial or total electrical failure of the connectors between the *frame*/*rack* and the vehicle must be signalled to the driver if he tries to use the *hydrogen system.* Furthermore, if the failure is likely to be a safety hazard, then the *hydrogen system* should not be able to operate.
Particular information must be provided in this respect in accordance with item 3.2. of appendix 10.

14.2.2.10. The criteria of paragraph 14.2.3. also apply to the *frame*/*rack* fixings.
If the dynamic tests carried out on the assembly consisting of the *frame*/*rack* fixings, the *frame*/*rack* and the elements contained within the *frame*/*rack* show that they meet the requirements of paragraph 14.2.3., then the requirements of this paragraph and those of paragraph 14.3.2. are considered as being met.

Renumber the former paragraphs 14.2.2, 14.2.2.3, 14.2.4, 14.2.5, and 14.2.6 to respectively 14.2.3, 14.2.4, 14.2.5, 14.2.6, and 14.2.7.

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JUSTIFICATION :

The field of automotive hydrogen has not yet reached sufficient maturity to be comparable to other fuels used in the field of transport.
In particular, the lack of refuelling stations will be a major obstacle to the development in the future public domain as well as in the restricted field of the first captive fleets.

It is likely that the first projects will be confronted, in addition to the obstacles relating to filling, storage problems of vehicles and their maintenance in installations that would have to be modified to enable them to accommodate hydrogen propelled vehicles. The required structures exist or will exist at the Manufacturers but not necessarily at all of them and at potential partners.

Under these conditions, it seems appropriate to consider solutions making it possible to overcome these difficulties without decreasing the level of safety that the compliance with construction rules of the regulation project implies.

Our proposal aims at making possible the storage of hydrogen for the vehicle to be filled, maintained and repaired, separately in relation to the vehicle (thermal or electric).
This principle which must be equivalent from the point of view of the operational safety in relation to a vehicle designed without *frame*/*rack,* we are suggesting introducing the complementary requirements, expressed in the first part of this document which we submit for examination to the ad hoc group of the GRPE.

Among the advantages of this proposal, we see, in addition to the facility of filling and maintenance of the *frame*/*rack* which would be treated as the equivalent products by the professional networks already in place, the possibility of checking at regular interval the entire high pressure system.
This possibility, although not strictly necessary must be regarded as an advantage accompanying the development of a new energy source, considered currently as not risk free.

Finally, the vehicles thus "unburdened" would be free to operate in areas that would otherwise be prohibited to them if equipped with their hydrogen reserve.

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Replace B5.2.3 with a combined flex-impulse test adapted from SAE J1405.

B5.2.3 Flexible Fuel Lines

The length of the flexible part of the *Flexible Fuel Line* with its fittings attached, to be used in the following test shall be calculated as follows:

$$L = 4.142R + 3.57D$$

where:

L = Length of the flexible part of the *Flexible Fuel Line*
R = Minimum bending radius specified by the *Manufacturer*
D= Outside diameter of the *Flexible Fuel Line*

The *Flexible Fuel Line* shall be bent in the manner depicted in Figure X and attached to a fixture in that position by the *Fittings* with which it is to be approved. One end of the *Flexible Fuel Line* shall be attached to a reciprocating manifold and the other end shall be attached to a stationary manifold connected to a hydraulic supply. The *Flexible Fuel Line* shall be pressurised quickly by means of a quick opening solenoid valve, such that one cycle consists of holding the pressure at 1.25 times the *Working Pressure* for 10 ± 1 seconds (except for *Flexible Fuel Lines* with a required material temperature of 120^0C where the hold pressure shall be 1.37 times *Working Pressure*) and then reducing it to less than 0.1 times the *Working Pressure* for 5 ± 0.5 seconds. The total number of test cycles shall be equal to 2.0 times the number of *Filling Cycles* or *Duty Cycles* as appropriate to the use of the *Flexible Fuel Line* in accordance with Paragraph 2.4.6 or 2.4.7 of this Regulation as appropriate. 50% of the test cycles shall be performed at the minimum and the remaining 50% at the maximum material temperature in accordance with Paragraph 2.4.5.1 of this Regulation.

Superimposed on the hydraulic pressure cycles is a flexing cycle. The flexing rate shall be 36 ± 2% of the hydraulic pressure cycling rate. This assures that the *Flexible Fuel Line* is in a different configuration on each succeeding pressure cycle impulse. The test fixture is shown in Figure X with the distance A calculated as:

$$A = 1.75R + D$$

The *Flexible Fuel Line* shall not show any visible signs of damage.

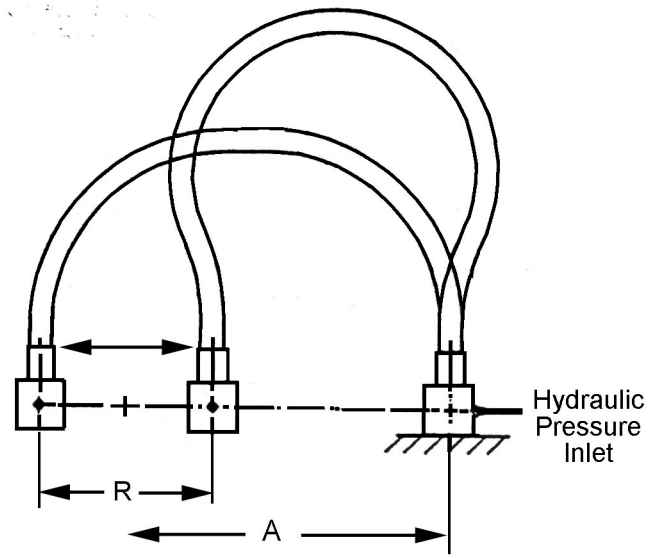

Figure X: Flex-impulse testing fixture