

**COMMENTS ON THE
GRPE DRAFT ECE COMPRESSED GASEOUS HYDROGEN (CGH₂) REGULATION
Version 10 Dated 06.11.02
(NON GRPE/ISO HARMONIZATION)**

GRPE - 001

2002-12-18

GENERAL COMMENTS

Paragraph/ Annex	Organisation	Comments/Proposed Modification	Agreed	Final Modification Or Reason For Rejection
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.		
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 <i>Specific Component</i> ” (as in paragraph 7.1 for instance). Change to “a <i>Specific Component</i> ”.		
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”?		

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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 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.		

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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.		
2.2	RA	Does not the classification of a container really belong under paragraph 6.2?		
2.2	GRPE Ad-hoc WG	<i>"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."</i>		
2.3	RA	Does not the pressure classification of a hydrogen component really belong under paragraph 6.1?		
2.4.4	DC	This "Gas Composition" is only for the tests regarding the tank system. This has to be mentioned very clearly.		
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.		

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6.1.8	DC	Add Container or Container Assembly		
10	RA	Change a part of the 1 st 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		
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.		
14.10.5	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”.		
Ann 7: A3.1.3	VTEC	Why does A3.1.3 refer to the appropriate type approval test, while A3.1.1 does not refer to B9?		

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Ann 7: A3.2&3	VTEC	Why are A3.2 & A3.3 in the "general" design requirements and not in A2 as they are requirements that would have to be fulfilled for type approval?										
Ann 7: A5.1.1 iii)	VTEC	Is that one (the same) Container or Liner that will be subjected to all of the other tests, or is a different one allowed for each test?										
Ann.7: B9-23	VTEC	<p>B9-23 Is there any logic to the numerical order of the tests(does there need to be?):</p> <p>i) In terms of the tests that should be carried out to ensure basic integrity before the service simulation tests - see order of ISO tests that seems more logical (see proposed renumbering at the end of my comments). Should we impose an test order for the main tests?</p> <p>ii) In terms of the e.g. B15 & B19 calling up a preceding test (B13).</p> <p>iii) It may not be necessary to undertake B9 if B14 fulfills certain requirements, so why not put B9 after B14</p> <p>Proposed renumbering of B9 to B23:</p> <table style="margin-left: 20px;"> <tr> <td>Old</td> <td>New</td> </tr> <tr> <td>B9</td> <td>B11</td> </tr> <tr> <td>B10</td> <td>B17</td> </tr> <tr> <td>B11</td> <td>B19</td> </tr> </table>	Old	New	B9	B11	B10	B17	B11	B19		
Old	New											
B9	B11											
B10	B17											
B11	B19											

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		B12 B23 B13 B9 B14 B10 B15 B14 B16 B12 B17 B13 B18 B15 B19 B16 B20 B18 B21 B20 B22 B21 B23 B22 Or in otherwords the new order is: New B9 Burst B10 Ambient temperature pressure cycling B11 LBB B12 Bonfire B13 Penetration B14 Environment B15 Composite flaw tolerance B16 Accelerated stress rupture B17 Extreme temperature pressure cycling B18 Impact damage B19 Leak B20 Permeation B21 Boss torque B22 Hydrogen gas cycling		

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		B23 Hydrostatic		
Ann.7: B15	VTEC	B15 Environment test requires a burst test in accordance with B13, then we have a conflict between the requirements of B15 and B13, suggest that the reference to B13 in B15 is clarified to "Paragraph 13.2 of this Annex".		
Ann.7: B15	VTEC	B19 Accelerated stress rupture test requires a burst test in accordance with B13, then we have a conflict between the requirements of B19 and B13, suggest that the reference to B13 in B19 is clarified to "Paragraph 13.2 of this Annex".		
Ann.7: B22	VTEC	i) B22 Accelerated stress rupture test requires a burst test in accordance with B13, suggest that the reference to B13 in B22 is clarified to "Paragraphs 13.2 & 13.3 of this Annex". ii) B22.2 Where is the test sequence given in Table 7A.6, does it mean Para. A5.1.1? iii) What is the requirement for batch testing?		
Annex 8, B5.2.3	EIHP2/Powertech	Replace the existing text with the proposal at the end of this document		

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Annex 8, B5.2.4 i)	DC	Delete within the last sentence everything after 20°C ±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.		
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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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 “ <i>Container</i> Type x” or “Type x <i>Container</i> ”, 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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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 1 st 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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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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13.4.ii	RA	Change from "Paragraph" to "Paragraphs".		
14.1.2	RA	Mark "Part I" in yellow.		
14.6.7	RA	Change from "Paragraphs" to "Paragraph".		
Ann 7: A2/3	VTEC	Why does A3 Container Design Requirements follow A2 Container Type Approval Requirements? Switch them around.		
Ann 7: Table 7A.4	VTEC	Delete blank line from Table 7A.4		
Ann 7: A3.2.5	VTEC	Insert line at end of A3.2.5		
Ann.7: A4.2.1.vii	RA	Write "Container Types 3 and 4 only" to clarify that it is not fibre type that is meant.		
Ann.7: A4.3.viii	RA	Write "Paragraph" instead of "Section".		

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Annex 7, A5.1 iii)	DC	Delete "the other tests" and write instead which tests are to be subjected.		
Ann.7: B1-B23	VTEC	In the sampling section of each test, why not make a clear statement regarding which type of test it is, i.e. type approval, batch or production: B10.1 Sampling The test applies to all Container Types. Type approval testing: Number of Finished Containers to be tested: 1		
Ann.7: B10	VTEC	B10.2 "Applies to Container Type 4 only"..Change to.."Applies to Type 4 Containers only" B10.3 "Containers of Type 4".. Change to.."Type 4 Containers")		
Ann.7: B15	RA	Is it an environment or an environmental test?		
Ann.7: B16.2	RA	Change to "(...) of 5.0 MPa at 15 °C."		
Ann.7: B19.3	VTEC	Reword requirement from "85% of the Working pressure times the Burst Pressure ratio..." to "0.85 WpxBPR...where Wp=..., BPR=..."		

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Ann.7: B22	VTEC	i) Remove unwanted yellow highlighting ii) Not mentioned in Table 7A.6 as a batch test		
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.		
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.		

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] cm³ 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.

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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.

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.

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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.

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°C 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 $36 \pm 2\%$ 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.

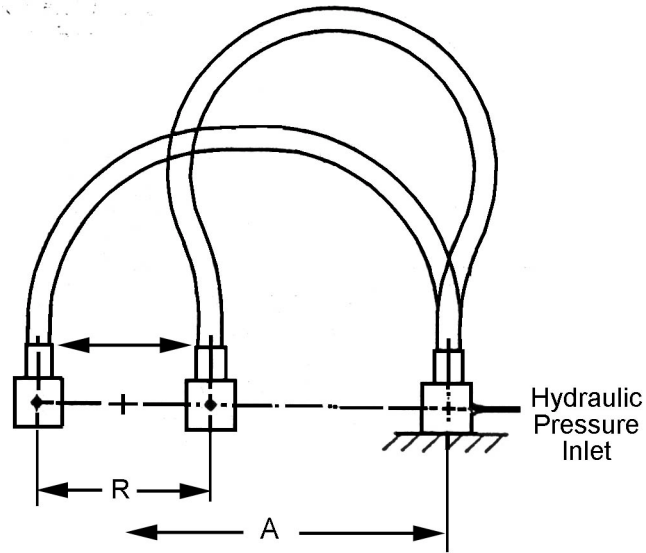


Figure X: Flex-impulse testing fixture